PTO/AIA/01 (06-12)
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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	FLOW CYTOMETER

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 14/555,102

filed on November 26, 2014.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

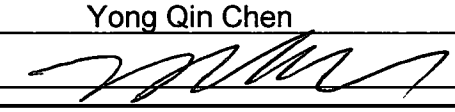
I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Yong Qin Chen Date (Optional): 3/9/2015

Signature: 

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

CYTEK V. BECKMAN
PGR2025-00088
BECKMAN 2055

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	12/22/2021 09:03:00 PM ET	BECC.P0002US.CIP.D2C1

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Myriah Clark
PATENT CENTER #	60458708	AUTHORIZED BY	Mark Tison
CUSTOMER #	32425	FILING DATE	-
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Yong Qin Chen

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 6496	E2021BLL03424383	Myriah Clark

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1111	UTILITY PATENT APPL. SEARCH FEE	700.00	1	700.00
1011	BASIC FILING FEE - UTILITY (PAPER FILING ALSO REQUIRES NON-ELECTRONIC FILING FEE UNDER 1.16(T))	320.00	1	320.00
1311	PATENT APPL. EXAMINATION FEE	800.00	1	800.00
			TOTAL AMOUNT:	$1,820.00

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized

by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/14 (02-18)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BECC.P0002US.CIP.D2C1
	Application Number	
Title of Invention	FLOW CYTOMETER	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 — Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Yong	Qin	Chen	

Residence Information (Select One) ● US Residency Non US Residency Active US Military Service

City	State/Province	Country of Residence
San Jose	CA	US

Mailing Address of Inventor:

Address 1	4097 Cortona Court
Address 2	

City	State/Province	Postal Code	Country
San Jose	CA	95135	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	32425		
Email Address	aoipdocket@nortonrosefulbright.com	Add Email	Remove Email

Application Information:

Title of the Invention	FLOW CYTOMETER		
Attorney Docket Number	BECC.P0002US.CIP.D2C1	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	35	Suggested Figure for Publication (if any)	

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BECC.P0002US.CIP.D2C1
	Application Number	
Title of Invention	FLOW CYTOMETER	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	32425		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	15/638477	2017-06-30

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BECC.P0002US.CIP.D2C1
	Application Number	
Title of Invention	FLOW CYTOMETER	

Prior Application Status	Patented	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15/638477	Division of	14/455102	2014-11-26	9746412	2017-08-29

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
14/455102	Continuation in part of	PCT/US2013/043453	2013-05-30

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
14/455102	Claims benefit of provisional	61/911859	2013-12-04

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/US2013/043453	Claims benefit of provisional	61/653245	2012-05-30

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/US2013/043453	Claims benefit of provisional	61/653328	2012-05-30

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/US2013/043453	Claims benefit of provisional	61/715819	2012-10-18

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/US2013/043453	Claims benefit of provisional	61/715836	2012-10-19

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/US2013/043453	Claims benefit of provisional	61/816819	2013-04-29

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BECC.P0002US.CIP.D2C1
	Application Number	
Title of Invention	FLOW CYTOMETER	

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BECC.P0002US.CIP.D2C1
	Application Number	
Title of Invention	FLOW CYTOMETER	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BECC.P0002US.CIP.D2C1
	Application Number	
Title of Invention	FLOW CYTOMETER	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	IRIS INTERNATIONAL, INC.		
Mailing Address Information For Applicant:			
Address 1	9172 Eton Avenue		
Address 2			
City	Chatsworth	**State/Province**	CA
Country	US	Postal Code	91311
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BECC.P0002US.CIP.D2C1
	Application Number	
Title of Invention	FLOW CYTOMETER	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☒

Organization Name	IRIS INTERNATIONAL, INC.

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1	9172 Eton Avenue		
Address 2			
City	Chatsworth	**State/Province**	CA
Country i	US	Postal Code	91311
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Mark Tison/			Date (YYYY-MM-DD)	2021-12-22
First Name	Mark	Last Name	Tison	Registration Number	65985

Additional Signature may be generated within this form by selecting the Add button. Add

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BECC.P0002US.CIP.D2C1
	Application Number	
Title of Invention	FLOW CYTOMETER	

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Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

FLOW CYTOMETER

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. Patent Application No. 15/638,477, which is a divisional application of U.S. Patent Application No. 14/455,102 entitled "Flow Cytometer," filed November 26, 2014, and issued as U.S. Patent No. 9,746,412, which claims the benefit of priority of U.S. Provisional Patent Application Serial No. 61/911,859 entitled "Flow Cytometer," filed on December 4, 2013. U.S. Patent Application No. 14/55,1012 is also a continuation-in-part of International Patent Application Serial No. PCT/US2013/043453 entitled "Flow Cytometer," filed on May 30, 2013, which claims the benefit of priority under 35 U.S.C. 119 to U.S. Provisional Patent Application Serial No. 61/653,245 entitled "Pulseless Peristaltic Pump," filed on May 30, 2012, U.S. Provisional Patent Application Serial No. 61/653,328 entitled "Composite Microscope Objective with a Dispersion Compensation Plate," filed on May 30, 2012, U.S. Provisional Patent Application Serial No. 61/715,819 entitled "Wavelength Division Multiplexing for Extended Light Source," filed on October 18, 2012, U.S. Provisional Patent Application Serial No. 61/715,836 entitled "Diode Laser Based Optical Excitation System," filed on October 19, 2012, and U.S. Provisional Patent Application Serial No. 61/816,819 entitled "A Simple Fluidic System for Supplying Pulsation Free Liquid to Flow Cell," filed on April 29, 2013. All of the above-identified applications are incorporated herein by reference in their entirety.

BACKGROUND

Technical Field

The present disclosure relates generally to the technical field of flow cytometry and, more particularly, to the structure and operation of an improved flow cytometer together with various individual subassemblies included therein.

Background

Flow cytometry is a biophysical technique employed in cell counting, sorting, biomarker detection and protein engineering. In flow cytometry, cells suspended in a stream of liquid pass through an electronic detection apparatus. Flow cytometry allows simultaneous

multiparametric analysis of physical and/or chemical characteristics of up to thousands of cells per second.

Flow cytometry has various applications including in the fields of molecular biology, pathology, immunology, plant biology and marine biology. Flow cytometry also has broad application in medicine (especially in transplantation, hematology, tumor immunology and chemotherapy, prenatal diagnosis, genetics and sperm sorting for sex preselection). In marine biology, the autofluorescent properties of photosynthetic plankton can be exploited by flow cytometry in characterizing abundance and community composition. In protein engineering, flow cytometry is used in conjunction with yeast display and bacterial display to identify cell surface-displayed protein variants with desired properties. A common variation of flow cytometry is physically sorting particles based on their properties thereby purifying a population of interest.

SUMMARY OF DISCLOSURE

The present disclosure provides an improved flow cytometer together with various improved components included therein, as well as component groups with interacting components.

In certain embodiments, the present disclosure provides a simple and reliable diode laser based optical system capable of delivering a focused laser beam of elliptical cross section with a Gaussian like intensity distribution along its minor axis and a width along major axis optimized for flow cytometric applications.

In certain embodiments, the present disclosure provides an imaging quality microscope objective that is easy to manufacture and has long working distance, large numerical aperture, large field of view and minimal chromatic aberration.

In certain embodiments, the present disclosure provides a simple fluidics system for flow cytometers that is not only reliable, compact and easy to manufacture, but also capable of supporting velocity critical applications such as in instruments with multiple spatially separated excitation laser beams or in droplet sorters.

In certain embodiments, the present disclosure provides a simple design for a peristaltic pump providing a pulseless liquid flow.

In certain embodiments, the present disclosure provides a peristaltic pump with minimal pulsation.

In certain embodiments, the present disclosure provides a peristaltic pump that is simple to manufacture and operate.

In certain embodiments, the present disclosure provides a device capable of collimating a light beam from an extended light source over an extended distance without significantly expanding the beam diameter.

In certain embodiments, the present disclosure provides a Wavelength Division Multiplexing (WDM) system to separate a light beam into multiple colored bands. The WDM system may be compatible with low noise semiconductor detectors. In addition, due to the diversity of fluorescent probes, the WDM system may be reconfigurable.

According to an exemplary embodiment, a flow cytometer may include:

1. a Laser Diode (LD) based optical subsystem for impinging a beam of light upon particles passing through a viewing zone;

2. a composite microscope objective for gathering and imaging light scattered from or fluoresced by particles passing through the viewing zone;

3. a fluidic subsystem for supplying a liquid sheath flow to the viewing zone;

4. a peristaltic pump for injecting a liquid sample flow carrying particles that pass together with the liquid sheath flow through the viewing zone;

5. a multimode optical fiber that receives scattered and fluoresced light from the viewing zone that the composite microscope objective gathers images; and

6. a wavelength division multiplexer for optically separating light received via the optical fiber into color bands.

According to an exemplary embodiment, the LD based optical subsystem for illuminating particles passing through the flow cytometer's viewing zone may generally include:

1. a laser diode oriented with its slow axis parallel to the direction of flow;

2. a collimating lens that converts the diverging beam from the LD into a collimated beam of elliptical shape with its major axis perpendicular to the flow;

3. a focusing lens system that reduces the laser beam at the viewing zone to an optimal width in the direction perpendicular to the flow; and

4. finally a high power cylindrical focusing element placed in the proximity of the viewing zone with its axis perpendicular to the direction of flow.

The high power cylindrical focusing element may transpose the far field profile of the LD along its slow axis to its Fourier conjugate at the viewing zone along the direction of flow, while maintains the transverse beam profile, such that the laser beam profile at the viewing zone is optimal for flow cytometric applications.

According to an exemplary embodiment, the composite microscope objective may generally include:

1. a concave spherical mirror;

2. a transparent aberration compensation plate with the flow cytometer's a viewing zone being located between the mirror and the plate. Scatter and fluorescence light emitted from particles in the viewing zone is collected by the mirror and reflected back toward the compensation plate. Optical aberrations originating from the mirror are significantly reduced after light passes through the compensation plate. In one embodiment of the present disclosure, the viewing zone may be located inside a flow cell provided by rectangular glass cuvette with a small rectangular channel through which a particle carrying liquid flows. The concave mirror may be made of an optically transparent material, such as glass or optical quality plastics, of plano-convex shape with a highly-reflective coating on the convex side for internal reflection. The plano-side of the mirror may be either gel-coupled or bonded to one side surface of the cuvette. The plano-aspheric compensation plate may be made of a transparent material, such as glass or optical quality plastics, with the plano side gel-coupled or bonded to the opposite side of the cuvette. The plano-convex shaped mirror and the aspheric compensation plate may also be formed integrally with the cuvettte. In yet another embodiment of the present disclosure, the viewing zone may be in a jet stream with both the concave mirror and the compensation plate being free standing from the viewing zone, and the mirror may be a front surface concave mirror.

According to an exemplary embodiment, the fluidic system may generally include a sheath liquid reservoir from which a liquid pump draws sheath liquid. Sheath liquid then flows from the liquid pump to an inlet of a T-coupling. One outlet arm of the T-coupling connects to a bypass that returns a fraction of the pumped sheath liquid back to the sheath liquid reservoir with the returned sheath liquid flowing into air within the sheath liquid reservoir. A second outlet arm of the T-coupling connects to a sheath route that includes a reservoir capsule followed by a particle filter and then the flow cell. The sheath liquid exiting the flow cell then goes to the waste tank. The fluidic resistance along the bypass is designed to be lower than the fluidic resistance along the sheath route. Consequently, only a small fraction of the sheath liquid goes through the flow cell. Note that typical sheath flow rate in flow cytometric applications is a few tens of milliliter per minute. The bypass therefore permits using higher flow rate liquid pumps that not only are much less expensive and more reliable, but also operates at higher pulsation frequency which is much easier to attenuate. Since the exit of the bypass route connects to air, it also serves as a large fluidic capacitor for significantly reducing pulsation in sheath liquid flowing along the sheath route. During operation, the inlet portion of the filter cartridge is filled with air. Therefore, the filter cartridge also serves as a fluidic capacitor, for further reducing pulsation in the sheath liquid at the flow cell to negligible level. Due to the large fluidic resistance at the flow cell, the air trapped near the inlet of the filter cartridge becomes compressed. If the liquid pump is turned off, the compressed air in filter cartridge being pushed back towards the sheath liquid reservoir becomes stored in the reservoir capsule whose size is chosen to prevent the trapped air from reaching the T-coupling.

According to an exemplary embodiment, the peristaltic pump may generally include a plurality of rollers located at the periphery of a rotor that moves the rollers circularly inside a housing's arcuate curved track and a compressible tube that the rollers compress against the track. In one embodiment of the present disclosure, the track of the peristaltic pump's housing may have one recess so the compressible tube is progressively decompressed to full expansion then compressed to full closure every time one of the rollers moves past the recess. The location and shape of the recess maintains the total volume of liquid within the compressible tube from the recess to the pump's outlet substantially invariant. The effect of tube expansion as a roller moves past the pump's outlet is compensated by the tube

compression when a different other roller immediately upstream of the pump outlet moves into the recess' compressing section. In another embodiment of the present disclosure, the track of the pump housing may contain a plurality of recesses, providing for a plurality of roller upstream of the pump outlet to progressively modify the tube compression in multiple sections along the compressible tube. The locations and shapes of the plurality of recesses are designed such that the modification of tube compression at these sections substantially compensates the effect due to the tube expansion near the pump outlet. In yet another embodiment of the present disclosure, the compressible tube is kept fully closed underneath the roller except in the inlet and exit sections. A variable speed motor may be used to drive the pump. When a roller reaches the exit section, the motor's rotation may programmatically speed up to compensate for the tube's expansion.

According to an exemplary embodiment, a wavelength division multiplexer ("WDM") may include at least two optical elements. The first optical element collimates a beam of light received from an extended light source, such as the light from a pinhole or from a multimode optical fiber. The first optical element magnifies the extended light source, for example, as defined by the pinhole, or the core of the multimode optical fiber, to an image having a size similar to the effective cross section of the first optical element thereby creating a collimated light beam between the first optical element and its image. A second optical element is positioned near the image, and relays the first optical element with unit magnification down the optical path. In this way, the second optical element effectively doubles the collimated path length. Additional optical elements in the same 1:1 image relay configuration may also be included to further extend the collimated optical path. The cascaded unit-magnification image relay architecture of the present disclosure extends the collimated optical path length without large beam expansion. As a result, WDM techniques well-established in the optical communication industry can be readily adapted for fluorescence light detection. In particular, multiple colored bands present in the beam of light can be separated using dichroic filters located along the optical path with the separated light being tightly focused into small spots compatible with low noise semiconductor photodetectors.

In one embodiment of a WDM, the first optical element is a lens and the second element is a concave mirror, although it is apparent to those skilled in the art that other types

of refractive and/or reflective optical components may also be used to achieve the same design goal. The optical path in the WDM of the present disclosure may be folded using dichroic filters. In one embodiment of the present disclosure, the light path may be folded into a zig-zag configuration. To facilitate the flow cytometer's reliable reconfiguration, each dichroic filter may be bonded to a mechanical holder having a reference surface that is optically parallel to the filter's reflective surface. As a result, all of the WDM's filters can be accurately positioned along the optical path by referencing the filter's holder against a common optical flat. In another embodiment of the present disclosure, the collimated beam passing through the dichroic filter is further branched out into multiple colored bands using secondary dichroic filters. It is apparent to those skilled in the art that dichroic filters may be inserted anywhere along the long, narrow and collimated beam path afforded by the present disclosure's relay imaging to thereby permit delivering a tightly focused beam to photo detectors using a variety of optical configurations, such as the star configuration discussed in United States Patent no. 6,683,314, the branched configuration discussed in United States Patent no. 4,727,020 and other types of WDM optical configuration widely practiced in the optical communication industry. Instead of concave mirrors, the WDM may be replaced by curved dichroic filters to further increase the number of colored bands selected by the WDM.

According to some exemplary embodiments, an optical system for impinging beams of light into a viewing zone in which a sample flow carrying objects and a sheath flow pass through includes a first light source for emitting a first beam of light along a first beam path to illuminate objects in the viewing zone at a first location, a second light source for emitting a second beam of light along a second beam path to illuminate objects in the viewing zone at a second location, a beam compressing optical element for reducing widths of the first and second beams of light on their major axes to a width less than the width of the sheath flow, and a first chromatic compensation element located on at least one of the first beam path and the second beam path for compensating chromatic aberration in the viewing zone such that the first location and the second locations are on a common plane parallel to the direction of the sample flow. The wavelength of the second light source is different from the wavelength of the first light source. The chromatic compensation allows compensating the properties of the different paths, resulting e.g. from the different wavelengths, the different path lengths,

different locations in the flow path etc. This applies also for multiple compensating elements in different paths, in particular when using two, three or more wavelengths for illumination.

According to some exemplary embodiments, an optical system includes a first light source for emitting a first beam of light to illuminate objects at a first location in a viewing zone, a composite microscope objective for imaging light scattered from and fluoresced by the objects at the first location in the viewing zone at an image plane external to the composite microscope, and a beam splitter for reflecting or transmitting scattered and fluoresced light, wherein the light source and the image plane are on two sides of the beam splitter. The composite microscope includes a concave mirror and an aberration corrector plate. The aberration corrector plate is an aspheric lens that has a first zone with negative optical power and a second zone with positive optical power radially inside the first zone. The viewing zone is positioned between the concave mirror and the aberration corrector plate. This allows a compact build-up, as the illumination and the detection of light scattered from and fluoresced by the objects in the viewing zone may be conducted from the same side of the microscope objective.

According to some exemplary embodiments, an axial light detection system includes a concave mirror for reflecting light that propagates from a viewing zone, and a detector for measuring axial light loss produced by an object in the viewing zone by detecting light reflected by the concave mirror. This allows an effective detection of light loss which may serve as a base for better interpretation of the measured values.

According to some exemplary embodiments, a power monitoring system for adjusting power of a light source includes a first light source for emitting a first beam of light, a second light source for emitting a second beam of light, a first dichroic filter for reflecting the first beam of light and passing the second beam of light, a second dichroic filter for reflecting the second beam of light, a first detector for measuring residual power of the first and second beams of light downstream of the first dichroic filter on a time-division multiplexing basis, and a control unit coupled with the first detector and the first and second light sources, wherein the control unit adjusts power of one or more of the first and second light sources based on measured residual power of the first and second beams of light by the first detector. This allows an effective detection of light power which may serve as a base for better

interpretation of the measured values, as well as an effective control procedure, in particular when controlling or adaption respective light sources.

According to another exemplary embodiment, an optical system includes an objective adapted for imaging light scattered from and fluoresced by an illuminated object within a viewing zone, an optical transmission member for propagating light received from the aspheric lens, a wavelength division multiplexer (WDM) for receiving light propagated by the optical transmission member. The objective includes an aspheric lens with a first zone with negative optical power and a second zone inside the first zone with positive optical power, and a concave mirror for reflecting light scattered from and fluoresced by the illuminated object through the aspheric lens, wherein the viewing zone is located between said concave mirror and the aspheric lens. The WDM includes a first optical element that produces a beam of light with an image of substantially the same size as the effective size of said first optical element, at least one dichroic filter located between said first optical element and said image, a second optical element located in one of said branches, and an image relay optical element located near the image produced by said first optical element in the other branch. The dichroic filter separates the beam of light into two branches of distinctive colors. The beam of light in said branch is focused to a spot by said second optical element. The image relay optical element produces an image of said first optical element at substantially unit magnification. This allows an adapted combined operation of the microscope objective and the WDM, as well as the optical coupling there between. In particular the microscope objective and the WDM as well as the optical coupling may be adapted to match to each other with respect to wavelength and other parameters.

According to another exemplary embodiment, an optical system includes a light source for emitting a beam of light to illuminate an object in a viewing zone, a concave mirror for receiving and reflecting light scattered from and fluoresced by the illuminated object, an aspheric lens with a first zone with negative optical power and a second zone inside the first zone with positive optical power, wherein light reflected by the concave mirror passes through the aspheric lens, and wherein the viewing zone is located between said concave mirror and the aspheric lens, an optical transmission member for receiving and propagating light from the aspheric lens, and a multiplexer for receiving light from the optical transmission member and separating the light into at least two colors. This allows an adapted

combined operation of the illumination system, the microscope objective and the WDM, as well as the optical coupling there between. In particular the illumination system, the microscope objective and the WDM as well as the optical coupling may be adapted to match to each other with respect to wavelength and other parameters.

According to another exemplary embodiment, an apparatus for imaging light scattered from and fluoresced by an illuminated object within a viewing zone includes a fluid delivery system for delivering an object to a viewing zone, a light source for illuminating the object in the viewing zone, a concave mirror located on one side of the viewing zone for reflecting light scattered from and fluoresced by the illuminated object, and an aspheric lens located on another side of the viewing zone for receiving the light reflected by the concave mirror and forming an image at an image plane, the aspheric lens having a first zone with negative optical power and a second zone radially inside the first zone with positive optical power. This allows an adapted combined operation of the fluid delivery system, the illumination system, and the microscope objective. In particular the fluid delivery system, the illumination system, and the microscope objective may be adapted to match to each other with respect to wavelength and other parameters.

According to other exemplary embodiments, an optical method for impinging beams of light into a viewing zone includes directing a first beam of light to illuminate objects in a viewing zone to produce scattered and fluoresced light, reflecting the scattered and fluoresced light using a concave mirror toward an aberration corrector plate, correcting aberrations in the reflected light with the aberration corrector plate, wherein the aberration corrector plate has a first zone with negative optical power a second zone radially inside the first zone with positive optical power, and reflecting or transmitting the corrected light using a beam splitter.

According to other exemplary embodiments, an optical method for detecting light includes reflecting light that propagates from a viewing zone using a concave mirror, and measuring axial light loss produced by an object in the viewing zone by detecting light reflected by the concave mirror.

According to other exemplary embodiments, a method of gathering and imaging light scattered from or fluoresced by objects in a viewing includes delivering an object to a viewing zone, illuminating the object in the viewing zone to produce scattered and fluoresced light,

reflecting the scattered and fluoresced light using a concave mirror toward a transparent aberration corrector plate, and correcting spherical aberrations in the reflected light with the transparent aberration corrector plate, wherein the transparent aberration corrector plate has a first zone with negative optical power and a second zone radially inside the first zone with positive optical power.

According to other exemplary embodiments, a composite microscope objective adapted for imaging light scattered from and fluoresced by an object present within a viewing zone, comprises a viewing zone, a concave mirror arrangement, an exit area and an illumination beam forming arrangement, wherein the viewing zone is arranged between the concave mirror arrangement and the exit area, and wherein the concave mirror is arranged to reflect scattered and fluoresced light impinging from an object present in the viewing zone to the exit area, and wherein the illumination beam forming arrangement is arranged so that an illumination beam entering the illumination beam forming arrangement is pre-definitely formed at the viewing zone. According to other exemplary embodiments there may be provided an aberration corrector plate, in particular an aspheric lens in the exit area. This allows an effective build-up of the microscope objective. It should be noted that the aberration corrector plate is not necessary when providing a concave mirror shape allowing a sufficient imaging of the light scattered and fluoresced from an object in the viewing zone. If required an aberration corrector plate, in particular an aspheric lens may be arranged in the exit area.

According to other exemplary embodiments a wavelength division multiplexer (WDM) for separating light emitted from a light source into multiple colored bands comprises an imaging optical arrangement, a dichroic filter arrangement, a semiconductor photo detector, and a focusing optical arrangement, wherein the imaging optical arrangement forms a beam of light from the light emitted from a light source and produces an image of substantially the same size as the effective size of said imaging optical arrangement, and wherein the dichroic filter arrangement is located between said imaging optical arrangement and said image, and separates the beam of light into a first branch and a second branch of distinctive colors, and wherein the semiconductor photo detector is located in the first branch, and wherein the focusing optical arrangement is located between the dichroic filter arrangement and the semiconductor photo detector so as to focus the beam of light onto the

semiconductor photo detector. Thus, an effective detection arrangement may be provided, which may be operated with a semiconductor detector. The semiconductor detector may be a semiconductor photo detector. The semiconductor detector may be an avalanche photo diode or a carbon nanotube detector. Thus, a reduced signal to noise ratio can be achieved.

In first aspect of the disclosure, a flow cytometer includes a laser diode (LD) based optical subsystem for directing a beam of light into a viewing zone of said flow cytometer through which a sample liquid carrying particles flows, the sample liquid being hydrodynamically focused within the viewing zone by a liquid sheath flow that also flows through the viewing zone, a composite microscope objective for imaging light scattered from and fluoresced by a particle present within the viewing zone, a fluidic subsystem for supplying the liquid sheath flow to the viewing zone, the liquid sheath flow lacking pulsations, a peristaltic pump for supplying the sample liquid carrying the particles, the sample liquid being hydrodynamically focused within the viewing zone by the liquid sheath flow, a peristaltic pump for supplying the sample liquid carrying the particles, the sample liquid being hydrodynamically focused within the viewing zone by the liquid sheath flow, and a wavelength division multiplexer (WDM) for separating into multiple colored bands a beam of light emitted initially from the viewing zone and imaged by the composite microscope objective into an optical fiber for transmission to the WDM. The LD based optical subsystem may include a LD for emitting a diverging beam of light from an edge thereof, the diverging beam of light having an elliptically shaped cross-sectional profile with both a major axis and a minor axis, a collimating lens for converting the diverging beam of light emitted from said LD into a collimated elliptical beam of light, wherein the minor axis of said collimated elliptical beam of light is oriented parallel to a direction in which particles pass through the viewing zone, a beam compressing optical el ement for reducing the size of said elliptical beam of light at the viewing zone whereby a width of said major axis of said elliptical beam of light oriented perpendicular to the direction in which particles pass through the viewing zone is less than a width of said liquid sheath flow, a cylindrical focusing element positioned adjacent to the viewing zone with an axis of said cylindrical focusing element being oriented perpendicular to the direction in which particles pass through the viewing zone whereby said minor axis of said beam of light becomes focused at the viewing zone, and the size of said major axis of said elliptical beam of light at the viewing zone remains essentially

unchanged. The composite microscope objective may include a concave mirror upon which scattered and fluoresced light impinges and an aberration corrector plate made of optically transparent material. The aberration corrector plate is an aspheric lens that has a first zone of said aberration corrector plate having negative optical power outside a neutral zone and a second zone of said aberration corrector plate inside the neutral zone having positive optical power light. The neutral zone is the thinnest portion of the aberration corrector plate. Light reflected from the concave mirror passes through said aberration corrector plate. The viewing zone of said flow cytometer is located between said concave mirror and said aberration corrector plate. The fluidic subsystem may include a liquid pump for supplying liquid drawn from a reservoir and a T-coupling having at least one (1) inlet and two (2) outlets. The inlet of said T-coupling receives liquid from said liquid pump. A first fraction of the liquid received by the inlet flows via a first one of the outlets and via a bypass conduit back to the reservoir. A second fraction of the liquid received by the inlet flows via a second one of the outlets and via a particle filter to the viewing zone of said flow cytometer. The peristaltic pump may include a pump housing having a arcuate curved track formed therein that extends between a pump inlet and a pump outlet, a plurality of rollers that are attached to a rotor, the rollers having a substantially equal angular spacing between each pair of immediately adjacent rollers, the rotor being rotatable together with the rollers attached thereto inside said pump housing, and a compressible tube sandwiched between said rollers and the arcuate curved track of said pump housing. The arcuate curved track includes an exit section and at least one pumping section along the arcuate curved track between the pump inlet and the pump outlet. As a roller rolls through the exit section, said compressible tube adjacent to said roller progressively expands from fully closed at a beginning of said exit section to fully open at the pump outlet where said roller breaks contact with said compressible tube. Said compressible tube is compressed to fully closed by at least one of said rollers. The wavelength division multiplexer (WDM) may include a collimating optical element that magnifies an to produce an image of substantially the same size as the effective size of said collimating optical element, at least one dichroic filter located between said collimating optical element and said image, said dichroic filter separating the collimated beam of light into two (2) branches of distinctive colors, a focusing optical element located in one of said branches, the beam of light in said branch being focused to a spot having a diameter of less

than 1.0 mm by said focusing optical element, and an image relay optical element located near the image produced by said collimating optical element in the other branch, said image relay optical element producing an image of said collimating optical element at substantially unit magnification.

In second aspect of the disclosure, said cuvette may have a rectangularly-shaped cross-section, and the viewing zone of the flow cytometer is located within a channel having a rectangularly-shaped cross-section that is located within said cuvette.

In third aspect of the disclosure, said cuvette may have a tubularly-shaped cross-section, and the viewing zone of the flow cytometer is located within a channel having a circularly-shaped cross-section that is located within said cuvette.

In fourth aspect of the disclosure, the sample liquid and the liquid sheath flow form a jet stream in which the viewing zone of the flow cytometer is located.

In fifth aspect of the disclosure, said cylindrical focusing element is in optical contact with an entrance face of said rectangularly-shaped cuvette.

In sixth aspect of the disclosure, said cylindrical focusing element is separated from said rectangularly-shaped cuvette.

In seventh aspect of the disclosure, said cylindrical focusing element is separated from said tubularly-shaped cuvette.

In eighth aspect of the present disclosure, said cylindrical focusing element is separated from said jet stream.

In ninth aspect of the present disclosure, the flow cytometer further comprises a polarization conditioning element through which said collimated elliptical beam of light passes.

In tenth aspect of the present disclosure, an optical image of the viewing zone is formed outside the composite microscope objective.

In eleventh aspect of the present disclosure, the viewing zone is located within a flow channel included in a rectangularly-shaped cuvette made of optically transparent material.

In twelfth aspect of the present disclosure, said concave mirror is a plano-concave back surface mirror made from an optically transparent material.

In thirteenth aspect of the present disclosure, the plano-surface of said plano-concave back surface mirror is optically coupled to a flat surface of said cuvette.

In fourteenth aspect of the present disclosure, an optical adhesive material accomplishes the optical coupling.

In fifteenth aspect of the present disclosure, an index matching gel accomplishes the optical coupling.

In sixteenth aspect of the present disclosure, an index matching fluid accomplishes the optical coupling.

In seventeenth aspect of the present disclosure, optical contact bonding accomplishes the optical coupling.

In eighteenth aspect of the present disclosure, the plano-concave back surface mirror formed integrally with said cuvette means.

In nineteenth aspect of the present disclosure, said aberration corrector plate is a plano-aspherical lens.

In twentieth aspect of the present disclosure, a plano-surface of said aberration corrector plate is optically coupled to a flat surface of said cuvette opposite of said plano-concave back surface mirror.

In twenty-first aspect of the present disclosure, an index matching gel accomplishes the optical coupling.

In twenty-second aspect of the present disclosure, an index matching fluid accomplishes the optical coupling.

In twenty-third aspect of the present disclosure, optical contact bonding accomplishes the optical coupling.

In twenty-fourth aspect of the present disclosure, the plano-aspherical lens is formed integrally with said cuvette.

In twenty-fifth aspect of the present disclosure, said aberration corrector plate is detached from said cuvette.

In twenty-sixth aspect of the present disclosure, the viewing zone is inside a jet stream.

In twenty-seventh aspect of the present disclosure, said concave mirror is a front surface mirror.

In twenty-eighth aspect of the present disclosure, the viewing zone is located on a surface of a flat, transparent substrate.

In twenty-ninth aspect of the present disclosure, said concave mirror is a plano-concave back surface mirror made from an optically transparent material.

In thirtieth aspect of the present disclosure, the plano-surface of said plano-concave back surface mirror is optically coupled to said flat, transparent substrate.

In thirty-first aspect of the present disclosure, an optical adhesive material accomplishes the optical coupling.

In thirty-second aspect of the present disclosure, an index matching gel accomplishes the optical coupling.

In thirty-third aspect of the present disclosure, an index matching fluid accomplishes the optical coupling.

In thirty-fourth aspect of the present disclosure, optical contact bonding accomplishes the optical coupling.

In thirty-fifth aspect of the present disclosure, said plano-concave back surface mirror is formed integrally with said flat, transparent substrate.

In thirty-sixth aspect of the present disclosure, said aberration corrector plate is detached from said flat, transparent substrate.

In thirty-seventh aspect of the present disclosure, the particle filter has inlet thereto for receiving liquid from the T-coupling, the inlet of the particle filter being disposed so that air becomes trapped within the particle filter at the inlet thereto.

In thirty-eighth aspect of the present disclosure when said liquid pump is turned off air cannot enter into the bypass conduit.

In thirty-ninth aspect of the present disclosure, the flow cytometer further comprises a small capsule disposed between the second one of the outlets of said T-coupling and the particle filter for storing air ejected from the particle filter when the liquid pump is turned off.

In fortieth aspect of the present disclosure, the flow cytometer further comprises a length of tubing disposed between the second one of the outlets of said T-coupling and the particle filter for storing air ejected from the particle filter when the liquid pump is turned off.

In forty-first aspect of the present disclosure, the flow cytometer further comprises an adjustable valve located in the bypass conduit between the first one of the outlets of the T-coupling and the reservoir for restricting liquid flow therebetween.

In forty-second aspect of the present disclosure, the flow cytometer further comprises an adjustable valve located between the second one of the outlets of the T-coupling and the viewing zone for restricting liquid flow therebetween.

In forty-third aspect of the present disclosure, the throughput of the liquid pump is adjustable.

In forty-fourth aspect of the present disclosure, the arcuate curved track of said pump housing includes at least two (2) pumping sections, the arcuate curved track further including at least one recess section located between said pumping sections along the arcuate curved track, and said compressible tube at said recess section becoming decompressed to full expansion then compressed to fully closed when one (1) of said rollers rolls through said recess section.

In forty-fifth aspect of the present disclosure, the peristaltic pump includes a plurality of recess sections along said arcuate curved track upstream of the pump outlet, the angular spacing between the compression part of said recess section adjacent to the pump outlet and said exit section of said arcuate curved track being substantially the same as the angular spacing between each pair of immediately adjacent rollers.

In forty-sixth aspect of the present disclosure, said compression part of said recess section adjacent to the pump outlet has a shape complementing a shape of said exit section of said arcuate curved track to maintain the total fluid volume inside a section of said compressible tube extending from said recess section to the pump outlet substantially invariant when one of said rollers progressively rolls off said exit section of the arcuate curved track.

In forty-seventh aspect of the present disclosure, the peristaltic pump includes a plurality of recess sections respectively interspersed between immediately adjacent pairs of a plurality of pumping sections.

In forty-eighth aspect of the present disclosure, both angular spacing between adjacent pairs of recess sections, and angular spacing between said exit section of said arcuate curved track and an adjacent recess section to said exit section are substantially the same as the angular spacing between each pair of immediately adjacent rollers.

In forty-ninth aspect of the present disclosure, shapes of a plurality of recess sections of said arcuate curved track complement a shape of said exit section of said arcuate curved track to maintain a fluid volume in sections of said compressible tube at the plurality of recess sections and said exit section substantially invariant when one of said rollers progressively rolls off said exit section of the arcuate curved track.

In fiftieth aspect of the present disclosure, a speed of said rotor is programmably controlled to vary substantially in inverse proportion to the fluid volume change rate in said compressible tube due to its changing compression near the exit section of said arcuate curved track.

In fifty-first aspect of the present disclosure, at least one additional dichroic filter is located between said image relay optical element and the image produced by said image relay optical element, said dichroic filter producing two (2) branches of the beam of light having distinctive colors.

In fifty-second aspect of the present disclosure, another focusing optical element is located in one of said branches and focuses the beam of light in the branch into a spot having a diameter of less than 1.0 mm.

In fifty-third aspect of the present disclosure, wherein successive combinations of said image relay optical element, dichroic filter, and focusing optical element are cascaded to produce additional focused spots having a diameter of less than 1.0 mm for multiple colored bands of said beam of light.

In fifty-fourth aspect of the present disclosure, the dichroic filter is assembled using a template that include two (2) optically flat glass plates bonded together in optical contact, and the dichroic filter is bonded to a filter holder using the template such that a coated filter surface of the dichroic filter is indented and optically parallel to a reference surface of the filter holder.

In fifty-fifth aspect of the present disclosure, the reference surface of the filter holder rests against an optically flat surface of an reference block included in the WDM thereby providing consistent optical alignment when installing the dichroic filter into the WDM.

In fifty-sixth aspect of the present disclosure, the LD based optical subsystem includes a LD for emitting a diverging beam of light from an edge thereof, the diverging beam of light having an elliptically shaped cross-sectional profile with both a major axis and a minor axis, a collimating lens for converting the diverging beam of light emitted from said LD into a collimated elliptical beam of light, wherein the minor axis of said collimated elliptical beam of light is oriented parallel to a direction in which particles pass through the viewing zone, a beam compressing optical element for reducing the size of said elliptical beam of light at the viewing zone whereby a width of said major axis of said elliptical beam of light oriented perpendicular to the direction in which particles pass through the viewing zone is less than a width of said liquid sheath flow, a cylindrical focusing element positioned adjacent to the viewing zone with an axis of said cylindrical focusing element being oriented perpendicular to the direction in which particles pass through the viewing zone whereby said minor axis of said beam of light becomes focused at the viewing zone, and the size of said major axis of said elliptical beam of light at the viewing zone remains essentially unchanged.

In fifty-seventh aspect of the present disclosure, the optical subsystem may further comprise a cuvette having a rectangularly-shaped cross-section, and the viewing zone may be located within a channel having a rectangularly-shaped cross-section that is located within said cuvette.

In fifty-eighth aspect of the present disclosure, the optical subsystem further comprises a cuvette having a tubularly-shaped cross-section, and the viewing zone is located within a channel having a circularly-shaped cross-section that is located within said cuvette.

In fifty-ninth aspect of the present disclosure, the sample liquid and the liquid sheath flow form a jet stream in which the viewing zone is located.

In sixtieth aspect of the present disclosure, cylindrical focusing element is in optical contact with an entrance face of said rectangularly-shaped cuvette.

In sixty-first aspect of the present disclosure, said cylindrical focusing element is separated from said rectangularly-shaped cuvette.

In sixty-second aspect of the present disclosure, said cylindrical focusing element is separated from said tubularly-shaped cuvette.

In sixty-third aspect of the present disclosure, said cylindrical focusing element is separated from said jet stream.

In sixty-fourth aspect of the present disclosure, the optical subsystem (50) further comprises a polarization conditioning element through which said collimated elliptical beam of light passes.

In sixty-fifth aspect of the present disclosure, a method for delivering an elliptically shaped beam of light using a LD based optical subsystem (50), the beam of light having a smooth profile at a focus of a minor axis thereof that is located at a viewing zone through which a sample liquid flows, the sample liquid being hydrodynamically focused within the viewing zone by a liquid sheath flow that also flows through the viewing zone, the method includes the steps of:

providing a LD that emits a diverging beam of light from an edge thereof, the diverging beam of light having an elliptically shaped cross-sectional profile with both a major axis and a minor axis, impinging the diverging beam of light emitted by the LD upon a collimating lens for converting the diverging beam of light emitted therefrom into a collimated elliptical beam of light wherein the minor axis of said collimated elliptical beam of light is oriented parallel to a direction in which sample liquid passes through the viewing zone, after passing through said collimating lens, impinging the collimated elliptical beam of light upon an beam

compressing optical element for reducing the size of said elliptical beam of light at the viewing zone whereby a width of said major axis of said elliptical beam of light oriented perpendicular to the direction in which sample liquid passes through the viewing zone becomes less than a width of said liquid sheath flow, and after passing through said beam compressing optical element, impinging the beam of light upon a cylindrical focusing element positioned adjacent to the viewing zone with an axis of said cylindrical focusing element being oriented perpendicular to the direction in which sample liquid passes through the viewing zone whereby said minor axis of said beam of light becomes focused at the viewing zone, and the size of said major axis of said elliptical beam of light at the viewing zone remains essentially unchanged.

In sixty-sixth aspect of the present disclosure, the viewing zone is located within a channel having a rectangularly-shaped cross-section that is located within a cuvette.

In sixty-seventh aspect of the present disclosure, the viewing zone is located within a channel having a circularly-shaped cross-section that is located within a cuvette.

In sixty-eighth aspect of the present disclosure, the viewing zone is located within a jet stream.

In sixty-ninth aspect of the present disclosure, the method further comprises a step of establishing an optical contact between said cylindrical focusing element and an entrance face of said cuvette.

In seventieth aspect of the present disclosure, the method further comprises a step of establishing a spacing between said cylindrical focusing element and said cuvette.

In seventy-first aspect of the present disclosure, the method further comprises a step of establishing a spacing between said cylindrical focusing element and said cuvette.

In seventy-second aspect of the present disclosure, the method further comprise a step of establishing a spacing between said cylindrical focusing element and said jet stream.

In seventy-third aspect of the present disclosure, the method further comprises a step of inserting a polarization conditioning element between the collimating lens and the beam compressing optical element whereby the collimated elliptical beam of light passes through the polarization conditioning element.

In seventy-fourth aspect of the present disclosure, The composite microscope objective includes a concave mirror upon which scattered and fluoresced light impinges and an aberration corrector plate made of optically transparent material. The aberration corrector plate is an aspheric lens that has a first zone of said aberration corrector plate having negative optical power outside a neutral zone and a second zone of said aberration corrector plate inside the neutral zone having positive optical power light. The neutral zone is the thinnest portion of the aberration corrector plate. Light reflected from the concave mirror passes through said aberration corrector plate. The viewing zone of said flow cytometer is located between said concave mirror and said aberration corrector plate.

In seventy-fifth aspect of the present disclosure, an optical image of the viewing zone is formed outside the composite microscope objective.

In seventy-sixth aspect of the present disclosure, the viewing zone is located within a flow channel included in a rectangularly-shaped cuvette made of optically transparent material.

In seventy-seventh aspect of the present disclosure, said concave mirror is a plano-concave back surface mirror made from an optically transparent material.

In seventy-eighth aspect of the present disclosure, a plano-surface of said plano-concave back surface mirror is optically coupled to a flat surface of said cuvette.

In seventy-ninth aspect of the present disclosure, an optical adhesive material accomplishes the optical coupling.

In eightieth aspect of the present disclosure an index matching gel accomplishes the optical coupling.

In eighty-first aspect of the present disclosure, an index matching fluid accomplishes the optical coupling.

In eighty-second aspect of the present disclosure, optical contact bonding accomplishes the optical coupling.

In eighty-third aspect of the present disclosure, the plano-concave back surface mirror formed integrally with said cuvette means.

In eighty-fourth aspect of the present disclosure, said aberration corrector plate is a plano-aspherical lens.

In eighty-fifth aspect of the present disclosure, a plano-surface of said aberration corrector plate is optically coupled to a flat surface of said cuvette opposite of said plano-concave back surface mirror.

In eighty-sixth aspect of the present disclosure, an index matching gel accomplishes the optical coupling.

In eighty-seventh aspect of the present disclosure, an index matching fluid accomplishes the optical coupling.

In eighty-eighth aspect of the present disclosure, optical contact bonding accomplishes the optical coupling.

In eighty-ninth aspect of the present disclosure, the plano-aspherical lens is formed integrally with said cuvette.

In ninetieth aspect of the present disclosure said aberration corrector plate is detached from said cuvette.

In ninety-first aspect of the present disclosure, the viewing zone is inside a jet stream.

In ninety-second aspect of the present disclosure, said concave mirror is a front surface mirror.

In ninety-third aspect of the present disclosure, the viewing zone is located on a surface of a flat, transparent substrate.

In ninety-fourth aspect of the present disclosure, said concave mirror is a plano-concave back surface mirror made from an optically transparent material.

In ninety-fifth aspect of the present disclosure, a plano-surface of said plano-concave back surface mirror is optically coupled to said flat, transparent substrate.

In ninety-sixth aspect of the present disclosure, an optical adhesive material accomplishes the optical coupling.

In ninety-seventh aspect of the present disclosure, an index matching gel accomplishes the optical coupling.

In ninety-eighth aspect of the present disclosure, an index matching fluid accomplishes the optical coupling.

In ninety-ninth aspect of the present disclosure, optical contact bonding accomplishes the optical coupling.

In one hundredth aspect of the present disclosure, said plano-concave back surface mirror is formed integrally with said flat, transparent substrate.

In one hundred first aspect of the present disclosure, said aberration corrector plate is detached from said flat, transparent substrate.

In one hundred second aspect of the present disclosure, a method for characterizing microscopic species using a microscope objective device includes a concave mirror, an aberration corrector plate made of optically transparent material, and a viewing zone located in between said concave mirror and said aberration corrector plate. The aberration corrector plate is an aspheric lens that has a first zone of said aberration corrector plate having negative optical power outside a neutral zone and a second zone of said aberration corrector plate inside the neutral zone having positive optical power light. The neutral zone is the thinnest portion of the aberration corrector plate.

In one hundred third aspect of the present disclosure, an optical image of the viewing zone is formed outside the device.

In one hundred fourth aspect of the present disclosure, the viewing zone is located within a flow channel contained in a rectangularly-shaped cuvette means made of optically transparent material.

In one hundred fifth aspect of the present disclosure, said concave mirror is a plano-concave back surface mirror made from an optically transparent material.

In one hundred sixth aspect of the present disclosure, a plano-surface of said plano-concave back surface mirror means is optically coupled to a flat surface of said cuvette means.

In one hundred seventh aspect of the present disclosure, an optical adhesive material accomplishes the optical coupling.

In one hundred eighth aspect of the present disclosure, an index matching gel accomplishes the optical coupling.

In one hundred ninth aspect of the present disclosure, an index matching fluid accomplishes the optical coupling.

In one hundred tenth aspect of the present disclosure, optical contact bonding accomplishes the optical coupling.

In one hundred eleventh aspect of the present disclosure the plano-concave back surface mirror is formed integrally with said cuvette.

In one hundred twelfth aspect of the present disclosure, said aberration corrector plate is a plano-aspherical lens.

In one hundred thirteenth aspect of the present disclosure, a plano-surface of said aberration corrector plate is optically coupled to a flat surface of said cuvette means opposite of said concave mirror.

In one hundred fourteenth aspect of the present disclosure an index matching gel accomplishes the optical coupling.

In one hundred fifteenth aspect of the present disclosure, an index matching fluid accomplishes the optical coupling.

In one hundred sixteenth aspect of the present disclosure, optical contact bonding accomplishes the optical coupling.

In one hundred seventeenth aspect of the present disclosure, the plano-aspherical lens is formed integrally with said cuvette.

In one hundred eighteenth aspect of the present disclosure, said aberration corrector plate is detached from said cuvette.

In one hundred nineteenth aspect of the present disclosure, the viewing zone is inside a jet stream.

In one hundred twentieth aspect of the present disclosure, said concave mirror is a front surface mirror.

In one hundred twenty-first aspect of the present disclosure, the viewing zone is located on a surface of a flat, transparent substrate.

In one hundred twenty-second aspect of the present disclosure said concave mirror is a plano-concave back surface mirror made from an optically transparent material.

In one hundred twenty-third aspect of the present disclosure, a plano-surface of said plano-concave back surface mirror means is optically coupled to said flat, transparent substrate.

In one hundred twenty-fourth aspect of the present disclosure, an optical adhesive material accomplishes the optical coupling.

In one hundred twenty-fifth aspect of the present disclosure, an index matching gel accomplishes the optical coupling.

In one hundred twenty-sixth aspect of the present disclosure, an index matching fluid accomplishes the optical coupling.

In one hundred twenty-seventh aspect of the present disclosure, optical contact bonding accomplishes the optical coupling.

In one hundred twenty-eighth aspect of the present disclosure, said plano-concave back surface mirror is formed integrally with said flat, transparent substrate.

In one hundred twenty-ninth aspect of the present disclosure, said aberration corrector plate is detached from said flat, transparent substrate.

In one hundred thirtieth aspect of the present disclosure, a fluidic subsystem for supplying a liquid flow pulsation free to an outlet of the fluidic subsystem includes a liquid pump for supplying liquid drawn from a reservoir and a T-coupling having at least one inlet and two outlets. The inlet of said T-coupling receives liquid from said liquid pump. A first fraction of the liquid received by the inlet flows via a first one of the outlets and via a bypass conduit back to the reservoir. A second fraction of the liquid received by the inlet flows via a second one of the outlets and via a particle filter to the viewing zone of said flow cytometer.

In one hundred thirty-first aspect of the present disclosure, the particle filter has an inlet thereto for receiving liquid from the T-coupling, the inlet of the particle filter being disposed so that air becomes trapped within the particle filter at the inlet thereto.

In one hundred thirty-second aspect of the present disclosure, when said liquid pump is turned off air cannot enter into the bypass conduit.

In one hundred thirty-third aspect of the present disclosure, the fluidic subsystem further comprises a small capsule disposed between the second one of the outlets of said T-coupling and the particle filter for storing air ejected from the particle filter when the liquid pump is turned off.

In one hundred thirty-fourth aspect of the present disclosure, the fluidic subsystem further comprises a length of tubing disposed between the second one of the outlets of said T-coupling and the particle filter for storing air ejected from the particle filter when the liquid pump is turned off.

In one hundred thirty-fifth aspect of the present disclosure, the fluidic subsystem further comprises an adjustable valve located in the bypass conduit between the first one of the outlets of the T-coupling and the reservoir for restricting liquid flow therebetween.

In one hundred thirty-sixth aspect of the present disclosure, the fluidic subsystem further comprises an adjustable valve located between the second one of the outlets of the T-coupling and the outlet of the fluidic subsystem for restricting liquid flow therebetween.

In one hundred thirty-seventh aspect of the present disclosure, the throughput of the liquid pump is adjustable.

In one hundred thirty-eighth aspect of the present disclosure, a method for supplying a liquid flow pulsation free to an outlet of the fluidic subsystem includes a liquid pump for supplying liquid drawn from a reservoir and a T-coupling having at least one (1) inlet and two (2) outlets. The inlet of said T-coupling receives liquid from said liquid pump. A first fraction of the liquid received by the inlet flows via a first one of the outlets and via a bypass conduit back to the reservoir. A second fraction of the liquid received by the inlet flows via a second one of the outlets and via a particle filter to the viewing zone of said flow cytometer.

In one hundred thirty-ninth aspect of the present disclosure, during normal operation certain amount of air is trapped near the inlet portion of said filter cartridge means.

In one hundred fortieth aspect of the present disclosure said reservoir means holds sufficient amount of liquid such that when said pump means is turned off, portion of the tubing between said T-coupling means and said reservoir means is still filled with liquid, preventing said trapped air from leaking into said bypass means.

In one hundred forty-first aspect of the present disclosure, said reservoir means is a capsule.

In one hundred forty-second aspect of the present disclosure, said reservoir means is a piece of tubing.

In one hundred forty-third aspect of the present disclosure an adjustable flow restrictor means is placed in the bypass route.

In one hundred forty-fourth aspect of the present disclosure an adjustable flow restrictor means is placed in the sheath route.

In one hundred forty-fifth aspect of the present disclosure, the throughput of the sheath pump is adjustable.

In one hundred forty-sixth aspect of the present disclosure, a peristaltic pump includes a pump housing having an arcuate curved track formed therein that extends between a pump inlet and a pump outlet, a plurality of rollers that are attached to a rotor, the rollers having a substantially equal angular spacing between each pair of immediately adjacent rollers, the rotor being rotatable together with the rollers attached thereto inside said pump housing, and a compressible tube sandwiched between said rollers and the arcuate curved track of said pump housing. The arcuate curved track includes an exit section and at least one pumping section along the arcuate curved track between the pump inlet and the pump outlet. As a roller rolls through the exit section, said compressible tube adjacent to said roller progressively expands from fully closed at a beginning of said exit section to fully open at the pump outlet where said roller breaks contact with said compressible tube. Said compressible tube is compressed to fully closed by at least one of said rollers.

In one hundred forty-seventh aspect of the present disclosure, the arcuate curved track of said pump housing includes at least two (2) pumping sections, the arcuate curved track further including at least one recess section located between said pumping sections along the arcuate curved track, and wherein said compressible tube at said recess section becomes decompressed to full expansion then compressed to fully closed when one (1) of said rollers rolls through said recess section.

In one hundred forty-eighth aspect of the present disclosure, the peristaltic pump includes a plurality of recess sections along said arcuate curved track upstream of the pump outlet, the angular spacing between the compression part of said recess section adjacent to the pump outlet and said exit section of said arcuate curved track being substantially the same as the angular spacing between each pair of immediately adjacent rollers.

In one hundred forty-ninth aspect of the present disclosure, said compression part of said recess section adjacent to the pump outlet has a shape complementing a shape of said exit section of said arcuate curved track to maintain the total fluid volume inside a section of said compressible tube extending from said recess section to the pump outlet substantially invariant when one of said rollers progressively rolls off said exit section of the arcuate curved track.

In one hundred fiftieth aspect of the present disclosure, the peristaltic pump has a plurality of recess sections respectively interspersed between immediately adjacent pairs of a plurality of pumping sections.

In one hundred fifty-first aspect of the present disclosure, both angular spacing between adjacent pairs of recess sections, and angular spacing between said exit section of said arcuate curved track and an adjacent recess section to said exit section are substantially the same as the angular spacing between each pair of immediately adjacent roller.

In one hundred fifty-second aspect of the present disclosure, shapes of a plurality of recess sections of said arcuate curved track complement a shape of said exit section of said arcuate curved track to maintain a fluid volume in sections of said compressible tube at the plurality of recess sections and said exit section substantially invariant when one of said rollers progressively rolls off said exit section of the arcuate curved track.

In one hundred fifty-third aspect of the present disclosure, a speed of said rotor is programmably controlled to vary substantially in inverse proportion to the fluid volume change rate in said compressible tube due to its changing compression near the exit section of said arcuate curved track.

In one hundred fifty-fourth aspect of the present disclosure, a method for delivering liquid using a peristaltic pump includes a pump housing having a arcuate curved track formed therein that extends between a pump inlet and a pump outlet, a plurality of rollers that are attached to a rotor, the rollers having a substantially equal angular spacing between each pair of immediately adjacent rollers, the rotor being rotatable together with the rollers attached thereto inside said pump housing, and a compressible tube sandwiched between said rollers and the arcuate curved track of said pump housing. The arcuate curved track includes an exit section and at least one pumping section along the arcuate curved track between the pump inlet and the pump outlet. As a roller rolls through the exit section, said compressible tube adjacent to said roller progressively expands from fully closed at a beginning of said exit section to fully open at the pump outlet where said roller breaks contact with said compressible tube. Said compressible tube is compressed to fully closed by at least one of said rollers.

In one hundred fifty-fifth aspect of the present disclosure the arcuate curved track of said pump housing includes at least two (2) pumping sections, the arcuate curved track further including at least one recess section located between said pumping sections along the arcuate curved track, and wherein said compressible tube at said recess section becomes decompressed to full expansion then compressed to fully closed when one (1) of said rollers rolls through said recess section.

In one hundred fifty-sixth aspect of the present disclosure, the peristaltic pump includes a plurality of recess sections along said arcuate curved track upstream of the pump outlet; The angular spacing between the compression part of said recess section adjacent to the pump outlet and said exit section of said arcuate curved track being substantially the same as the angular spacing between each pair of immediately adjacent rollers.

In one hundred fifty-seventh aspect of the present disclosure, said compression part of said recess section adjacent to the pump outlet has a shape complementing a shape of said

exit section of said arcuate curved track to maintain the total fluid volume inside a section of said compressible tube extending from said recess section to the pump outlet substantially invariant when one of said rollers progressively rolls off said exit section of the arcuate curved track.

In one hundred fifty-eighth aspect of the present disclosure, the pump has a plurality of recess sections respectively interspersed between immediately adjacent pairs of a plurality of pumping sections.

In one hundred fifty-ninth aspect of the present disclosure, both angular spacing between adjacent pairs of recess sections, and angular spacing between said exit section of said arcuate curved track and an adjacent recess section to said exit section are substantially the same as the angular spacing between each pair of immediately adjacent roller.

In one hundred sixtieth aspect of the present disclosure, shapes of a plurality of recess sections of said arcuate curved track complement a shape of said exit section of said arcuate curved track to maintain a fluid volume in sections of said compressible tube at the plurality of recess sections and said exit section substantially invariant when one of said rollers progressively rolls off said exit section of the arcuate curved track.

In one hundred sixty-first aspect of the present disclosure, a speed of said rotor of the peristaltic pump is programmably controlled to vary substantially in inverse proportion to the fluid volume change rate in said compressible tube due to its changing compression near the exit section of said arcuate curved track.

In one hundred sixty-second aspect of the present disclosure, the wavelength division multiplexer (WDM) includes a collimating optical element that magnifies an to produce an image of substantially the same size as the effective size of said collimating optical element, at least one dichroic filter located between said collimating optical element and said image, said dichroic filter separating the collimated beam of light into two (2) branches of distinctive colors, a focusing optical element located in one of said branches, the beam of light in said branch being focused to a spot having a diameter of less than 1.0 mm by said focusing optical element, and an image relay optical element located near the image produced by said collimating optical element in the other branch, said image relay optical element producing an image of said collimating optical element at substantially unit magnification.

In one hundred sixty-third aspect of the present disclosure, at least one additional dichroic filter is located between said image relay optical element and the image produced by said image relay optical element, wherein said dichroic filter produces two (2) branches of the beam of light having distinctive colors.

In one hundred sixty-fourth aspect of the present disclosure, another focusing optical element is located in one of said branches and focuses the beam of light in the branch into a spot having a diameter of less than 1.0 mm.

In one hundred sixty-fifth aspect of the present disclosure, successive combinations of said image relay optical element, dichroic filter and focusing optical element are cascaded to produce additional focused spots having a diameter of less than 1.0 mm for multiple colored bands of said beam of light.

In one hundred sixty-sixth aspect of the present disclosure, the dichroic filter is assembled using a template that include two (2) optically flat glass plates bonded together in optical contact, and wherein the dichroic filter is bonded to a filter holder using the template such that a coated filter surface of the dichroic filter is indented and optically parallel to a reference surface of the filter holder.

In one hundred sixty-seventh aspect of the present disclosure, the reference surface of the filter holder rests against an optically flat surface of an reference block included in the WDM thereby providing consistent optical alignment when installing the dichroic filter into the WDM.

In one hundred sixty-eighth aspect of the present disclosure, a method for separating beam of light into colored bands using a WDM includes a collimating optical element that magnifies an to produce an image of substantially the same size as the effective size of said collimating optical element, at least one dichroic filter located between said collimating optical element and said image, said dichroic filter separating the collimated beam of light into two (2) branches of distinctive colors, a focusing optical element located in one of said branches, the beam of light in said branch being focused to a spot having a diameter of less than 1.0 mm by said focusing optical element, and an image relay optical element located near the image produced by said collimating optical element in the other branch, said image

relay optical element producing an image of said collimating optical element at substantially unit magnification.

In one hundred sixty-ninth aspect of the present disclosure, at least one additional dichroic filter may be located between said image relay optical element and the image produced by said image relay optical element, wherein said dichroic filter produces two (2) branches of beam of light having distinctive colors.

In one hundred seventieth aspect of the present disclosure, another focusing optical element is located in one of said branches and focuses the beam of light in the branch into a spot having a diameter of less than 1.0 mm.

In one hundred seventy-first aspect of the present disclosure, successive combinations of said image relay optical element, dichroic filter and focusing optical element are cascaded to produce additional focused spots having a diameter of less than 1.0 mm for multiple colored bands of said beam of light.

In one hundred seventy-second aspect of the present disclosure, the dichroic filter is assembled using a template that include two (2) optically flat glass plates bonded together in optical contact, and wherein the dichroic filter is bonded to a filter holder using the template such that a coated filter surface of the dichroic filter is indented and optically parallel to a reference surface of the filter holder.

In one hundred seventy-third aspect of the present disclosure, the reference surface of the filter holder rests against an optically flat surface of an reference block included in the WDM thereby providing consistent optical alignment when installing the dichroic filter into the WDM.

In one aspect of the disclosure, a flow cytometer having a wavelength division multiplexer (WDM), which includes an extended light source providing light that forms an object, a collimating optical element that captures light from the extended light source and projects a magnified image of the object as a first light beam, and a first focusing optical element configured to focus the first light beam to a size smaller than the object of the extended light source to a first semiconductor detector.

In an additional aspect of the disclosure, a flow cytometer includes a viewing zone where a particle in a flow stream is illuminated by light, and a composite microscope objective. The composite microscope objective further includes a concave mirror configured to gather light scattered from or fluoresced by the illuminated particle and to reflect the light back towards the viewing zone, and an aberration corrector plate configured to reduce optical aberrations in the reflected light caused by the concave mirror.

In an additional aspect of the disclosure, a flow cytometer having a fluidic system, which includes a liquid pump for supplying liquid drawn from a reservoir, and a T-coupling having at least one inlet and two outlets. The inlet of the T-coupling receives the liquid from the liquid pump. The first fraction of the liquid received by the inlet flows via a first one of the outlets and via a bypass conduit back to the reservoir. The second fraction of the liquid received by the inlet flows via a second one of the outlets and via a particle filter to the outlet of the fluidic system.

In an additional aspect of the disclosure, a flow cytometer having a peristaltic pump, which includes a pump housing having an arcuate curved track formed therein that extends between a pump inlet and a pump outlet, a plurality of rollers that are attached to a rotor, the rollers having a substantially equal angular spacing between each pair of immediately adjacent rollers, the rotor being rotatable together with the rollers attached thereto inside the pump housing, a compressible tube sandwiched between the rollers and the arcuate curved track of the pump housing, and a recess section located between the at least two pumping sections. The compressible tube at the recess section is not fully closed. The arcuate curved track further includes an exit section and at least two pumping sections along the arcuate curved track between the pump inlet and the pump outlet. As one of the plurality of rollers rolls through the exit section, the compressible tube adjacent to the roller progressively expands from fully closed at a beginning of the exit section to fully open at the pump outlet where the roller breaks contact with the compressible tube. The compressible tube is compressed to fully closed by at least one of the plurality of rollers at the at least two pumping sections.

In an additional aspect of the disclosure, a flow cytometer having a laser diode (LD) system, which includes a LD for emitting a diverging beam of light from an edge thereof, the

diverging beam of light having an elliptically shaped cross-sectional profile with both a major axis and a minor axis, a collimating lens for converting the diverging beam of light emitted from the LD into a collimated elliptical beam of light, the minor axis of the collimated elliptical beam of light being oriented parallel to a direction in which particles pass through a viewing zone, a beam compressing optical element for reducing the size of the elliptical beam of light at the viewing zone whereby a width of the elliptical beam of light oriented perpendicular to the direction in which the particles pass through the viewing zone is less than a width of a liquid sheath flow, and a cylindrical focusing element positioned adjacent to the viewing zone with an axis of the cylindrical focusing element being oriented perpendicular to the direction in which the particles pass through the viewing zone whereby the minor axis of the elliptical beam of light becomes focused at the viewing zone; and the size of the major axis of the elliptical beam of light at the viewing zone remains essentially unchanged.

The foregoing has outlined rather broadly the features and technical advantages of the present application in order that the detailed description that follows may be better understood. Additional features and advantages will be described hereinafter which form the subject of the claims. It should be appreciated by those skilled in the art that the conception and specific aspect disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present application. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the present application and the appended claims. The novel features which are believed to be characteristic of aspects, both as to its organization and method of operation, together with further objects and advantages will be better understood from the following description when considered in connection with the accompanying figures. It is to be expressly understood, however, that each of the figures is provided for the purpose of illustration and description only and is not intended as a definition of the limits of the present claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagram schematically illustrating an embodiment of a flow cytometer in accordance with the present disclosure that includes:

a) a LD based optical illumination subsystem;

b) a composite microscope objective upon which light emitted from the LD based optical illumination subsystem impinges, the composite microscope objective having a fluid-passing channel formed therethrough with a particle illumination viewing zone located inside a cuvette thereof;

c) a fluidic system for supplying a pulsation free flow of sheath liquid to the fluid-passing channel formed through the composite microscope objective;

d) a peristaltic pump for introducing a pulsation free flow of sample liquid that carries cells or particles to be analyzed into the sheath flow of liquid supplied by the fluidic system; and

e) a wavelength division multiplexer ("WDM") having a zig-zag configuration for separating a beam of light into several different colored bands, the WDM receiving light via an optical fiber that is scattered from cells or particles as they pass through the composite microscope objective's fluid passing channel and are illuminated therein by light emitted from the LD based optical illumination subsystem.

FIG. 2 is a schematic view depicting a typical high power edge emitting LD that illustrates the fast and slow axes of light emitted therefrom.

FIG. 2A shows a typical far field profile for a laser beam emitted from the LD chip depicted in FIG. 2.

FIG. 3A depicts a 3-dimensional view of a conventional LD based optical illumination subsystem for flow cytometric instruments together with the system's flow cell.

FIG. 3B depicts a typical time dependent profile of light scattering from a cell or particle passing through the laser beam depicted in FIG. 3A at the focus thereof within the system's flow cell.

FIG. 4A is an elevational view of an alternative prior art LD based optical illumination subsystem configuration across the liquid flowing through the fluid-passing channel with the beam profile at the focus thereof in the flow cytometer system's viewing zone.

FIG. 4B is a plan view along the liquid flowing through the fluid-passing channel of the alternative prior art LD based optical illumination subsystem depicted in FIG. 4A.

FIG. 5A is an elevational view across liquid flowing through the fluid-passing channel of the composite microscope objective depicted in FIG. 1, wherein the LD's slow axis oriented transversely to the liquid flow in accordance with one aspect of the present disclosure.

FIG. 5B is a plan view along liquid flowing through the fluid-passing channel of the composite microscope objective depicted in FIG. 1, wherein the LD's slow axis oriented transversely to the liquid flow in accordance with one aspect of the present disclosure.

FIG. 5C depicts a typical time dependent profile of light scattering from a cell or particle passing through the fluid passing channel of the composite microscope objective depicted in FIG. 1.

FIG. 5D depicts a perspective view of the cylindrical lens of the LD based optical subsystem coupled with the composite microscope objective in accordance with one aspect of the present disclosure.

FIG. 5E depicts an enlarged view of the beam profile shown in FIG. 5D.

FIG. 6 is a perspective view of an alternative embodiment of a LD based optical illumination subsystem in accordance with one aspect of the present disclosure adapted for use in a flow cytometer system in which a jet stream of liquid passes through the viewing zone.

FIG. 6A is an enlarged perspective view of the alternative embodiment of a LD based optical illumination subsystem of Fig. 6 depicting in greater detail the jet stream of liquid passes through the viewing zone.

FIG. 7 is a perspective view of an alternative embodiment of a LD based optical illumination subsystem in accordance with one aspect of the present disclosure adapted for use in a flow cytometer system which orients the LD's slow axis parallel to the direction of liquid flowing through the fluid-passing channel of the composite microscope objective depicted in FIG. 1.

FIG. 8 is a perspective view of a composite microscope objective in accordance with one aspect of the present disclosure adapted for use in the flow cytometer system depicted in FIG. 1, the composite microscope objective having a fluid-passing channel formed therethrough with the particle illumination viewing zone located inside a cuvette therein.

FIG. 8A is a perspective view of a combined microscope objective in accordance with one aspect of the present disclosure.

FIG. 8B illustrates the combined microscope objective depicted in FIG. 8A coupled with a flow cell in accordance with one aspect of the present disclosure.

FIG. 9A is a cross-sectional elevational view of the composite microscope objective taken along the line 9A-9A in FIG. 8 that includes ray traces from three (3) spatially separated locations in the viewing zone to an image plane for the objective illustrating scatter and fluorescence emission propagation.

FIGs. 9B1-9B3 are spot diagrams near the image plane depicted in FIG. 9A for the three (3) spatially separated light emission locations depicted in FIG. 9A.

FIG. 10 is a cross-sectional elevational view similar to that of FIG. 9A for an alternative embodiment composite microscope objective in accordance with one aspect of the present disclosure that includes ray traces from three (3) spatially separated locations in a viewing zone therein to an image plane for the objective illustrating scatter and fluorescence emission propagation.

FIG. 11 is a perspective view of yet another alternative embodiment a composite microscope objective in accordance with one aspect of the present disclosure adapted for use in the flow cytometer system depicted in FIG. 1, the alternative embodiment composite microscope objective having a fluid-passing channel formed therethrough with the particle illumination viewing zone located inside a cuvette therein.

FIG. 12 is a perspective view of an embodiment of a composite microscope objective in accordance with one aspect of the present disclosure adapted for use in the flow cytometer system depicted in FIG. 1, adapted for use wherein a viewing zone is located inside the jet stream depicted in FIGs. 6 and 6A.

FIG. 13 is a perspective view of an embodiment of a composite microscope objective in accordance with one aspect of the present disclosure adapted for use wherein a viewing zone is located on the surface of a microscope slide.

FIG. 14 is a schematic diagram depicting a fluidic system in accordance with one aspect of the present disclosure for supplying stable liquid sheath flow to a flow cytometer flow cell that includes:

1. a small capsule located between a sheath liquid pump and the flow cell; and

2. a particle filter located between the small capsule and the flow cell, both the particle filter and the small capsule providing air reservoirs for dampening pump pulsations.

FIG. 15 is a schematic diagram depicting an embodiment of a fluidic subsystem similar to that illustrated in FIG 14 that replaces the small capsule with a length of tubing for providing an air reservoir.

FIGs. 16A and 16B are histograms that compare measured particle flight times at the flow cell when the inlet portion of the particle filter has air trapped therein (FIG. 16A), and when there is no air within the fluidic subsystem between the sheath liquid pump and the flow cell (FIG. 16B).

FIG. 17 is a perspective view of a 3-roller peristaltic pump in accordance with one aspect of the present disclosure depicting the pump's rollers, tube and surrounding pump housing.

FIGs. 18A through 18D depict simplified views for several states of the 3-roller peristaltic pump depicted in FIG. 17 with the rollers in different locations.

FIGs. 19 is a detailed longitudinal cross-sectional view of the peristaltic pump's tube being partially compressed by the pump's roller.

FIG. 19A and 19B are detailed cross-sectional views orthogonal to the peristaltic pump's tube's length taken along the lines 19A and 19B in FIG. 19 illustrating the tube's partial compression by the roller.

FIGs. 20A and 20B are schematic diagrams illustrating the pump's rollers and tube viewed along the pump's circular coordinates to depicting the pulseless flow provided by the peristaltic pump.

FIG. 21 is a graph depicting the functional relationship with respect to the roller position when it rolls off the exit section of the compressible tube of:

1. the total volume of liquid in the exit half of the pump; as well as
2. the liquid volumes in the pump's:
   a. recess section; and
   b. exit section.

FIG. 22 is a simplified plan view of a 4-roller peristaltic pump in accordance with one aspect of the present disclosure.

FIG. 23 is a simplified plan view of a 6-roller peristaltic pump in accordance with one aspect of the present disclosure.

FIG. 24A is a longitudinal cross-sectional illustration of rollers and a compressible tube for a pulsation minimizing 3-roller peristaltic pump in accordance with one aspect of the present disclosure having a rotor with programmable speed.

FIG. 24B is simplified plan view illustrating the pulsation minimizing 3-roller peristaltic pump in accordance with one aspect of the present disclosure having a rotor with programmable speed.

FIG. 24C is a graph depicting for the pulsation minimizing peristaltic pump depicted in FIG. 24B having a programmable speed rotor:

1. negative volume change rate with respect to the roller position;
2. rotor speed; and
3. pump flow rate.

FIG. 25 is a diagram illustrating optical ray tracing for an exemplary 6 port wavelength division multiplexer ("WDM") using a zig-zag configuration in accordance with one aspect of the present disclosure.

FIG. 25A illustrates a top view of a light detection assembly of the WDM illustrated in FIG. 25 in accordance with one aspect of the present disclosure.

FIG. 25B illustrates a front perspective view of the light detection assembly of the WDM illustrated in FIGs. 25 and 25A.

FIG. 26 is a diagram illustrating ray tracing of prior art collimating devices showing the device's limitation in collimating an extended light source.

FIG. 27 is a perspective illustration of an embodiment of a 6 port WDM using a combination of zig-zag and branched configurations in accordance with one aspect of the present disclosure.

FIG. 28 is a perspective illustration of another embodiment of a WDM having concave dichroic filters in accordance with one aspect of the present disclosure.

FIGs. 29A and 29B are perspective illustrations depicting an assembly process for constructing a replaceable dichroic filter assembly for a reconfigurable WDM in accordance with the present disclosure.

FIG. 29C is a perspective illustration of a replaceable dichroic filter assembly build in accordance with the illustrations of FIGs. 29A and 29B.

FIGs. 30A and 30B are perspective illustrations of a WDM in accordance with one aspect of the present disclosure depicting installing into the WDM the replaceable dichroic filter assembly depicted in FIG. 29C and its removal therefrom.

FIG. 31 is a diagram schematically illustrating an optical system with a single light source in accordance with one aspect of the present disclosure.

FIG. 32 is a diagram schematically illustrating an optical system with multiple light sources in accordance with one aspect of the present disclosure.

FIG. 33 illustrates an enlarged view of beams of light shown in FIG. 32.

FIG. 34 is a diagram schematically illustrating an optical system with chromatic compensation elements in accordance with one aspect of the present disclosure.

FIG. 35 is a diagram schematically illustrating a power monitoring system in accordance with one aspect of the present disclosure.

FIG. 36 is a diagram schematically illustrating an optical system in accordance with one aspect of the present disclosure.

FIG. 37 is a diagram schematically illustrating an axial light loss detection system in accordance with one aspect of the present disclosure.

FIG. 38 is a diagram schematically illustrating an axial light loss detection system coupled with a second light detection system in accordance with one aspect of the present disclosure.

DETAILED DESCRIPTION

Flow Cytometer

A flow cytometer system may include one or more following components.

1. A flow cell through which a liquid stream, usually called a sheath flow, carries and hydrodynamically aligns cells or particles so that they pass single file through the flow cell.

2. A measuring subsystem system coupled to the flow cell that detects cells or particles passing through the flow cell and is usually either:

a. an impedance or conductivity measuring subsystem; or

b. an optical illumination subsystem together with an optical sensing subsystem.

3. A conversion subsystem for converting the output signal from the measuring subsystem into computer processable data.

4. A computer for analyzing the data produced by the conversion subsystem.

The optical illumination subsystem provides a collimated and then focused beam of light, usually laser light of a single wavelength, that impinges upon the hydrodynamically-focused stream of liquid passing through the flow cell. Accordingly, the flow cytometer system may have one or more light sources that may include:

1. one or more lamps, e.g., mercury or xenon;

2. one or more high-power water-cooled lasers, e.g., argon, krypton or dye laser;

3. one or more low-power air-cooled lasers, e.g., argon (488 nm), HeNe (red-633 nm), HeNe (green) and HeCd (UV); and/or

4. one or more diode lasers (blue, green, red and violet).

The optical sensing subsystem includes one or more detectors aimed where the focused liquid stream passes through the light beam. Such detectors may include:

1. detectors in line with the light beam (Forward Scatter or FSC);

2. detectors perpendicular to it (Side Scatter or SSC); and

3. fluorescence detectors.

Each suspended particle passing through the beam scatters the light, and fluorescent material present in the particle or attached to the particle excited by the impinging light emit light at a longer wavelength than that of the impinging light.

Detecting and analyzing brightness changes in a combination of scattered and fluorescent light at each detector (one for each fluorescent emission peak) permits deriving various types of information about the physical and chemical structure of each individual particle. FSC correlates with cell volume. Due to light being scattered off of internal components within a cell, SSC depends on the inner complexity of the particle (i.e., shape of the nucleus, the amount and type of cytoplasmic granules or the membrane roughness). Some flow cytometers omit a fluorescence detector and detect only scattered light. Other flow cytometers form images of each cell's fluorescence, scattered light, and transmitted light. The flow cytometer system's conversion subsystem, which may include one or more amplifiers which may be either linear or logarithmic, generally includes one or more Analogue-to-Digital Converters ("ADCs") for converting the measuring subsystem's output signal into data that is then processed by the computer.

Modern flow cytometers usually include up to four (4) lasers and numerous fluorescence detectors. Increasing the number of lasers and detectors permits labeling cells with several different antibodies, and can more precisely identify a target population by their phenotypic markers. Some instruments can even capture digital images of individual cells, allowing for the analysis of a fluorescent signal location within or on the surface of cells.

FIG. 1 depicts a flow cytometer in accordance with one aspect of the present disclosure identified by the general reference number 40. The flow cytometer 40 may include:

1. a LD based optical subsystem 50;

2. a composite microscope objective 60;

3. a fluidic subsystem 70 for supplying a liquid sheath flow;

4. a peristaltic pump 80 for injecting a liquid sample flow that contains particles to be analyzed into the liquid sheath flow supplied by the fluidic subsystem 70, the liquid sample

flow becoming hydrodynamically focused by the liquid sheath flow passes through a viewing zone with the composite microscope objective 60 gathering and imaging light scattered and/or fluoresced by particles in the viewing zone;

5. an optical fiber 852 that receives light scattered and/or fluoresced by particles in the viewing zone that the composite microscope objective 60 gathers and images;

6. a wavelength division multiplexer 90 ("WDM 90") for optically processing scattered and/or fluoresced light received from the optical fiber 852; and

7. a photodetector system 938 to detect the light processed by the WDM 90.

Optical Subsystem 50

In most of the instruments, particles of interest, such as blood cells or microspheres, are carried by the sheath flow using hydrodynamic focusing into a viewing zone inside a cuvette or jet stream and illuminated there by a focused laser beam. The technique provides the means to accurately identify and count particles of interest without being overwhelmed by background noise occurring outside a registration time window (Practical Flow Cytometry, Howard M. Shapiro, Wiley (2003) ISBN 0471411256). To increase detection sensitivity, the cross section of the focused laser beam is usually elliptical, with the minor axis along the direction of flow. In order to maintain the threshold integrity, the laser profile must have a smooth or bell shaped profile along the flow direction. One common method for producing such an beam is to elongate a 5 nearly collimated circular Gaussian beam along the direction of flow with a beam expander made of either prism or cylindrical lens pair, then focus the beam down with a spherical lens. Since the shape of the beam at the focus is the spatial Fourier transform of the beam at far field, this produces a Gaussian shaped elliptical spot with minor axis along the flow.

Conventional lasers are expensive, bulky and power hungry. More recently, laser diodes ("LD") have become available. Differing from conventional lasers, the new generation of LDs is cost effective, compact and power efficient, and shows great promise for new generation of compact biomedical instruments. A LD emits light having an elliptical cross-section with the ellipse's major axis, frequently called the fast axis, perpendicular to the LD's junction, and the ellipse's minor axis, frequently called the slow axis, parallel to the

LD's junction. Unfortunately, the beam quality of a typical LD, particularly along its fast axis, leaves much to be desired, preventing its wide acceptance in flow cytometric applications.

In principle, the quality of the LD beam can be significantly improved by spatial filtering. If a small pinhole or a single mode optical fiber is positioned at the focal point of a lens, such that it only accepts the lowest order spatial mode, the beam passing through the pinhole or single mode optical fiber will be of nearly perfect Gaussian shape. United States Patent no. 5,788,927 discloses that such a beam can then be collimated and expanded in the direction of flow through the cytometer, and finally focused down to an elliptical shaped Gaussian beam with minor axis along the flow direction. Unfortunately, the size of desktop instrumentation limits the diameter of a pinhole to less than 5 micron. The core size of a visible wavelength single mode optical fiber also has a similar dimension. The challenge to manufacture such a precision spatial filter and maintain its long-term stability not only increases the cost of LD based laser system, but also reduces its reliability.

More recently, in an effort to reduce the possible side lobes due to the edge effect of limited numerical aperture of collimating lens, United States Patent no. 6,713,019 ("the '019 patent") discloses rotating the LD by ninety degrees (90°) such that its slow axis is parallel to the direction of flow. A beam diffusing section, such as a concave cylindrical lens, is then introduced to diffuse the collimated beam in the direction perpendicular to the flow, followed by a beam spot forming section, such as a spherical focusing lens, to form an elliptical spot within the cytometer's particle viewing zone. As described in detail in the '019 patent, the laser beam after the spot forming section is extremely astigmatic. In particular, the width of the beam at the viewing zone in the direction perpendicular to the flow is comparable or even wider than the width of the flow channel. This not only reduces the amount of laser energy impinging upon the particle and consequently the signal intensity, but also increases undesired background scattering from the liquid-flow cell interface. Instead of rotating the LD, United States Patent nos. 7,385,682 and 7,561,267 disclose using a large numerical aperture aspheric lens for LD collimation. Such a design, however, cannot correct the fringe effect inherent in the LD's beam profile. Consequently, there presently exists a need for a simple LD based optical system for use in flow cytometers that can reliably produce a focused elliptical beam with near Gaussian shape along its minor axis and a width along major axis.

In accordance with one aspect of the present disclosure, the optical subsystem 50 may include a LD 501 that, as depicted in greater detail in FIG. 2, emits a diverging beam of light from an edge thereof. As more graphically depicted in FIGs 2 and 2A, the diverging beam of light has an elliptically shaped cross-sectional profile with both a major axis, a.k.a. the fast axis, and a minor axis, a.k.a. the slow axis. The diverging beam of light emitted from the LD 501 may impinge upon a collimating lens 502 which converts the diverging beam of light emitted by LD 501 into a collimated beam of light having an elliptical cross-section. Although not essential, the optical subsystem 50 may also include an optional mirror 503 positioned to direct the collimated elliptical beam of light towards the composite microscope objective 60. A plano-convex lens 504, positioned near the composite microscope objective 60, may reduce the major axis of the elliptically shaped beam of light that is oriented perpendicular to the direction in which the liquid sample and the surrounding liquid sheath flow through the viewing zone within the composite microscope objective 60. At the viewing zone, the width of the elliptically shaped beam of light:

1. perpendicular to the direction in which the liquid sample flow passes through the viewing zone may be slightly less than the width of the liquid sheath flow; while

2. still sufficiently wide so particles in the sample flow pass through a nearly flat portion of the elliptically shaped beam of light at the beam's maximum intensity.

In accordance with one aspect of the present disclosure, it is apparent to those skilled in the art that the plano-convex lens 504 may be replaced by other types of optical elements such as an achromatic doublet lens or combination of spherical lenses, cylindrical lenses, and/or prism pairs. Alternatively, the mirror 503 and the lens 504 may also be replaced by a concave mirror. For polarization sensitive applications of the flow cytometer 40, an optional polarization conditioning element, such as a half-wave plate, may also be placed in the collimated section of the beam of light extending from the collimating lens 502 to the lens 504. Finally, before passing through the viewing zone the beam of light may pass through a high power cylindrical lens 505, positioned adjacent to the viewing zone. As depicted in FIG. 1, the axis of the cylindrical lens 505 is oriented perpendicular to the direction in which the liquid sample flow passes through the viewing zone, and the focal length of the cylindrical lens 505 produces a tight focusing of the beam of light's minor axis at the viewing zone.

An advantage of the optical subsystem 50 in comparison with conventional LD based optical subsystem may be discerned more clearly in FIGs. 2 and 2A. Most commercially available laser diodes suitable for use in a flow cytometer emit a beam of light from an edge thereof. As depicted in FIG. 2, a gain section 509 of such a LD chip 510 is highly confined in the transverse direction indicated by an arrow 511. Consequently, to achieve high output power LD manufacturers often sacrifice beam quality, particularly along the transverse or fast axis direction that is oriented parallel to the arrow 511. FIG. 2A shows this characteristic of light emitted from a LD wherein multiple fringes 512 due to gain confinement are clearly visible at the far field in the minor axis direction of the emitted beam of light. It should be noted that the fringes 512 appearing in the illustration of FIG. 2A contain only a minor amount of total energy in the beam of light, and therefore have little impact on the conventional M-square characterization of the corresponding beam profile. However, as discussed in greater detail below, the fringes 512 do have a detrimental effect on the performance of conventional flow cytometers. Alternatively, gain confinement along the slow axis direction of an edge emitting LD that is oriented perpendicular to the arrow 511 is much more relaxed. Consequently, as shown in FIG. 2A, the far field beam profile is much smoother along the slow axis of the LD's beam of light.

FIG. 3A depicts a conventional LD based optical subsystem for a flow cytometer. Those elements depicted in FIG. 3A that are common to the optical subsystem 50 illustrated in FIG. 1 carry the same reference numeral distinguished by a prime (') designation. As depicted in FIG. 3A, the conventional optical subsystem orients the fast axis of the LD 501 parallel to the direction in which the liquid sample flow passes through the viewing zone. In its most simplified configuration, the elliptical beam profile of the LD 501' is directly transposed by the spherical focusing lens 504' into the viewing zone. In an attempt to achieve optimal aspect ratio for the focused beam of light, various different conventional LD based optical subsystems have also included beam shaping optical elements in addition to those depicted in FIG. 3A.

The detrimental effect of fringes 512 along the fast axis of the LD 501' for conventional optical subsystem configurations clearly appears in the light scattering time profile depicted in FIG. 3B. Since scattering or fluorescence intensity is directly proportional to the local laser power impinging upon a particle, any fine structure in the beam of light's

profile along the direction in which the liquid sample flow passes through the viewing zone will appear in the time profile of the signal produced by the flow cytometer. Such structures in the time profile are indistinguishable from signals generated by small particles, and will therefore cause the flow cytometer to trigger falsely and misidentify particles. In addition, the fringes 512 will also lead to uncertainty in the measurement of other cytometric parameters, such as in the area and width of the pulse depicted in FIG. 3B.

FIGs. 4A and 4B depict a yet another prior art optical subsystem for LD based flow cytometric applications disclosed in the '019 patent identified previously. Those elements depicted in FIGs. 4A and 4B that are common to the optical subsystem 50 illustrated either in FIG. 1 or 3A carry the same reference numeral distinguished by a double prime (") designation. As depicted in FIGs. 4A and 4B, by orienting the slow axis of the LD 501" parallel to the direction in which the liquid sample flow passes through the viewing zone the optical subsystem depicted in FIGs. 4A & 4B effectively overcomes the problem caused by the fringes 512 as described above. Unfortunately, the beam-diffusing element 513" placed before the spherical focusing lens 504" in FIGs. 4A and 4B to diffuse the beam of light perpendicular to the direction in which the liquid sample flow passes through the viewing zone produces a highly astigmatic beam of light near the viewing zone. Specifically, focusing this astigmatic beam of light at the viewing zone in the direction in which the liquid sample flow passes through the viewing zone increases the width of the beam of light perpendicular to the direction in which the liquid sample flow passes through the viewing zone so the beam's width become similar to or even wider than the sheath flow. Consequently, the optical subsystem depicted in FIGs. 4A and 4B not only diminishes the amount of light energy impinging upon particles flowing through the viewing zone, the optical subsystem also increases undesirable scattering of light from the interface between the liquid sheath flow and adjacent parts of the composite microscope objective 60.

FIG. 5 highlights the main differences between the optical subsystem disclosed in the '019 patent and the optical subsystem 50 depicted in FIG. 1. Instead of placing an out-of-plane beam-diffusing element 513" before the spherical beam focusing lens 504 as shown in FIG. 4, the high power cylindrical lens 505, depicted in FIGs. 5A and 5B as a cylindrical plano-convex lens, may be placed along the beam of light after the spherical beam focusing lens 504 and may be juxtaposed with the composite microscope objective 60. As shown in

FIGs. 5A and 5B, the cylindrical lens 505 may focus the minor axis of the beam of light in the viewing zone while leaving the major axis of the beam of light essentially unchanged. Consequently, the optical subsystem 50 depicted in FIGs. 1, 5A and 5B may establish a beam of light profile at the viewing zone which is elliptical with:

1. a tightly focused minor axis that spans across the combined liquid sample and sheath flows; and

2. a smooth minor axis profile in the direction of the combined liquid sample and sheath flows that is the Fourier conjugate of the far field beam profile along the slow axis of LD 501.

Meanwhile, as shown in FIG. 5B, the out-of-plane beam width may be unaffected by the cylindrical lens 505. FIG. 5C shows a measured time profile of light scattered from a micro particle using the optical subsystem 50 depicted in FIGs. 1, 5A and 5B. The LD 501 used in making the measurement presented in FIG. 5C is the same as that used in generating the measured time profile of light scattered from a micro particle appearing in FIG. 3B. As shown in FIG. 5C, the side lobes caused by the fringes 512 along the fast axis of the LD 501 no longer have any material effect on performance of the flow cytometer 40.

FIG. 5D illustrates a perspective view of the cylindrical lens 505 of the LD based optical subsystem 50 coupled with the composite microscope objective 60 in accordance with some embodiments of the present disclosure. A beam of light may pass through the cylindrical lens 505 and a cuvette 603 of the microscope objective 60 substantially along the z axis and establish a beam profile 524 on a x-y plane at the viewing zone inside a flow channel 604 of the composite microscope objective 60.

FIG. 5E illustrates an enlarged view of the beam profile 524 shown in FIG. 5D in accordance with some embodiments of the present disclosure. FIG. 5E shows that the minor axis of the beam of light may be along the y axis and substantially parallel to the direction of liquid sample and sheath flows and the major axis of the beam of light may be along the x axis and substantially perpendicular to the direction of liquid sample and sheath flows.

FIG. 6 depicts yet another alternative diode laser based optical subsystem in accordance with some embodiments of the present disclosure adapted for use in a flow

cytometer. Those elements depicted in FIGs. 6 and 6A that are common to the optical subsystem 50 illustrated in FIGs. 1, 5A and 5B carry the same reference numeral distinguished by a triple prime (‴) designation. The optical subsystem 50‴ depicted in FIGs. 6A and 6B is almost identical to that shown in FIGs. 1, 5A and 5B except that the viewing zone occurs without a composite microscope objective 60 because it occurs in a free-flowing jet stream 519 that includes both the sample and sheath flows that is emitted from a nozzle 518. Consequently, for the configuration of the optical subsystem 50‴ depicted in FIGs. 6A and 6B, the high power cylindrical lens 505 is detached from the viewing zone that is located within the jet stream 519.

In the exemplary embodiments of the present disclosure depicted in FIGs. 1, 5A, 5B, 6A and 6B, the minor axis, i.e. the slow axis, of the LD 501 is substantially oriented perpendicular to the direction in which the liquid sample flow passes through the viewing zone. However, it will be apparent to those skilled in the art that using an alternative optical configuration the major axis, i.e. the fast axis, of the LD 501 may be reoriented to be perpendicular to the direction in which the liquid sample flow passes through the viewing zone. FIG. 7 depicts one example of such an alternative configuration of optical elements. Those elements depicted in FIG.7 that are common to the optical subsystem 50 illustrated in FIGs. 1, 5A, 5B, 6A and 6B carry the same reference numeral distinguished by a quadruple prime (⁗) designation. As shown, the slow axis of the LD 501⁗ is oriented in the z-direction. The beam of light emitted from the LD 501⁗ is then rotated to the in-plane y-direction by a pair of ninety degrees (90°) reflection mirrors 523a and 523b. In the illustration of FIG. 7, a normal to the first elliptically-shaped light beam reorienting mirror 523a is oriented in the x-y plane at forty-five degrees (45°) to the x-axis, and a normal to the second elliptically-shaped light beam reorienting mirror 523b is oriented in the y-z plane at forty-five degrees (45°) to the z-axis.

Composite Microscope Objective 60

Modern flow cytometers include a spatial filter, usually either a mechanical pinhole or a large core optical fiber, located at an image location of an objective lens to prevent undesired background light from entering the cytometer's detector(s). Because particles remain in the cytometer's viewing zone for a few microseconds, microscope objectives with

large numerical aperture must be used to maximize light collection efficiency. To support multiple spatially separated excitation laser beams in flow cytometers, as disclosed in United States Patent No. 4,727,020, it is also desirable to use an objective with large field of view. In order to achieve these goals, United States Patent Nos. 6,5100,07 and 7,110,192 disclose an objective design using a modified apochromat with a gel-coupled or epoxy bonded near hemisphere lens as the optical element closest to the sample that is followed by multiple meniscus lenses. While such microscope objectives provide both a satisfactory numerical aperture and field of view, they significantly sacrificed image quality thereby:

1. limiting effective use of the spatial filter; and

2. exhibiting poor background light discrimination.

Further, such refractive microscope objectives are bulky, expensive to manufacture and often exhibit severe chromatic aberration. To overcome these limitations, Published Patent Cooperation Treaty ("PCT") Patent Application No. WO 01/27590 discloses an alternative objective design based on a spherical concave mirror. The design offers large numerical aperture and good image quality along the optical axis. However, due to its poor off-axis characteristics, such a design is unsuitable for flow cytometers having multiple, spatially separated laser beams.

FIG. 8 depicts one embodiment in accordance with the present disclosure for the composite microscope objective 60 depicted in FIGs. 1, 5A, 5B and 7. As depicted in FIG. 8, the composite microscope objective 60 may image a viewing zone that is located inside a prismatically-shaped glass cuvette 603 within a small flow channel 604, that may have a rectangular cross-sectional shape, through which passes the particle carried by combined liquid sample and sheath flows. A plano-concave back-surface mirror 601 included in the composite microscope objective 60 may be made of an optically transparent material that may have a refractive index similar to that of the glass cuvette 603, such as glass or optical quality plastics. To minimize optical loss, the back-surface mirror 601 may include a flat front surface that is optically coupled to an abutting flat surface of the prismatically-shaped cuvette 603. Optical coupling of the back-surface mirror 601 to the cuvette 603 may employ an index-matching gel, optical adhesive or direct optical bonding. Alternatively, the back-surface mirror 601 may also be formed integrally with the cuvette 603.

The composite microscope objective 60 may also include a plano-aspheric corrector plate 602 that is also made of an optically transparent material that may have a refractive index similar to that of the glass cuvette 603, such as glass or optical quality plastics. To reduce optical loss, a flat surface of the corrector plate 602 may be optically coupled to an abutting flat surface of the prismatically-shaped cuvette 603 on a face thereof that is diametrically opposite to the back-surface mirror 601. Optical coupling of the corrector plate 602 to the cuvette 603 may employ an index-matching gel, optical adhesive or direct optical bonding. The aspheric surface of the corrector plate 602 furthest from the corrector plate 602 may carry an anti-reflective coating to reduce optical transmission loss, although such a coating is not a mandatory requirement for a composite microscope objective 60 in accordance with some embodiments of the present disclosure. The shape of the aspheric surface of the corrector plate 602 is similar to that in a classical Schmidt camera, (Schmidt, B., *Mitt. Hamburg Sternwart* 7 (36) 1932). As known by those skilled in the art, the corrector plate of a Schmidt camera includes a circularly shaped neutral zone where the corrector plate does not deviate rays of light passing through the plate. For use in the composite microscope objective 60, outside of the neutral zone of the corrector plate 602, where the plate thickness is thinnest, the corrector plate 602 may have negative optical power while inside the neutral zone the corrector plate 602 may have positive optical power. The exact shape of the aspheric corrector plate 602 may be readily obtained using any commercially available optical ray tracing tool by any person having ordinary skill in the art. Note that in the flow cytometer 40, the beam of light generated by the optical subsystem 50 depicted in FIGs. 1, 5A, 5B and 7 enters the cuvette 603 perpendicularly to the flow channel 604 through one (1) of the two (2) faces of the cuvette 603 that do not abut the back-surface mirror 601 or corrector plate 602.

Combined Microscope Objective 65

FIG. 8A illustrates a perspective view of a combined microscope objective 65 in accordance with some embodiments of the present disclosure. The combined microscope objective 65 may include the composite microscope objective 60, as illustrated in FIG. 8 and the cylindrical lens 505. The cylindrical lens 505 may direct a beam of light to the viewing zone in the flow channel 604 to illuminate particles in the sample flow. After particles are

illuminated in the viewing zone, the composite microscope objective 60 then may collect imaging light scattered from and fluoresced by particles within the view zone.

FIG. 8B illustrates a perspective view of the combined microscope objective 65 coupled with a flow cell 619 in according with some embodiments of the present disclosure. Liquid sample 623 may be pumped up from a sample tube 621 into a flow section 620 of the flow cell 619 by a pump 624. The pump 624 may be the peristaltic pump 80, as illustrated in FIG. 17. Liquid sheath 622 may be also pumped into the flow section 620 of the flow cell 619. The pump for pumping the liquid sheath 622 into the flow cell 619 may be a part of the fluidic system 70, as illustrated in FIG. 14 or 15. The liquid sample 623 may be combined with the liquid sheath 622 in the flow section 620 of the flow cell 619 and then hydrodynamically focused within the viewing zone inside the flow channel 604 of the combined microscope objective 65. The combined microscope objective 65 or the composite microscope objective 60 may be positioned on the flow cell 619. Persons skilled in the art may also refer to a combination of the microscope objective 65 or the composite microscope objective 60 and the flow cell 619 as a flow cell. The cross-sectional area of the flow section 620 at the top of the flow cell 619 may be smaller than the cross-sectional area of the flow section 620 at the bottom of the flow cell 619 to facilitate hydrodynamic focusing of the liquid sample 623 in the viewing zone. It should be noted that the various aspects of the present disclosure are not limited to specific direction of liquid sheath or sample flow and specific shape of the flow cell or the microscope objective.

FIG. 9A depicts the result of ray tracing for the embodiment of composite microscope objective 60 illustrated in FIG. 8. As depicted in FIG. 9A, scatter and fluorescence emissions from three (3) spatially separated locations in the flow channel 604 near the center of the cuvette 603 may:

1. initially propagate toward back-surface mirror 601 and pass first through the cuvette 603 to be internally reflected by the back-surface mirror 601;

2. then pass through the cuvette 603;

3. subsequently pass through the aspheric corrector plate 602; and

4. finally forms three (3) distinct images near an image plane 605.

Note that rays traversing the composite microscope objective 60 depicted in FIG. 9A are nearly optically-uniform and that light emitted near the center of the cuvette 603 traverses the corrector plate 602 at near normal incidence. Consequently, the composite microscope objective 60 introduces very little chromatic dispersion in light emitted near the center of the cuvette 603.

Further, it is well known in the astrophysics community that Schmidt camera offers the unparalleled combination of a fast focal ratio and a large field of view with near diffraction limited optical performance. The principal drawback in a conventional Schmidt camera is that the image surface lies inside the instrument. For the composite microscope objective 60, light near the center of the cuvette 603 propagates opposite to that of a conventional Schmidt camera and therefore the image surface lies outside the composite microscope objective 60. Consequently, the present disclosure takes full advantage of the optical performance of the Schmidt camera without experiencing its limitation. FIGs. 9B1 through 9B3 depict spot diagrams near the image plane 605 for three (3) emission locations, 606, 607, 608 in viewing zone within the flow channel 604 that may be separated 150 micron from each other. The diameters of all images depicted in FIGs. 9B1 through 9B3 may be less than 35 microns.

Light emitted from the viewing zone within the flow channel 604 of the composite microscope objective 60 depicted in FIGs. 8 and 9A that traverses the aspheric corrector plate 602 may suffer from a small amount of chromatic aberration. FIG. 10 depicts an alternative embodiment for the composite microscope objective 60 depicted in FIGs. 1, 5A, 5B and 7 in accordance with some embodiments of the present disclosure. Those elements depicted in FIG. 10 that are common to the composite microscope objective 60 illustrated in FIGs. 8 and 9A carry the same reference numeral distinguished by a prime (') designation. The shapes of the back-surface mirror 601' and the aberration corrector plate 602' depicted in FIG. 10 are modified slightly to produce collimated afocal images of the emission locations near the viewing zone within the flow channel 604'. In FIG. 10 the composite microscope objective 60' may include a chromatic compensating doublet lens 609 inserted between the corrector plate 602' and the image plane 605'. In addition to focusing the light emitted from the corrector plate 602' onto the image plane 605', the doublet lens 609 may also serve to further reduce the residual chromatic aberration introduced by the aspheric corrector plate 602'.

It is not essential that the flat surface of the corrector plate 602 to be optically coupled to the cuvette 603. FIG. 11 depicts an alternative embodiment of the composite microscope objective 60 in accordance with some embodiments of the present disclosure. Those elements depicted in FIG. 11 that are common to the composite microscope objective 60 illustrated in FIGs. 8 and 9A carry the same reference numeral distinguished by a double prime (") designation. FIG. 11 depicts the aberration corrector plate 602" optically decoupled from the cuvette 603". Although not essential for operation of the composite microscope objective 60", to improve the light transmission efficiency both surfaces of the corrector plate 602" and the exposed flat surface of the cuvette 603" may carry an anti-reflectively coating. It is understood that the corrector plate 602" shown in FIG. 11 may be held in fixed relationship to the combined back-surface mirror 601 and cuvette 603 by a mechanical support not depicted in FIG. 11. Similar to the composite microscope objective 60 and 60' depicted respectively in FIGs. 9A and 10, the composite microscope objective 60" with detached corrector plate 602" may be configured to provide either finite focal length image, or an afocal system which in turn is focused to a finite distance image plane by an additional chromatic compensating doublet lens 609.

FIG. 12 depicts yet another alternative embodiment of the composite microscope objective 60. Those elements depicted in FIG. 12 that are common to the composite microscope objective 60 illustrated in FIGs. 8, 9A and 11 carry the same reference numeral distinguished by a triple prime ('") designation. The composite microscope objective 60'" depicted in FIG. 12 is adapted for collecting scatter and fluorescence emissions from cells or other microscopic particles carried in the jet stream 519 emitted by the nozzle 518. The composite microscope objective 60'" may include a concave, spherically shaped, front surface mirror 610 and an aberration corrector plate 612. The front surface mirror 610 may be made of glass or other types of hard material with a highly reflective coating on the concave surface 611 or made of metal with polished concave surface 611. Similar to the corrector plate 602, the plano-aspheric corrector plate 612 may be made of a thin piece of transparent material, such as glass or optical quality plastics. The aspheric surface may be formed on either side of the corrector plate 612. Both surfaces of the corrector plate 612 may be coated with an anti-reflective coating to reduce optical transmission loss, although such a coating is not a mandatory requirement for a corrector plate 612 in accordance with some

embodiments of the present disclosure. It is understood that the front surface mirror 610 and the corrector plate 612 may be held in fixed relationship to each other by a mechanical support not depicted in FIG. 12. Scatter and fluorescence light emitted from cells or other types of microscopic particles in the viewing zone inside the jet stream 519 may be reflected by the concave surface 611 of the front surface mirror 610. The aberration due to reflection from the concave surface 611 may be corrected by the corrector plate 612 after light traverses through the corrector plate 612. It is understood by those having skill in the art that the composite microscope objective 60''' may be configured to provide either a finite focused image similar to that depicted in FIG. 9A, or a collimated afocal image which is focused at finite distance from the composite microscope objective 60''' by a chromatic aberration correction doublet similar to the doublet lens 609 depicted in FIG. 10.

FIG. 13 depicts an adaptation of the composite microscope objective 60 for imaging specimens fixed to the surface of a transparent substrate such as a glass slide. Those elements depicted in FIG. 13 that are common to the composite microscope objective 60 illustrated in FIGs. 8, 9A and 11 carry the same reference numeral distinguished by a quadruple prime ("") designation. The composite microscope objective 60"" depicted in FIG. 13 may include two (2) optical elements, one a plano-concave back surface mirror 617 made of a transparent material, such as glass or optical quality plastics, and an aberration corrector plate 618. As depicted in FIG. 13, the specimen to be imaged may be fixed to a front surface 615 of a transparent, usually glass slide 616. The slide 616 may be optically coupled, for example, using a thin layer of index matching fluid, to the flat surface of the back surface mirror 617. Scatter and fluorescence light emitted by the specimen may:

1. initially propagate through the slide 616 and the back surface mirror 617;

2. be internally reflected by the back surface mirror 617 back through the slide 616;

3. then pass through the corrector plate 618; and

4. finally form an image at an image plane that is located beyond the corrector plate 618.

Fluidic Subsystem 70

The performance of a flow cytometer depends critically on a stable liquid sheath flow. In particular, flow cytometers that have multiple spatially separated excitation laser beams or perform droplet sorting rely on a constant velocity of the liquid sheath flow for timing synchronization. As disclosed in United States Patent No. 5,245,318, conventional flow cytometers provide a stable liquid sheath flow by using an airtight fluidic system that either:

1. applies constant air pressure in a sheath liquid reservoir to push the fluid through the flow cell; or

2. by sucking the fluid from the sheath liquid reservoir through the flow cell using a vacuum pump.

These systems are bulky, expensive to manufacture, and prone to failure. More recently, United States Patent No. 8,187,888 discloses including a sheath liquid subsystem that pumps the liquid sheath flow from the sheath liquid reservoir into the viewing zone and a waste sheath liquid pump that pumps waste sheath liquid from the viewing zone into the waste tank. Although it appears that the disclosed sheath liquid subsystem has never been used in velocity critical flow cytometers, this patent reports that the disclosed sheath liquid subsystem overcomes most of the drawbacks of conventional sheath liquid flow stabilization by:

1. damping pump pulsations by locating:

   a. one fluidic capacitor between the sheath liquid pump and the flow cell; and

   b. another fluidic capacitor between the flow cell and the waste pump; and

2. a pump controller whose operation is responsive to a pressure sensor that measures the pressure difference between the inlet and outlet of the flow cell.

However, the disclosed sheath liquid subsystem has other limitations. For example, the pressure sensor located near the outlet of the flow cell could be a potential source of contamination.

FIG. 14 depicts a fluidic subsystem 70 in accordance with some embodiments of the present disclosure that includes a sheath liquid reservoir 702 and a liquid pump 701 that draws sheath liquid from the sheath liquid reservoir 702. The liquid pump 701 may be a diaphragm pump, a peristaltic pump, a piston pump, or any types of continuous fluid pump.

An outlet of the liquid pump 701 may connect to an inlet of a T-coupling 703 that receives sheath liquid from the liquid pump 701. The T-coupling 703 may have two (2) outlets. The first outlet may connect to a bypass conduit 710 for returning a fraction of the sheath liquid received by the T-coupling 703 from the liquid pump 701 back to the sheath liquid reservoir 702. Returning a fraction of the sheath liquid received by the T-coupling 703 from the liquid pump 701 back to the sheath liquid reservoir 702 is advantageous for two (2) reasons.

1. As depicted in FIG. 14, the bypass conduit 710 is left open to the surrounding atmosphere which effectively dampens pulsation to thereby significantly reducing the pulsation inherent in the operation of the liquid pump 701.

2. Returning a fraction of the sheath liquid received by the T-coupling 703 from the liquid pump 701 back to the sheath liquid reservoir 702 also effectively reduces the throughput of the liquid pump 701 thereby allowing the use of comparatively high flow rate, low cost pumps in the flow cytometer 40.

Denote the flow resistance of the bypass conduit 710 as *"r"* and the flow resistance of path from the T-coupling 703 to the flow channel 604 of the cuvette 603 as *"R."* The output resistance to the sheath pump R_p is then equal to:

$$R_p \frac{rR}{r+R} \quad (1)$$

Since $R >> r$, the behavior of the liquid pump 701 is therefore dominated by the resistance of the bypass conduit 710 whose fluid dynamic properties may be temperature insensitive. Thus, the configuration of the fluidic subsystem 70 depicted in FIG. 14 may also provide a simple mechanism for achieving a temperature insensitive sheath liquid flow to the flow channel 604. As depicted in FIG. 14, the second outlet of the T-coupling 703 connects to the flow channel 604 that extends through the cuvette 603 first via a small reservoir capsule 704 and then via a filter cartridge 705. As depicted in FIG. 15, a piece of tubing 704', which may be, for example, about 4 ft. long may be substituted for the small reservoir capsule 704. During initialization of the fluidic subsystem 70, some air becomes trapped in the filter cartridge 705 near its inlet which as depicted in FIG. 15 is located above an outlet of the filter cartridge 705. The air trapped in the filter cartridge 705 may act as an additional fluidic capacitor effectively reducing to negligible level the pulsation in sheath liquid emitted into

the flow channel 604. Due to the large fluidic resistance at the flow channel 604, the air trapped inside the filter cartridge 705 becomes compressed. When the liquid pump 701 is turned off, a trapped in the filter cartridge 705 is pushed back towards the T-coupling 703 analogous to a discharging capacitor. Without the small reservoir capsule 704, some air ejected from the filter cartridge 705 reaches the bypass conduit 710 due to its low fluidic resistance, and will be pushed out of the fluidic subsystem 70 once the liquid pump 701 is turned on again. Without additional air supply, such a scenario will repeat until most of the air becomes purged from the fluidic subsystem 70 causing the filter cartridge 705 to lose its effectiveness as a pulsation damper. The purpose of the small reservoir capsule 704 or the piece of tubing 704' is therefore to provide a reservoir for isolating the filter cartridge 705 from the bypass conduit 710 ensuring that air trapped inside the filter cartridge 705 remains within the fluidic subsystem 70 despite repeated on-off operations of the liquid pump 701.

The pulsation damping effect of the trapped air near the inlet of the filter cartridge 705 is clearly evident in the histograms depicted in FIGs. 16A and 16B. FIG. 16A depicts measured particle flight times at the flow channel 604 when a pocket of air is trapped near the inlet of the filter cartridge 705. FIG. 16B depicts measured particle flight times at the flow channel 604 when the trapped air is purged from the fluidic subsystem 70. The result depicted in the histograms of FIGs. 16A and 16B is made using two (2) knife edge shaped laser beams focused near the center of the flow channel 604 that are spaced approximately 200 micrometers apart. The horizontal axis of the FIGs. 16A and 16B is the flight time a particle takes from one laser beam to the other measured by recording the peak arrival time of light scattered from the particle at ninety degrees (90°) from the excitation beams. In both cases, the average flight time for particles to cross the two laser beams is the same. As shown in FIG. 16A, when the filter cartridge 705 retains some air, all particles take about the same amount of time to cross the two laser beams. If the filter cartridge 705 retains no air, as shown in FIG. 16B, the distribution of flight times not only broadens, but also becomes bimodal. In other words, some particles take less time while others take longer than average amount of time to cross the two laser beams, a phenomenon that can be easily attributed to sheath liquid velocity pulsation at the flow channel 604.

In the embodiments of the present disclosure discussed so far, the fluidic resistance along bypass conduit 710 as well as between the T-coupling 703 and the flow channel 604

may not be adjustable. As should be apparent to those ordinary skilled in the art, flow restrictors such a fixed restrictor or adjustable valves 712, 712' and 711, 711' and may be advantageously inserted in the bypass conduit 710 and between the T-coupling 703 and the flow channel 604 to permit adjusting the flow rate through the flow channel 604. Alternatively, the velocity of sheath liquid flowing through the flow channel 604 may also be adjusted using a liquid pump 701 that is driven by a variable speed brushless DC motor.

Peristaltic Pump 80

Peristaltic pumps are volumetric pumps in which a set of linearly or circularly moving rollers progressively compress a compressible tube to propel the fluid through the tube. Peristaltic pumps are widely used particularly to pump clean/sterile or aggressive fluids to avoid cross contamination with exposed pump components. Conventional peristaltic pump exhibits a pulsation. Each time a roller rolls off the tube near the pump outlet, caused by the temporary increase of tube volume when the compressed tube expands back to its original shape. The pulsation is undesirable in applications that require smooth flow. Many attempts have been made in the past to reduce the pulsation. For example, United States Patent Nos. 3,726,613 and 3,826,593 introduced a cam operated pusher which synchronously exerts an external pressure on the tube to compensate for the tube expansion. In United States Patent No. 4,834,630, a plurality of tubes mounted on segmented rollers are joined together at the pump inlet and outlet by T-shaped couplers such that pulsations from individual tubes would be reduced by averaging. United States Patent No. 7,645,127 proposed a pump tube with slightly larger inner diameter near the inlet so that the tube decompression near the pump outlet is compensated by the compression of a larger volume tube near the inlet. The various methods either significantly increased the complexity of the peristaltic pump or had limited success in reducing the pulsation effect.

A peristaltic pump 80 in accordance with some embodiments of the present disclosure is illustrated in FIG. 17. The pump may include a housing 809 with arcuate curved track 808, three rollers 810, 811 and 812 attached to a rotor 816 rotatable within the housing 809, and a compressible tube 807 sandwiched between the arcuate curved track 808 of the housing 809 and the rollers 810, 811 and 812, in particular at the surface 814 of rollers 810, 811 and 812. As depicted schematically in FIGs. 18A through 18D, the rollers 810, 811 and 812 of the

peristaltic pump 80 are spaced at substantially equal angular distances, separations or spacings from each other around the perimeter of the rotor 816. The rollers 810, 811, 812 may rotate about a longitudinal axis thereof, so that limited friction occurs between the rollers and the compressible tube. This may also apply for the subsequently described rollers. For simplicity, it is assumed in the following discussions that the rotor 816 rotates counterclockwise, although it is to be understood that the discussions apply equally well to a peristaltic pump with clockwise rotating rotor. The compressible tube 807 of the housing 809 may be divided into several sections:

1. an open section between point 801 and point 806 where the compressible tube 807 experiences no compression;

2. a pump inlet section between point 801 and point 802 where the compressible tube 807 is progressively compressed until fully closed when a roller rolls over the section;

3. two pumping sections between point 802 and point 803, as well as between point 804 and point 805 wherein the compressible tube 807 is fully closed by the roller;

4. a recess section between point 803 and point 804 in which the compressible tube 807 progressively expands from fully closed to fully open as a roller rolls through the expansion part of the recess section from point 803 to point 813;

5. then the compressible tube 807 is progressively compressed to fully closed as a roller rolls through a compression part of the recess section from point 813 to point 804; and

6. the exit section between point 805 and point 806 where the compressible tube 807 progressively expands from fully closed to fully open as a roller rolls through the section.

In other words, when a roller rolls anticlockwise over the compressible tube 807 from inlet point 801 to outlet point 806, the inner gap of the compressible tube 807 may:

1. progressively decrease from fully open at point 801, to fully closed at point 802 and remain closed until point 803;

2. then progressively expand back to fully open at point 813;

3. then progressively decrease to fully closed at point 804, and remain closed until the roller reaches point 805; and

4. finally progressively expand back to fully open at point 806.

The size of the gap inside the compressible tube 807 is schematically illustrated in FIGs. 18A through 18D as the spacing between dashed circle and the solid compressible tube 807. As illustrated in FIGs. 18A through 18D, in this embodiment of the peristaltic pump 80, the angular distances, separations or spacings between points 801 and 803, points 802 and 813, point 813 and 805, as well as between point 804 and 806 may be identical to the angle between adjacent rollers. As a result, when the roller 810 rolls through the pumping section from point 804 to point 805, as depicted in FIGs. 18A through 18B, its interaction with the compressible tube 807 may completely determine the fluid flow rate of the peristaltic pump 80. Once the roller 810 reaches the exit section between point 805 and 806, as shown in FIG. 18C, the compressible tube 807 underneath the roller 810 may start to progressively expand and a gap may start to grow. Meanwhile, the roller 811 may arrive at the compression part of the recess section and start to progressively compress the compressible tube 807. In the peristaltic pump 80, the shape of the compression part of the recess section between point 813 and point 804 along the compressible tube 807 is such that the volume of liquid pushed out by the compression of the underneath roller 811 in the compression part of the recess section between point 813 and point 804 may substantially fill the volume created by the compressible tube 807 expansion underneath roller 810 in the exit section between point 805 and point 806. During this period, the compressible tube 807 is partially open underneath both rollers 810 and 811 and completely closed underneath roller 812. Consequently, the pumping action may be mainly delivered by roller 812. In particular, since by design the total volume of liquid in the section of the compressible tube 807 between point 813 and point 816 remains substantially constant during this period, the flow rate of the peristaltic pump 80 in the state shown in FIG. 18C may remain substantially the same as that in the state shown in FIGs. 18A and 18B. Once the roller 810 passes point 806, roller 811 reaches the pumping section between point 804 and point 805. Note there is no physical difference between the rollers 810, 811 and 812, the flow rate of the peristaltic pump 80 may therefore remain substantially constant throughout the entire process.

The mechanism of the pulseless peristaltic pump in accordance with some embodiments of the present disclosure may be understood more clearly if it is viewed along a circular coordinate following the movement of the rollers. Referring to FIG. 19, denote as

V the volume of the fluid inside a compressible tube 819 from the outlet to a nearest roller 820 that closes off the compressible tube 819, i.e., the amount of fluid represented by the hatched area 818 shown in FIG. 19. Clearly, V depends on the angular position, θ, of the roller 820, as well as δ, the amount of tube compression exerted by all other downstream rollers.

$$V = V(\theta, \delta_1, \delta_2, ...) \quad (2)$$

Consequently, the flow rate, F, of a peristaltic pump is related to the time derivative of Vc by:

$$-F = \frac{dv}{dt} = \frac{\partial v}{\partial \theta} R + \sum_i \frac{\partial v}{\partial \delta_i} \frac{d\delta_i}{dt} \quad (3)$$

Here R is the rotational speed of the rotor and the subscripts are used to identify multiple downstream rollers. The first term on the right hand side of Eqn. (3) represents the contribution from the roller that closes off the tube. The partial derivative $\frac{\partial v}{\partial \theta}$ is therefore independent of θ. The summation term represents contributions from all other downstream rollers partially compressing the compressible tube 819. Now let ΔS be the cross sectional area change due to the compression of the compressible tube 819 by the roller 817, and L be the length of tube where its cross sectional shape is affected by the tube compression. Then, it is obvious to a person skilled in the art that L is proportional to the tube compression δ, and ΔS proportional to its square, δ^2. Consequently, ΔV, the volume of fluid lost due to the compression of the compressible tube 807 by the roller, follows Eqn. (4):

$$\Delta V \alpha L \cdot \Delta S \alpha \delta^3 = (D - G)^3 \quad (4)$$

where D is the inner diameter of the compressible tube and G is the minimum gap indicated in FIGs. 19, 19A and 19B which is also represented in FIGs. 18A through 18D by the spacing between the dashed circle and the solid track 808 of the housing 809. FIG. 19A and 19B are detailed cross-sectional views orthogonal to the peristaltic pump's tube's length taken along the lines 19A and 19B in FIG. 19 illustrating the tube's partial compression by the roller. FIG. 19A shows the cross-sectional area 818a taken along the line 19A in FIG. 19. FIG. 19B shows the cross-sectional area 818b taken along the line 19B in FIG. 19. Now referring to

FIGS. 20A and 20B, in the circular coordinate system, FIG. 20A corresponds to the state of pump shown in FIGs. 18A and 18B. During this period, there is no roller downstream of the roller 810' and the summation term in Eqn. (3) vanishes. FIG. 20B corresponds to the state of the pump shown in FIG. 18C. The compressible tube 807 is closed off by roller 812' and partially compressed by the rollers 810' and 811'. However, volumetric changes introduced by the two rollers 810' and 811' substantially cancel each other. Consequently, the summation term is Eqn.(3) vanishes as well. As a result, the flow rate of the peristaltic pump 80 may remain substantially constant regardless of roller positions.

The shape of the compressible tube 807 satisfying the above requirement can be readily derived from Eqn. (4). Referring to FIG. 18C, if the gaps of the arcuate curved track 808 in the compression part of the recess section between point 813 and point 804, $G_{13,4}$, and in the exit section between point 805 and point 806, $G_{5,6}$, follow the equation:

$$(D - G_{13,4})^3 + (D - G_{5,6})^3 = D^3 \quad (5)$$

then the total fluid volume in the two sections may remain substantially constant, as shown in FIG. 21. In the peristaltic pump 80, the shape of the pump housing 809 may be symmetrical with respect to its center line, such that the entrance half of the pump housing 809 is the mirror image of the exit half of the housing 809, as shown in FIG. 17. The peristaltic pump 80 can therefore be operated both in counterclockwise and clockwise rotation with very little pulsation, although it is understood that the symmetry is not required to realize a pulseless peristaltic pump in accordance with some embodiments of the present disclosure. For example, as long as the gaps of the arcuate curved track 808 in the section between point 813 and point 803, $G_{13,3}$, and in the section between point 802 and point 801, $G_{2,1}$, follow Eqn. (6)

$$(D - G_{13,3})^3 + (D - G_{2,1})^3 = D^3 \quad (6)$$

a peristaltic pump in accordance with some embodiments of the present disclosure will exhibit little pulsation when the rotor 816 rotates clockwise.

FIG. 22 depicts an alternative embodiment of a peristaltic pump in accordance with some embodiments of the present disclosure. Those elements depicted in FIG. 22 that are common to the peristaltic pump 80 illustrated in FIG. 17 carry the same reference numeral

distinguished by a prime (') designation. The peristaltic pump 80' may include an arcuate curved track 808' having two (2) recesses 818 and 819, and four (4) rollers 820, 821, 822 and 823. In the embodiment depicted in FIG. 22, the fluid volume loss due to the tube expansion near the outlet of the pump is compensated by the combined effect of the compression of the compressible tube by rollers 820 and 823 near the two recesses 818 and 819.

FIG. 23 depicts yet another alternative embodiment of a peristaltic pump in accordance with the present disclosure. Those elements depicted in FIG. 23 that are common to the peristaltic pump 80 illustrated in FIG. 17 and the peristaltic pump 80' illustrated in FIG. 22 carry the same reference numeral distinguished by a double prime (") designation. The peristaltic pump 80" may include six (6) rollers 820, 821, 822, 823, 824, 825 and an arcuate curved track 808" having two recesses 818" and 819". In the peristaltic pump 80", the fluid volume loss due to the tube expansion near the outlet of the pump is compensated by the action of the roller immediately upstream of the one recess 818" or 819" near the pump outlet.

Pulsation due to the expansion of a compressed compressible tube near the outlet of a peristaltic pump may also be overcome by a peristaltic pump having a programmable rotor speed. FIGs. 24A through 24C illustrate pertinent aspects of an alternative embodiment mechanism for minimizing peristaltic pump pulsation in accordance with the present disclosure for a 3-roller peristaltic pump. As depicted in FIG. 24B, the track 828 is substantially circular between the pump inlet and pump exit section. Consequently, as indicated by the spacing between the dashed circle 829 and the solid curve of the track 828, the compressible tube is completely closed by various ones of the pump's three (3) rollers 825, 826, 827 between the pump inlet and pump outlet. FIG. 24A illustrates schematically in a circular coordinate system the roller positions for the peristaltic pump depicted in FIG. 24B. Since there is only one roller downstream of the one that closes off the tube, Eqn. (3) is much simplified:

$$-F = R\left(\frac{\partial V_c}{\partial \theta} + \frac{\partial V_c}{\partial \delta}\frac{d\delta}{d\theta}\right) \quad (7)$$

Here the tube compression $\delta(\theta)$ is explicitly expressed as a function of roller position θ. The terms inside the parentheses represent the change rate of fluid volume with respect to roller

position. The first term is the contribution from the roller that closes off the tube, i.e., roller 827 in FIG. 24A, and the second term the contribution from the roller in the exit section. Note that by definition, the volume change rate is negative and the second term inside the parentheses vanishes when there is no roller in the exit section. The dotted curve in FIG. 24C is a representative plot of the negative volume change rate with respect to the position of the roller. The bump along the curve, due to the tube expansion when a roller rolls off the tube near the pump outlet, is the cause for pulsation in conventional peristaltic pumps having a constant rotor speed. However, for the peristaltic pump depicted in FIGs. 24A through 24C, the rotor speed, R, shown as dashed curve in FIG. 24C, may be set to vary in synchronism with the rotor position and inversely proportional to the change rate of the fluid volume. Consequently, the flow rate of the pump, which is the product of the rotor speed and the change rate of the fluid volume, may remain constant, as indicated by the solid line at the top of FIG. 24C. Note the terms inside the parentheses of Eqn. (7) may be uniquely determined by the mechanical structure of the pump. The rotor speed profile can therefore be readily generated from the shape of the track 828 in accordance with Eqn. (4). To those skilled in the art, there are many ways to realize a programmable rotor, for example, with stepping motor or DC servo motor.

WDM Device 90

In many multicolor fluorescence detection instrumentations, such as flow cytometers, (Practical Flow Cytometry, Howard M. Shapiro, Wiley (2003) ISBN 0471411256), the fluorescence light emitted from the object of interest is:

1. collected by a microscope objective;

2. reimaged through a small pinhole or a multimode optical fiber;

3. then collimated and separated into multiple colored bands; and

4. finally detected by photo detector, such as photomultiplier tube (PMT), PIN photodiode or avalanche photodiode (APD).

A PMT is essentially a special type of electron tube. This "pre-semiconductor age" device is bulky and expensive. In addition, it has poorer quantum efficiency and less

reproducible spectral response than silicon based semiconductor detectors, particularly in the biologically important red to near infrared spectral region. Despite the disadvantages, PMT has excellent noise characteristics. For example, the dark current of a typical 13mm PMT (e.g., the R9305 from Hamamatsu Corporation of Japan) is only about 1nA. In contrast, an APD's dark current would be 10 times greater even if its active area were reduced to 1/20th of that of the PMT. As a result, PMT has been the de-facto low-level light detector in many commercial fluorescence detection flow cytometers. Only in certain scientific applications where event rate is low and dark current may be discriminated against by expensive photon-counting techniques that the PMT has been replaced by APD detectors. (c.f., High-Throughput Flow Cytometric DNA Fragment Sizing, A.V. Orden, R.A. Keller, and W. P.Ambrose, *Anal. Chem.*, 2000, 72 (1), p 37–41). More recently, a Geiger mode APD array was also promoted as PMT replacement. (For example, the multi pixel photon counter of Hamamatsu Photonics of Japan and the solid-state photomultiplier of SensL Inc. of Ireland.) These detectors, however, also have high dark current and are nonlinear at high event rate.

The only industry where APD has found wide acceptance is in optical communication. It is known that if the APD's active area is reduced to less than $1mm^2$, the corresponding dark current will be reduced to the same level as a PMT. In optical communication, the light is a laser beam out of single mode optical fiber. Such a beam can be easily collimated then focused down to an area much smaller than $1mm^2$. It should be noted that the color separation devices used in the fluorescence light detection instruments, as described in United States Patent Vo. 6,683,314 and references therein, are almost identical in function and architecture to the wavelength division multiplexers (WDM) widely used in optical communication, as described in United States Patent Nos. 4,482,994, and 5,786,915. A fundamental reasons preventing the use of small area APD in fluorescence detection instrumentation is the well-known theorem of etendue conservation: the fluorescence light coming through a pinhole or multimode optical fiber is an extended light source with an etendue hundreds of times greater than that of a laser beam out of a single mode optical fiber. Consequently, as illustrated in FIG. 26, it cannot be collimated over an extended distance unless the diameter of the beam is significantly expanded. Unfortunately, the larger the beam diameter, the greater the technical challenge to focus it down to a small spot. Since efficient color separation can only be accomplished economically with collimated

light beam, small area APD has not been considered viable for multicolor fluorescence light detection applications. Clearly, a technology capable of collimating a large etendue light beam over an extended distance without significantly expanding the beam diameter would be highly desirable. Such a technology would enable a WDM like device for fluorescence light detection with characteristics comparable to low noise semiconductor detectors.

FIG. 25 shows the optical ray trace for an exemplary 6 port wavelength division multiplexer of the present disclosure using zig-zag configuration. As shown in FIG. 25, fluorescence light going through a pinhole or emitted from the facet of a multimode optical fiber, such as the optical fiber 852 depicted in FIG. 1, forms an extended object or light source at location 901, i.e. the optical input of the WDM 90. The size of the object is defined by the diameter of the pinhole or the core diameter of the multimode optical fiber. Note that the practical size of the pinhole or the core diameter of the multimode optical fiber is measured in millimeters, in contrast to the diameter of single mode optical fibers that are measured in micrometers. Consequently, the etendue of the fluorescence light source, defined as the product of beam size and its divergence angle, is hundreds times greater than its counterpart in optical communication. According to the theorem of the conservation of etendue (Julio Chaves, *Introduction to Nonimaging Optics*, CRC Press, 2008 [ISBN 978-1420054293]), light from such an extended source, similar to that from a flash light, can only be kept collimated for a very limited distance, particularly when the diameter of the collimated portion needs to be small.

As depicted in FIG. 25, a collimating optical element, in this case an achromatic doublet lens 902, may capture the light from source 901, and project a magnified image of the object near a final focusing lens 905. The size of the image near 905 may be kept approximately the same as the effective size of the collimating optical element 902. Consequently, beam of light propagating between the collimating optical element 902 and the focusing lens 905 may be effectively collimated. As shown in FIG. 25, so long as the magnification factor is kept small, for example, less than around 10, using a simple singlet lens as the focusing lens 905, the collimated beam of light can readily focused down to a spot smaller than that of the beam of light received by the WDM 90 at location 901. The ability to focus the beam of light down to such a small size permits placing a small area

semiconductor detector at a focal point 906 of the focusing lens 905 for efficient photo detection.

A dichroic filter 903, oriented at a slanted angle, may be inserted into the optical path in between the collimating optical element 902 and the focusing lens 905. The dichroic filter 903 may pass the color band of interest and reflects the remaining colors in the beam of light for further processing within the WDM 90. An optional band pass filter 904 may be inserted following the dichroic filter 903 to further improve the color isolation capability of the WDM 90.

Light reflected from the dichroic filter 903 may impinge upon a second optical element 907, such as a concave mirror. The concave mirror 907 may a radius of curvature approximately equal to the distance between the collimating optical element 902 and the image near focusing lens 905. The concave mirror 907 therefore creates a second image of the collimating lens 902 near a second focusing lens 908. The light beam between the concave mirror 907 and the second image at the lens 908 may have substantially the same diameter as the beam of light between the collimating lens 902 and the first image near the focusing lens 905. The relay imaging concave mirror 907 therefore effectively doubles the collimated beam path without expanding the beam's diameter. Again, the extended yet collimated beam can be easily focused down to a spot smaller than that of the light source at 901. The diameter of the spot may be smaller than 1mm, for example, around 600 μm, A second dichroic filter 909 may then be inserted in between the relay imaging concave mirror 907 and the second image near focusing lens 908. The second dichroic filter 909 may pass another band of color in the beam of light received by the WDM 90 at location 901 and reflect the remainder of the impinging beam of light for further processing. The first and second dichroic filters 903 and 909 may be inserted approximately midway between the collimating optical element 902 and the focusing lens 905 and between the relay imaging concave mirror 907 and the second image near focusing lens 908, respectively.

As shown in FIG. 25, additional relay collimating optical elements 910, 911, 912, 913 and dichroic filters 914, 915, 916, 917 can be cascaded in the same way to produce multiple images near focusing lenses 918, 919, 920 and 921, each of these images corresponding to a specific color band of light received by the WDM 90 at location 901. As shown in FIG. 25,

due to the present disclosure's 1:1 imaging relay architecture, the spots of light produced by focusing lenses 905, 908, 918, 919, 920 and 921 are all smaller than the source of the beam of light, and therefore can be easily captured by small area APD's.

Although FIG 25 illustrates a 6-port wavelength division multiplexer for a beam of light from the extended light source, it is readily apparent to those skilled in the art that WDM's having different numbers of ports can be easily built in accordance with some embodiments of the present disclosure. It is also apparent to those skilled in the art that although the WDM 90 may use achromatic doublets as the first collimating optical element, singlet lens can also be used since the images created before the focusing lenses 905, 908, 918, 919, 920 and 921 are all nearly monochromatic. Instead of using concave mirrors for relaying the beam of light reflected from the dichroic filters, one may also use refractive optics, such as a convex lens, as a relay element to extend the path of the collimated beam of light. One of the advantages of the zig-zag architecture used in the WDM 90, however, is the possibility for using array detectors, which would lead to a more compact WDM suitable for portable instrumentation.

FIG. 25A illustrates a top view of a light detection assembly 937 with the WDM 90 illustrated in FIG. 25 in accordance with some embodiments of the present disclosure. The light detection assembly 937 may include the WDM 90 and a photodetector system 938. A beam of light which emits from the facet of the optical fiber 852 may be processed by the WDM 90 and detected by the photodetector system 938. The concave mirrors 907, 910, 911, 912, and 913 and the dichroic filters 903, 909, 914, 915, 916, and 917 may be formed on two sides of a reference block 935. The reference block 935 may be made of glass or any material which allows light to pass through it. Accordingly, a zig-zag optical pattern, as illustrated in FIG. 25 may be formed among the collimating optical element 902, the dichroic filters 903, 909, 914, 915, 916, and 917, the reference block 935, the concave mirrors 907, 910, 911, 912, and 913, and the focusing lens 905, 908, 918, 919, 920, and 921. After being processed by the WDM 90, the beam of light emitting from the facet of the optical fiber 852 may split into multiple colored bands with different wavelengths to be detected by photodetectors 940, 941, 942, 943, 944, and 945, respectively. The photodetector can be, but is not limited to, a semiconductor detector, an avalanche photodetector (APD), and a carbon nanotube detector.

In some embodiments, the concave mirrors 907, 910, 911, 912, and 913 may be structurally formed on a relaying assembly 939. It should be understood by those having skill in the art that the concave mirror can be replaced with a convex lens, which is also able to converge and relay the beam of light.

In some embodiments, the dichroic filter can be replaced with a mirror to prevent the beam of light from entering a photodetector when a user wants to decrease the number of light signal channels to be detected. It should be understood by those having skill in the art that the dichroic filter can also be replaced by a dichroic mirror, a beam splitter, or any optical element which is able to split or filter a beam of light.

FIG. 25B illustrates a front view of the light detection assembly 937 with the WDM 90 illustrated in FIGs. 25 and 25A in accordance with some embodiments of the present disclosure. The light detection assembly 937 may have a top cover 940 which is openable. Therefore, the user can open the top cover 940 to change the dichroic mirrors 903, 909, 914, 915, 916, and 917 and modify the light detection system 938 or the WDM 90 inside.

FIG. 26 illustrates an optical ray trace for a prior art collimating device. The technique depicted in FIG. 26 is extensively used in conventional multicolor fluorescence instruments, for example, in United States Patent No. 6,683,314. As shown in FIG. 26, the beam of light diverges rapidly beyond the image 924 created by the collimating optical element 923. Consequently, the only option for constructing a multi-color device is to insert dichroic filters in between the collimating element 923 and its image 924.

Due to the constraint of etendue conservation, the diameter of the collimated beam must be significantly expanded to accept multiple dichroic filters in the section. The expanded beam creates serious challenge to refocusing the collimated beam down to small spots suitable for small area semiconductor detectors. To overcome these difficulties, some instrument manufacturers have chosen to use PMT exclusively for fluorescence detection such as in the main stream flow cytometers manufactured by Becton-Dickinson, Beckman Coulter and Partec 's and the MegaBACE series of DNA sequencers by GE Amersham. Other instruments, such as the Luminex multiplexed bead analyzers, have selected certain color bands with known bright fluorescence, and uses large area APD for detecting light in the selected color bands.

FIG. 27 illustrates a perspective view of an alternative embodiment for a 6-port WDM 90 using a combination of zig-zag and branched configurations. The design is a modification of zig-zag configuration depicted in FIG. 25. In the alternative embodiment depicted in FIG. 27, band pass filter 904 of FIG. 25 may be replaced by a dichroic filter 904'. The filter 904' is positioned to let one color pass through and reflects other colors at ninety degrees (90°). The optical path length of the beam of light passing through the dichroic filter 904' and that being reflected from the 904' are substantially the same, such that one arm is focused by lenses 905 and the other by lens

905' to small spots compatible with small area semiconductor detectors placed at focal location 906 and 906'. As shown in FIG. 25, the remaining color of the light reflected by dichroic filter 903 is relay imaged by a concave mirror 907 and the configuration including optical elements 903, 904', 905 and 905' is cascaded two (2) more times to form a 6 port-WDM.

FIG. 28 illustrates a perspective view of an alternative embodiment for a 8-port WDM 90. By replacing the concave mirrors 907 and 910 in FIG. 27 with concave shaped dichroic filters 907' and 910', the WDM depicted in FIG. 28 may provide 2 more color bands in comparison with the WDMs depicted in FIGs. 25 and 27.

Numerous fluorescence probes for use in flow cytometry have been developed over the years. More recently, multiple fluorescence proteins have also become an important tool in biomedical studies. To accommodate different types of fluorescence probe, various techniques have been developed to enable user selection of dichroic filters suitable for their particular needs. A significant challenge for replaceable

dichroic filters is avoiding direct contact of the coated filter surface with any hard flow cytometer reference frame. Repeated direct contact between the coated filter surface and any hard reference frame may damage a replaceable dichroic filter. Presently, most conventional solutions addressing this problem use precision-machined mechanical spacers for holding replaceable dichroic filters in place. One example of such a solution appears in United States Patent No. 6,683,314. However, such a solution becomes unreliable if the detector's active area is smaller than 1.0 mm^2.

FIGs. 29A and 29B depict fabricating a replaceable dichroic filter assembly 934 illustrated in FIG. 29C suitable for small area detectors. Assembly of the replaceable dichroic filter assembly 934 begins in FIG. 29A which depicts constructing a reference template for its fabrication. The reference template may be a staircase made of two (2) optically parallel glass plates 925 and 926. Bonding the two (2) glass plates 925 and 926 together in optical contact can ensure that a surface 929 of the glass plate 925 becomes optically parallel to a surface 930 of the glass plate 926. A front surface 932 of a replaceable dichroic filter 927 may then be pressed against the surface 929 of the template. A filter holder 928, which loosely fits the dichroic filter 927, may include a reference surface 931 and a filter slot 933. During assembly of the replaceable dichroic filter, the filter slot 933 may be partially filled with epoxy adhesive and the reference surface 931 of the filter holder 928 may be pressed against the surface 930 of the template while filter holder 928 slides toward the dichroic filter 927. While the epoxy adhesive sets, part of the dichroic filter 927 remains seated within the filter slot 933 while pressure is applied against the dichroic filter 927 and filter holder 928. It should be apparent to those skilled in the art that the epoxy adhesive may be either UV or thermally curable, or made by blending together components of an A/B mixture. FIG. 29C depicts a dichroic filter fabricated as depicted in FIGs. 29A and 29B and described above. The assembly process depicted in FIGs. 29A and 29B and described above can ensure that the front surface 932 of the replaceable dichroic filter assembly 934 can be optically parallel to the reference surface 931, and indented with respect to the latter at a spacing accurately determined by the thickness of the glass plate 925. The dichroic filter 927 depicted in FIGs. 29A, 29B, and 29C may be the dichroic filters 903, 909, 914, 915, 916, or 917 used with the WDM illustrated in FIG. 25 or the dichroic filter 903 or the filter 904' used with the WDM illustrated in FIG. 27.

FIGs. 30A and 30B depict an embodiment of the present disclosure where the fore-mentioned replaceable dichroic filter assembly 934 is used in the WDM 90 for optically processing a beam of light from an extended light source. A notable feature of the WDM 90 is a glass reference block 935 having an optically flat surface. As will be apparent to those skilled in the art, the glass reference block 935 may be made of other materials. As shown in FIG 30B, when installing a dichroic filter 927 the reference surface 931 of the replaceable dichroic filter assembly 934 may slide against the flat surface of the glass reference block

935 and be kept in contact therewith by a spring loaded screw 936. Consequently, the coated front surface 932 of the replaceable dichroic filter assembly 934 can remain optically parallel to the optical flat and accurately located. In the meantime, the indentation of front surface 932 with respect to the reference surface 931 may protect it from in physical contact with any object during filter replacement. It is apparent to those skilled in the art that many modifications and variations of the described embodiments of the replaceable dichroic filter assembly 934 are possible. For example, an alternative embodiment of the present disclosure may be a pedestal assembled using a first and a second round optical flat. When assembling the replaceable dichroic filter assembly 934, the reference surface of a filter holder may rest against a surface of the first optical flat and the coated surface of the dichroic filter may rest against the flat surface of the second optical flat. Epoxy bonding then may hold the coated surface of the dichroic filter optically parallel to the reference surface of a filter holder, yet indented at a distance accurately determined by the thickness of the second optical flat.

Optical System with Single Light Source 41

FIG. 31 is a diagram schematically illustrating an optical system with a single light source 41 in accordance with some embodiments of the present disclosure. The optical system with a single light source 41 may include a LD based optical subsystem 50, a composite microscope objective 60, a WDM 90, and a light detection system 938. The beam of light may propagate substantially along the z axis and enter the composite microscope objective 60 from the LD based optical subsystem 50 to illuminate particles present within the viewing zone inside the composite microscope objective 60. The light scattered from and fluoresced by particles may then be reflected by the concave mirror 601, corrected by the corrector plate 602, and collected by the optical fiber 852 substantially along the x axis. The optical fiber 852 may be fixed by a fiber holder 940.

Common wavelengths of light sources may include, but not limited to, 375nm, 405nm, 440nm, 488nm, 502nm, 534nm, 561nm, 591nm, 637nm, and 637nm. The light detection system 938 may be coupled with circuits for processing light signals. The more ports the WDM 90 has, the more light signal channels the user can use.

Optical System with Multiple Light sources 42

FIG. 32 is a diagram schematically illustrating an optical system with multiple light sources 42 in accordance with some embodiments of the present disclosure. The optical system with multiple light sources 42 may include multiple LD based optical subsystems 50, multiple WDMs 90, multiple light detection systems 938, and a composite microscope objective 60 with a viewing zone. The number of WDMs 90 may correspond to the number of LD based optical subsystems 50. In FIG. 32, the optical system with multiple light sources 42 includes three laser diodes 501 for emitting multiple beams of light with different wavelengths, three collimating lenses 502 in front of the three LDs for collimating the beams of light respectively, three dichroic filters 506, 507, and 508 for passing beams of light with certain wavelength range or reflecting beams of light with certain wavelength range, a plano-convex lens 504 for shaping the beams of light on the major axis, a cylindrical lens 505 for focusing the beams of light onto three spatially separated locations in the flow channel 604, a composite microscope objective 60 for directing the light scattered from and fluoresced by the illuminated particles at three spatially separated locations to be collected by three optical fibers 852, respectively, three optical fibers 852 for collecting scatter and fluorescence emissions and transmitting the emissions to three WDMs 90, respectively, and three WDMs 90 and light detection systems 938 for processing and detecting the scatter and fluorescence light, respectively. The direction of beams of light entering the composite microscope objective 60 may be perpendicular to the direction of scatter and fluoresce emissions to be collected by the optical fiber 852. It should be noted that the plano-convex lens 504 and the cylindrical lens 505 can be replaced with any conventional beam shaper and any focusing lens. It should also be noted that the various aspects of the present disclosure are not limited to specific numbers of laser diodes, collimating lenses, dichroic filters, plano-convex lenses, composite microscope objectives, optical fibers, WDMs, and light detection systems and specific wavelength and direction of each beam of light.

FIG. 33 illustrates an enlarged view of beams of light 509 and 510 shown in FIG. 32. The beams of light 509 and 510 are emitted from different laser diodes 501 with different wavelengths and then are focused onto spatially divided locations in the flow channel 604 inside the composite microscope objective 60.

Optical System with Chromatic Compensation Elements 51

FIG. 34 is a diagram schematically illustrating an optical system with chromatic compensation elements 51 in accordance with one aspect of the present disclosure in accordance with some embodiments of the present disclosure. The optical system with chromatic compensation elements 51 may include the optical system with multiple light sources 42, as shown in FIG. 32, and multiple chromatic compensation elements 514, 515, and 516. Each of the chromatic compensation elements 514, 515, and 516 may be positioned on the beam paths of beams of light emitting from light sources 511, 512, and 513, respectively, and compensate chromatic aberration in the viewing zone. As such, the beams of light emitting from the light sources 511, 512, and 513 with different wavelengths may be focused onto three spatially divided locations on a common plane which is in the viewing zone and substantially parallel to the direction of a sample flow. The optical properties of chromatic compensation elements 514, 515, and 516 may be different from each other. For example, their thicknesses and shapes may be different to accommodate various beams of light with different wavelengths.

In some embodiments, the optical system shown in FIG. 34 may only need one or two chromatic compensation elements to compensate chromatic aberration in the viewing zone. It should be noted that the various aspects of the present disclosure are not limited to specific numbers or optical properties of chromatic compensation elements.

Power Monitoring System 43

FIG. 35 is a diagram schematically illustrating a power monitoring system 43 in accordance with some embodiments of the present disclosure. The power monitoring system 43 may include a first light source 513 for emitting a first beam of light, a second light source 512 for emitting a second beam of light, a first dichroic filter 519 for reflecting the first beam of light and passing the second beam of light, a second dichroic filter 518 for reflecting the second beam of light, a first detector 401 for measuring residual power of the first and second beams of light downstream of the first dichroic filter 519 on a time-division multiplexing basis, and a control unit 522 coupled with the first detector 401, the first light source 513, and the second light source 512. The first detector 401 may be positioned near or coupled to the first dichroic filter 519. The first and second light sources 513 and 512 may emit beams of light with different wavelengths.

In order to reduce interference between the residual power of the first and second beams of light, the first detector 401 may measure the residual power of the first beam of light when the second light source 512 is off or measure the residual power of the second beam of light when the first light source 513 is off. The residual power of the first and second beams of light may include power of the first beam of light passing through the first dichroic filter 519 and power of the second beam of light reflected by the first dichroic filter 519.

In some embodiments, the control unit 522 may include a feedback circuit to increase the power of the light source when residual power of the light source drops below a certain level or to lower the power of the light source when the residual power of the light source increases above a certain level.

In some embodiments, a second detector 400 may be applied with the power monitoring system 43 and positioned near or coupled to the second dichroic filter 518 to measure the residual power of the second beam of light downstream of the second dichroic filter 518. The residual power of the second beam of light downstream of the second dichroic filter 518 may include power of the second beam of light passing through the second dichroic filter 518. The second detector 400 may also be coupled to the control circuit 522. When the second detector 400 is applied to the power monitoring system 43, the first detector 401 may only need to monitor the residual power of the first beam of light.

In some embodiments, a third light source 511 for emitting a third beam of light and a third dichroic filter 517 for reflecting the third light may be also applied with the power monitoring system 43. The third light source 511 may be also coupled to the control circuit 522. As such, the first detector 401 may measure residual power of the first, second, and third beams of light downstream of the first dichroic filter 519 on a time-division multiplexing basis.

In some embodiments, the second detector 400 may measure residual power of the second and third beams of light downstream of the second dichroic filter 518 on a time-division multiplexing basis. The residual power of the second and third beams of light downstream of the second dichroic filter 518 may include power of the second beam of light passing through the second dichroic filter 518 and power of the third beam of light reflected by the second dichroic filter 518.

In some embodiments, a third detector (not shown in FIG. 35) may also be applied with the power monitoring system 43 and positioned near or coupled to the third dichroic filter 517 to measure residual power of the third beam of light downstream of the third dichroic filter 517. The third detector may be also coupled to the control circuit 522. The residual power of the third beam of light at the downstream of the third dichroic filter 517 may include power of the third beam of light passing through the third dichroic filter 517.

The second beam of light can either be detected by the first detector 401 or the second detector 400. The third beam of light can be detected by the first detector 401, the second detector 400, or the third detector which is positioned near or coupled to the third dichroic filter 517. The control circuit 522 may control the operation of the detectors and light sources.

It should be understood by those having skill in the art that the dichroic filter can also be replaced by a dichroic mirror or a beam splitter. It should also be noted that the various aspects of the present disclosure are not limited to specific numbers of light sources, dichroic filters, and detectors.

Optical System 44

FIG. 36 is a diagram schematically illustrating an optical system 44 in accordance with some embodiments of the present disclosure. The optical system 44 may include a composite microscope objective 60, as shown in FIG. 8, a light source 403, and a beam splitter 402. The light source 403 may emit beams of light to illuminate objects in a viewing zone, which is located in a flow channel 604 inside a cuvette 603. The composite microscope objective 60 may image light scattered from and fluoresced by the objects in the viewing zone at an image plane 404 external to the composite microscope objective 60. The light source 403 and the image plane 404 may be located on two sides of the beam splitter 402.

The composite microscope objective 60 may include a concave mirror 601 and an aberration corrector plate 602 coupled to the two sides of the cuvette 603. The aberration corrector plate 602 may be an aspheric lens that has a first zone with negative optical power and a second zone with positive optical power radially inside the first zone. A neutral zone may be the thinnest portion of the aberration corrector plate 602 and located between the first

zone and the second zone. The aspheric lens may be a plano-aspherical lens. The concave mirror may be a plano-concave back surface mirror or a front surface mirror. The concave mirror 604 and the aberration corrector plate 602 may be made of an optically transparent material.

In FIG. 36, the beam of light emitting from the light source 403 may be reflected by the beam splitter 402 and enter into the composite microscope objective 60 to illuminate objects in the viewing zone. The light scattered from and fluoresced by objects may be reflected by the concave mirror 604, transmit through the aberration corrector plate 602 and the beam splitter 402, and form an image at the image plane 404 external to the composite microscope objective 60. The light source 403 may include multiple laser diodes 403a, 403b, and 403c emitting multiple beams of light with different wavelengths to illuminate objects at multiple locations in the flow channel 604. Accordingly, multiple images 404a, 404b, 404c may be formed at the image plane 404.

In some embodiments, the locations of the light source 403 and the image plane 404 may be swapped. Accordingly, the beam of light emitting from the light source 403 may transmit through the beam splitter 402 and enter into the composite microscope objective 60 to illuminate objects in the viewing zone. The light scattered from and fluoresced by objects may be reflected by the concave mirror 604, transmit through the aberration corrector plate 602, be reflected by the beam splitter 402, and form an image at the image plane 404 external to the composite microscope objective 60.

In some embodiments, the viewing zone may be located in a jet stream or a surface of a substrate containing objects (not shown in FIG. 36). The objects may be delivered into the viewing zone by a fluidic system, such as a fluidic system shown in FIG. 14 or 15.

In some embodiments, the scattered and fluoresced light imaged at the image plane 404 may be received by a fiber (not shown in FIG. 36) which transmits the light to a photodetector. The scattered and fluoresced light may be processed by a wavelength division multiplexer (WDM) (not shown in FIG. 36) before being detected by the photodetector. The WDM may be configured as a WDM illustrated in FIGs. 25, 25A, and 25B. The photodetector can be, but not limited to, a semiconductor photodetector, a multi-pixel photon counter, and a carbon nanotube detector.

In some embodiments, the light source 403 may emit coherent light or incoherent light. The light source 403 can be single or multiple laser diodes, light emitting diodes, illumination devices emitting beam of light, or any combination of them.

In some embodiments, a chromatic compensating lens (not shown in the figure) may be inserted between the aberration corrector place 602 and the image plane 404 to serve to reduce the residual chromatic aberration.

Axial Light Loss Detection System 45

FIG. 37 is a diagram schematically illustrating an axial light loss detection system 45 in accordance with some embodiments of the present disclosure. The axial light loss detection system 45 may include a concave mirror 406 for reflecting light that propagates from a viewing zone and a detector 408 for measuring axial light loss produced by the object in the viewing zone by detecting light reflected by the concave mirror 406. The light reflected by the concave mirror 406 may include forward scattered light (FSC) and remaining light of beam of light entering into the viewing zone from a light source 412 to irradiate the object therein, which is so called axial light loss (ALL). The axial light loss of the beam of light along its propagation direction may result from the object passing through the beam of light. The beam of light may be blocked or absorbed by the object.

The axial light loss detection system 45 may utilize the concave mirror 406 to direct both FSC and remaining light into the detector 408 in order to determine the size of object. The FSC and remaining light may have the same wavelength, and therefore the signals of FSC and remaining light detected by the detector 408 may be proportional to square of the sum of their electric fields as follows:

$$(E_{FSC} + E_{ALL})^2 \quad (8)$$

E_{FSC} represents the electric field of FSC. E_{ALL} represents the electric field of remaining light.

On the contrary, a conventional ALL detection system disclosed in prior art usually requires a pinhole positioned along a laser beam path to block FSC in order to detect

remaining light of the laser beam. Accordingly, the signals of remaining light detected by an ALL detector is proportional to square of its electric field as follows:

$$(E_{ALL})^2 \quad (9)$$

Further, a conventional FSC detection system disclosed in prior art usually requires a mask positioned along a laser beam path to block remaining light of the laser beam in order to detect FSC. Accordingly, the light signals of FSC detected by a FSC detector is proportional to square of its electric field as follows:

$$(E_{FSC})^2 \quad (10)$$

Apparently, neither of the conventional ALL detection system nor conventional FSC detection system could operate without using a pinhole or a mask.

In some embodiments, the concave mirror 406 may be an ellipsoidal mirror or a combination of a flat mirror and a lens. The detector 408 may be an axial light loss detector to determine the size of the object.

In some embodiments, the detector 408 may be in a heterodyne mode detecting the coherent interference of FSC and the remaining light. The wavelengths of FSC and remaining light may be the same.

In some embodiments, a light source 412 emitting beam of light may be used to illuminate the object in the viewing zone. The optical axis of the beam of light is substantially perpendicular to the flow direction of the object.

In some embodiments, multiple light sources 412 emitting beams of light with different wavelengths may be used to illuminate the objects in the viewing zone. When multiple light sources 412 are applied to the axial light loss detection system 45, a filter 407 may be positioned upstream of the detector 408 to separate the light irradiated by the first light source and reflected by the concave mirror 406 and the light irradiated by the second light source and reflected by the concave mirror 406. As such, the detector 408 may measure them separately, for example, on a time-division multiplexing basis.

In some embodiments, the viewing zone may be located within a microscope objective 410. The viewing zone may be located in a flow channel 409, a jet stream, or a

substrate. In some embodiments, a cylindrical lens 411 may be coupled to the microscope objective 410 to focus beams of light emitting from the light source 412 to the viewing zone. The optical axis of the cylindrical lens 411 is substantially perpendicular to the optical axis of the light reflected by the concave mirror 406.

FIG. 38 is a diagram schematically illustrating an axial light loss detection system 45 coupled with a second light detection system 413 in accordance with some embodiments of the present disclosure. The axial light loss detection system 45 may utilize a composite microscope objective 60, as illustrated in FIG. 8 The composite microscope objective 60 may include a second concave mirror 415 and an aberration corrector plate 414 located on two sides of the viewing zone of the composite microscope objective 60. The optical axes of the second concave mirror 415 and the aberration corrector plate 414 are substantially parallel to the optical axis of the light reflected by the concave mirror 406. The FSC and remaining light propagating from the viewing zone may be reflected by the concave mirror 406 and detected by the detector 408 while the side-scattered fluoresced light may be reflected by the second concave mirror 415, propagate out of the composite microscope objective 60 via the aberration corrector plate 414, and be detected by the second light detection system 413.

In some embodiments, one or more control circuits may be coupled with one or more of the detector 408, the second light detection system 413, and the light source 412 to process detected light signals. As known by one skilled in the art, the control circuit may include an amplifier to amplify detected light signals, a noise filter to reduce noise interference, and a processor to process detected light signals and generate corresponding information regarding the properties of the object.

Alternative Combined Microscope Objective

FIGs. 11, 12 and 13 illustrate the build-up of a composite microscope objective 60 adapted for imaging light scattered from and fluoresced by an object present within a viewing zone. The illustrated composite microscope objective comprises a viewing zone, a concave mirror arrangement 601, 610, 617, an exit area and an illumination beam forming arrangement 505, as illustrated in FIG. 8A. It should be noted that in Fig. 11, 12 and 13 the beam forming arrangement is not illustrated. The viewing zone in Fig. 11 may be located in

e.g. a channel 604 of a cuvette 603. In FIG. 12, the viewing zone may be located e.g. along the droplets of the jet stream 519 leaving the nozzle 518. In FIG. 13, the viewing zone maybe located e.g. in the plane of the substrate. The exit area of the microscope objective is an area through which scattered light and fluoresced light impinging from an object present in the viewing zone passes, which scattered and fluorescent light is reflected by the concave mirror of the microscope objective. The aberration corrector plate 602 in FIG. 11, 612 in FIG. 12 and 618 in FIG. 13 may be located in the exit area. It should be noted that the corrector plate may be used, in particular in combination with a spherical mirror 601, 610, 617. However the corrector plate may be omitted when using a concave mirror having already implemented a correcting shape. Thus, the exit area does not have to include a corrector, if a concave mirror has an appropriate shape and the gain of the corrector plate is not required. As can be seen in FIGs. 11, 12 and 13, the viewing zone is arranged between the concave mirror arrangement and the exit area. The concave mirror 601, 610, 617 is arranged to reflect scattered and fluoresced light impinging from an object present in the viewing zone to the exit area. The illumination beam forming arrangement 505 is illustrated e.g. in FIG. 8A. Fig. 8A illustrates an arrangement of FIG. 11 having attached illumination beam arrangement 505 to the cuvette 603. The illumination beam arrangement 505 is arranged so that an illumination beam entering the illumination beam forming arrangement is pre-definitely formed at the viewing zone. A path of an illumination beam from an illumination system can be seen e.g. in FIG. 1 or 3A. FIGs 11, 12 and 13 as well as FIG. 8A illustrate that the concave mirror arrangement, the viewing zone and the exit area are arranged along a first axis, also referred to as x-axis. FIG. 9A illustrated that an optical image of the viewing zone, e.g. within channel 604 in FIG. 9A is formed outside the composite microscope objective in the image plane 605 with image locations 606, 607 and 608. The illumination beam forming arrangement 505 is arranged so that an illumination beam impinges the viewing zone along a second axis, also referred to as z-axis, which is substantially perpendicular to said x-axis. The above described cuvette 603 may be manufactured of an optical transparent material, wherein the viewing zone is formed in the cuvette, in particular in the channel 604 of the cuvette 603. The channel extends along a third axis, also referred to as y-axis being substantially perpendicular to the x-axis and the z-axis, so that a liquid flow in the channel flows along the y-axis, as illustrated e.g. in FIG. 5D, wherein the viewing zone is located within the channel. FIG. 8 and 8A

illustrated that the cuvette 603 may be of rectangular cross section in a plane of the first axis/x-axis and second axis/z-axis. It should be noted that the cross section of the cuvette 603 may also be of a form, that a sheath flow covering the sample flow forces the sample flow into a rectangular cross section. The cross section of the channel 604 may be constant along the y-axis, but may also vary along the y-axis. In particular the channel may have a focused cross section in the area of the viewing zone. The viewing area may include a plurality of predefined viewing points distributed along the y-axis for different illumination wavelengths, as can be seen in FIG. 33, or along the z-axis, which may be a varying focal point varying along the z-axis, when adjusting the objective 60 with respect to the illumination system 50, as will described later. Although element 505 may be allocated to the illumination system 50, element 505 may also be part of the objective 60, in particular it may be attached to the cuvette 603. The illumination beam forming arrangement 505 is adapted to compress an illumination beam, so that the illumination beam in the viewing zone has a compressed dimension along the y-axis. The illumination beam forming arrangement 505 may be a cylindrical lens, in particular having a cylindrical axis parallel to the x-axis, as can be seen in FIGs. 5D and 5E. It should be noted that the illumination beam forming arrangement can be assembled by a plurality of optical elements, so that the arrangement 505 may not have a defined axis. The aberration corrector arrangement 602, 612, 618 may be arranged in the exit area, as can be seen in FIGs. 11, 12 and 13. The aberration corrector arrangement may be an aspheric lens made of optically transparent material. As can be seen in FIG. 9A, said aberration corrector arrangement may have a first zone with negative optical power, a second zone radially inside the first zone with positive optical power, and a neutral zone between the first zone and the second zone. The neutral zone in FIG. 9A is thinner than each of the first zone and the second zone, so that light reflected from the concave mirror arrangement passing through said aberration corrector arrangement forms a focal area. Although FIG. 9A illustrates a corrector plate with convex and concave portions, it should be noted that the positive and negative optical power may be achieved by using different optical materials at different locations of the corrector plate. The concave mirror arrangement 601, the viewing zone and the aberration corrector arrangement 602 form a reversed Schmidt camera. The concave mirror arrangement may be formed by plane-convex lens, as can be seen in FIG. 11. The concave mirror may be a plano-concave back surface mirror. The plano-concave back

surface mirror may be made from an optically transparent material. As can be seen in FIG. 8A a plano-surface of said plano-concave back surface mirror is optically coupled to a flat surface of said cuvette. Plano-concave back surface mirror means that although the optical lens body is a plano-convex lens body, the surface when seeing into the mirror, which is the inside of the optic body, is concave. The plano-surface of said plano-concave back surface mirror may also be optically coupled to said flat, transparent substrate, as can be seen in FIG. 13. Said concave mirror may also be a front surface mirror, as can be seen from FIG. 12. It should be noted that the mirror of FIG. 12 can also be used in combination with a cuvette, and the mirror of FIG. 11 can also be used for a jet stream. The concave mirror arrangement, the aberration corrector arrangement and the illumination beam forming arrangement may be attached to the cuvette by at least one of index matching gel, index matching fluid, optical adhesive material and optical contact bonding. It should be noted that also a combination may be used for attaching.

As can be seen in FIGs. 1, 3A, 31, 32 or 34-38, the composite microscope objective 60 may be combined with or comprise an illumination system. Although not mandatory, the illumination may be an illumination system as described above, in particular with a laser source 501, an collimating optical arrangement 502 to form a collimated laser beam and a beam shaping arrangement 504, 505 being adapted to shape a collimated beam, wherein the beam shaping arrangement includes the illumination beam forming arrangement 505. The laser source may be a laser diode and the collimating arrangement may be arranged with respect to the laser diode so as to form a collimated beam. As an alternative, the laser source may be a conventional laser with an optic arrangement to form a collimated beam of a desired cross section. The laser diode and the collimation optical arrangement, or alternatively the conventional laser with the optics are adapted to form a beam having an elliptical cross section having a major axis and a minor axis, wherein the minor axis is oriented substantially along the y-axis and the major axis is oriented substantially along the x-axis, as can be seen in FIG. 5E. The beam shaping arrangement may include a major axis optical beam compressing arrangement 504 being adapted to compress at least the major axis of the collimated elliptical beam. The illumination beam forming arrangement 505 is adapted to compress at least the minor axis of the collimated elliptical beam. This can be seen for example in FIGs 1, 3A or 6.

The viewing zone may be movable along the z-axis with respect to the illumination system so as to vary a focus of the compressed elliptical beam within the viewing zone along the z-axis. This allows a scanning along the z-axis. In particular this allows to sense or scan properties of a cell in the viewing zone at different locations. It should be understood, that either the objective 60 may be controllably moved or the illumination system 50 or both. It should also be understood that the variation of the focus may also be achieved by moving single components of the illumination system, e.g. one of the mirrors 523b, 523a or the element 504, as illustrated in FIG. 7. Also single components of the objective may be moved to vary the focus along the z-axis. The actuation can be conducted by e.g. piezo actuators or acoustic actuators. In particular the varying focus can be achieved by a modulation or an sinusoidal oscillation of the respective component. Thus the cuvette is movable with respect to the laser source so as to spatially vary a focus of the laser source in the channel. For this purpose, a control unit can be provided being adapted to control the movement of components of the composite microscope objective along the z-axis so as to spatially vary a focus of the laser source in the channel. It should be noted that likewise also a variation of the focus can be achieved along the y-axis or even the x-axis.

Combined Wavelength Division Multiplexer (WDM) with Semiconductor Photo Detector

FIGs. 25, 27, and 28 illustrate a wavelength division multiplexer (WDM) for separating light emitted from a light source into multiple colored bands. The wavelength division multiplexer may comprise an imaging optical arrangement 902, a dichroic filter arrangement 903, 904, a semiconductor photo detector 906 and a focusing optical arrangement 905. The imaging optical arrangement 902 forms a beam of light from the light emitted from a light source 901 and produces an image of substantially the same size as the effective size of said imaging optical arrangement. The light source may be an outlet of an optical fiber, which fiber may transfer detected light from the microscope objective 60 to the WDM. The dichroic filter arrangement 903, 904 may be located between said imaging optical arrangement 902 and said image, and separates the beam of light into a first branch and a second branch of distinctive colors. As can be seen in FIG. 25, the first branch travels toward

element 905, whereas the second branch travels toward element 907. The semiconductor photo detector 906 is located in the first branch behind the focusing optical arrangement 905, which is located between the dichroic filter arrangement 903, 904 and the semiconductor photo detector 906 so as to focus the beam of light onto the semiconductor photo detector. Light means an electromagnetic wave, coherent or non-coherent, particularly having a wavelength which transits the used optical elements. In particular, the term light is not limited to the visible part of light, e.g., light between 380nm and 780nm. It should be noted that also infrared light and ultraviolet light may be used, if the used optical components are capable of being operated with such wavelengths. The focusing optical element arrangement 905 is located in or in proximity to an image plane of said image. It should be noted that the imaging arrangement 902 as well as the focusing arrangement 905 may be composed of more than one optical element. In particular, a plurality of lenses may be combined so as to form the imaging arrangement 902 or the focusing arrangement 905. Likewise the dichotic filters may be composed of more than one filter or optic element. In particular to compose particular properties of the respective arrangements. The focusing optical arrangement and the semiconductor photo sensor may be arranged to each other that the beam of light is focused to a spot having a diameter of less than 1.0 mm, particularly of less than 0.6 mm. In particular when using semiconductor sensors the signal to noise ration SNR can be significantly reduced. As can be seen in FIG. 25, the wavelength division multiplexer as described above may further comprise an image relay optical arrangement 907. This image relay optical arrangement may be located in or in proximity to an image plane produced by said imaging optical arrangement in the second branch, wherein said image relay optical arrangement is adapted to produce an image of said imaging optical arrangement in a third branch having substantially the same size as the image in the second branch. The third branch in FIG. 25 is the beam traveling from the element 907 toward element 909. The effective size of the optical element is the area where beams from the object transit the optical element. Consequently, producing an image of substantially the same size as the effective size of said optical element means that between the optical element and the image the beam is within a virtual parallel tube. For illustration purposes, in the hypothetical case the object is a pinhole the optical element produces a collimated beam. The image relay optical arrangement 907 may be a concave mirror. Alternatively the image relay optical arrangement 907 may be a combination

of a lens and a mirror, in particular a plane mirror. The wavelength division multiplexer as described above may further comprise an additional dichroic filter arrangement 909, wherein the additional dichroic filter arrangement is located between said image relay optical arrangement 907 and an image produced by said image relay optical arrangement 907. Said additional dichroic filter arrangement 909 from the third branch produces a fourth branch and a fifth branch of the beam of light having distinctive colors. The fourth branch in FIG. 25 is the beam traveling from the dichroic filter 909 toward the focusing element 908, whereas the fifth branch is the beam traveling from the dichroic filter toward the element 910. The above described wavelength division multiplexer further may comprise an additional focusing optical arrangement 908 and an additional semiconductor photo detector, wherein the additional focusing optical arrangement 908 is located in the fourth branch and focuses the beam of light in the fourth branch so as to focus the beam of light onto the additional semiconductor photo detector. The wavelength division multiplexer may further comprise a plurality of image relay optical arrangements 910, 911, 912, 913, a plurality of dichroic filter arrangements 914, 915, 916, 917, a plurality of semiconductor photo detectors and a plurality of focusing optical arrangements 918, 919, 920, 921, wherein each of the plurality of focusing optical arrangements is arranged between a respective one of the plurality of dichroic filter arrangements and a respective one of the plurality of semiconductor photo detectors so as to form a cascaded arrangement, as can be seen in FIG. 25. The additional focused spots may have a diameter of less than 1.0 mm, particularly of less than 0.6 mm for multiple colored bands of said beam of light. The plurality of dichroic filter arrangements are arranged in a common plane, as can be seen in FIG. 25A. The wavelength division multiplexer may further comprise a plan-parallel optical basis having a first surface and second surface parallel thereto, wherein the plurality of dichroic filter arrangements are arranged parallel, preferably in abutment to the first surface of the plan-parallel optical basis, as described with respect to the WDM 90. The dichroic filter arrangements are assembled using a template that includes two optically flat glass plates bonded together in optical contact, wherein the dichroic filter arrangements are bonded to a filter holder using the template such that a coated filter surface of the dichroic filter arrangements are indented and optically parallel to a reference surface of the filter holder, as can be seen in FIGs 29A, B and C. The reference surface of the filter holder rests against an optically flat surface of an reference block included in the wavelength

division multiplexer thereby providing consistent optical alignment when installing the dichroic filter arrangements into the wavelength division multiplexer. The respective image relay optical arrangements may be formed into the second surface of the plan-parallel optical basis, as can be seen in FIG. 25A. At least one of the semiconductor photo detectors is an avalanche photo diode detector. As an alternative or in addition, at least one of the semiconductor photo detectors is a carbon nanotube detector.

Industrial Applicability

Although an embodiment of the present disclosure of an LD based optical system for flow cytometric application has been described in some detail, and equally advantageous embodiments have also been described for a stream based flow cytometric instrument, it will be apparent to those of ordinary skill in the art that many modifications and variations of the described embodiment are possible in the light of the above teachings without departing from the principles and concepts of the disclosure as set forth in the claims.

Although an embodiment of the present disclosure of wavelength division multiplexing device for separating light beam from an extended light source into multiple color bands has been described in some detail, and several other equally advantageous embodiments have also been described, it will be apparent to those ordinary skilled in the art that many modifications and variations of the described embodiments are possible in the light of the above teachings without departing from the principles and concepts of the disclosure as set forth in the claims.

Although the present disclosure describes certain exemplary embodiments, it is to be understood that such disclosure is purely illustrative and is not to be interpreted as limiting. Consequently, without departing from the spirit and scope of the disclosure, various alterations, modifications, and/or alternative applications of the disclosure will, no doubt, be suggested to those skilled in the art after having read the preceding disclosure. Accordingly, it is intended that the following claims be interpreted as encompassing all alterations,

modifications, or alternative applications as fall within the true spirit and scope of the disclosure.

WHAT IS CLAIMED IS:

1. A flow cytometer, comprising:

a light source arranged to illuminate a stream of particles in a viewing zone of a flow cell in the flow cytometer;

a collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a collimating optical element arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to project a collimated beam,

a first semiconductor detector configured to detect and quantitate a first color band in the collimated beam,

a first curved mirror arranged to receive at least a portion of the collimated beam, the first curved mirror configured to reflect the portion of the collimated beam received from the collimating optical element towards the first semiconductor detector, and

a first dichroic filter optically disposed between the curved mirror and the first semiconductor detector, the dichroic filter configured to allow the first color band in the collimated beam to pass through the first dichroic filter onto the first semiconductor detector, and to reflect the second color band in the collimated beam away from the first semiconductor detector.

2. The flow cytometer of claim 1, further comprising an optical fiber optically disposed between the collecting optical element and the WDM, the optical fiber arranged and configured to deliver the fluorescent light collected by the collecting optical element to the WDM.

3. The flow cytometer of claim 1, further comprising a first focusing optical element optically disposed between the first dichroic filter and the first semiconductor detector, the

first focusing optical element configured to focus the first color band in the collimated beam passing through the first dichroic filter onto the first semiconductor detector.

4. The flow cytometer of claim 3, further comprising a second semiconductor detector arranged and configured to detect and quantitate the second color band in the collimated beam reflected by the first dichroic filter.

5. The flow cytometer of claim 4, further comprising a second curved mirror and a second dichroic filter, the second curved mirror arranged and configured to reflect at least a portion of the collimated beam reflected by the first dichroic filter towards the second semiconductor detector, the second dichroic filter arranged and configured to allow the second color band in the collimated beam to pass through the second dichroic filter onto the second semiconductor, and to reflect a third color band in the collimated beam away from the second semiconductor detector.

6. The flow cytometer of claim 5, further comprising a third semiconductor detector arranged and configured to detect and quantitate the third color band in the collimated beam reflected by the second dichroic filter.

7. The flow cytometer of claim 1, wherein the first curved mirror reflects the portion of the collimated beam received from the collimating optical element to form an image.

8. The flow cytometer of claim 7, wherein the formed image is an image of the collimating optical element.

9. The flow cytometer of claim 1, wherein the light source is arranged and configured to illuminate the stream of particles from one side of the flow cell, and wherein the collecting optical element is arranged and configured to collect fluorescent light from another side of the flow cell.

10. The flow cytometer of claim 9, wherein the collecting optical element is further configured to collect and focus side-scatter light scattered by the illuminated particle in the stream.

11. The flow cytometer of claim 1, wherein the light source comprises a plurality of lasers.

12. The flow cytometer of claim 11, wherein the plurality of lasers comprises a first laser configured to illuminate a particle in the stream at a first location in the viewing zone, and a second laser configured to illuminate the particle at a second location in the viewing zone.

13. A flow cytometer comprising:

a light source arranged to illuminate a stream of particles in a viewing zone;

a collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a row of mirrors arranged and configured to sequentially reflect different color bands of the fluorescent light collected by the collecting optical element, the row of mirrors including at least one curved mirror;

a row of dichroic filters opposed to the row of mirrors, each dichroic filter configured to pass one color band of the fluorescent light reflected by a mirror in the row of mirrors, and to reflect another color band of the fluorescent light reflected by the mirror;

a row of semiconductor detectors, each semiconductor detector arranged and configured to detect and quantitate the band of fluorescent light passing through a dichroic filter in the row of dichroic filters.

14. The flow cytometer of claim 13, further comprising a row of focusing optical elements, each focusing optical element in the row arranged and configured to focus the band of fluorescent light passing through a dichroic filter in the row of dichroic filters onto the corresponding semiconductor detector.

15. The flow cytometer of claim 14, wherein the row of mirrors includes at least one curved mirror configured to form an image in the fluorescent light reflected by said curved mirror.

16. The flow cytometer of claim 15, wherein the image formed by said curved mirror is an image of the collimating optical element.

17. The flow cytometer of claim 13, wherein fluorescent light received by the collimating optical element is reflected back and forth between the row of mirrors and the row of dichroic filters in a zig-zag pattern.

18. A flow cytometer, comprising:

a light source arranged to illuminate a flow-stream of particles in a viewing zone from a first side of the flow stream;

a collecting optical element arranged on a second side of the flow stream, the collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a collimating optical element arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to project a collimated beam,

a first semiconductor detector configured to detect and quantitate a first color band in the collimated beam,

a first curved mirror arranged to receive at least a portion of the collimated beam, the first curved mirror configured to reflect the portion of the collimated beam received from the collimating optical element towards the first semiconductor detector, and

a first dichroic filter disposed between the curved mirror and the first semiconductor detector, the dichroic filter configured to allow the first color band in

the collimated beam to pass through the first dichroic filter onto the first semiconductor detector, and to reflect a second color band in the collimated beam away from the first semiconductor detector.

19.. The flow cytometer of claim 19, wherein the first side of the flow stream is orthogonal to the second side of the flow stream.

20. The flow cytometer of claim 19, wherein the collecting optical element is further configured to collect and focus side-scatter light scattered by the illuminated particle.

ABSTRACT

The disclosed flow cytometer includes a wavelength division multiplexer (WDM). The WDM includes an extended light source providing light that forms an object, a collimating optical element that captures light from the extended light source and projects a magnified image of the object as a first light beam, and a first focusing optical element configured to focus the first light beam to a size smaller than the object of the extended light source to a first semiconductor detector. The disclosed flow cytometer further includes a composite microscope objective to direct light emitted by a particle in a flow channel in a viewing zone of the composite microscope to the extended light source, a fluidic system and a peristaltic pump configured to supply liquid sheath and liquid sample to the flow channel, and a laser diode system to illuminate the particle in the flow channel.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**12/22/2021 09:03:00 PM ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Myriah Clark
PATENT CENTER #	60458708	FILING DATE	-
CUSTOMER #	32425	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Mark Tison

Documents

TOTAL DOCUMENTS: 6

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
beccp0002uscipd2c1_ADS.pdf	9	Application Data Sheet	1227 KB
beccp0002uscipd2c1_declaration.pdf	1	Oath or Declaration filed	60 KB
beccp0002uscipd2c1_figures.pdf	35	Drawings-only black and white line drawings	517 KB
beccp0002uscipd2c1_specification.pdf	96	-	361 KB
beccp0002uscipd2c1_specification-SPEC.pdf (1-90)	90	Specification	343 KB

beccp0002uscipd2c1_specification-CLM.pdf	(91-95)	5	Claims	36 KB
beccp0002uscipd2c1_specification-ABST.pdf	(96-96)	1	Abstract	28 KB

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

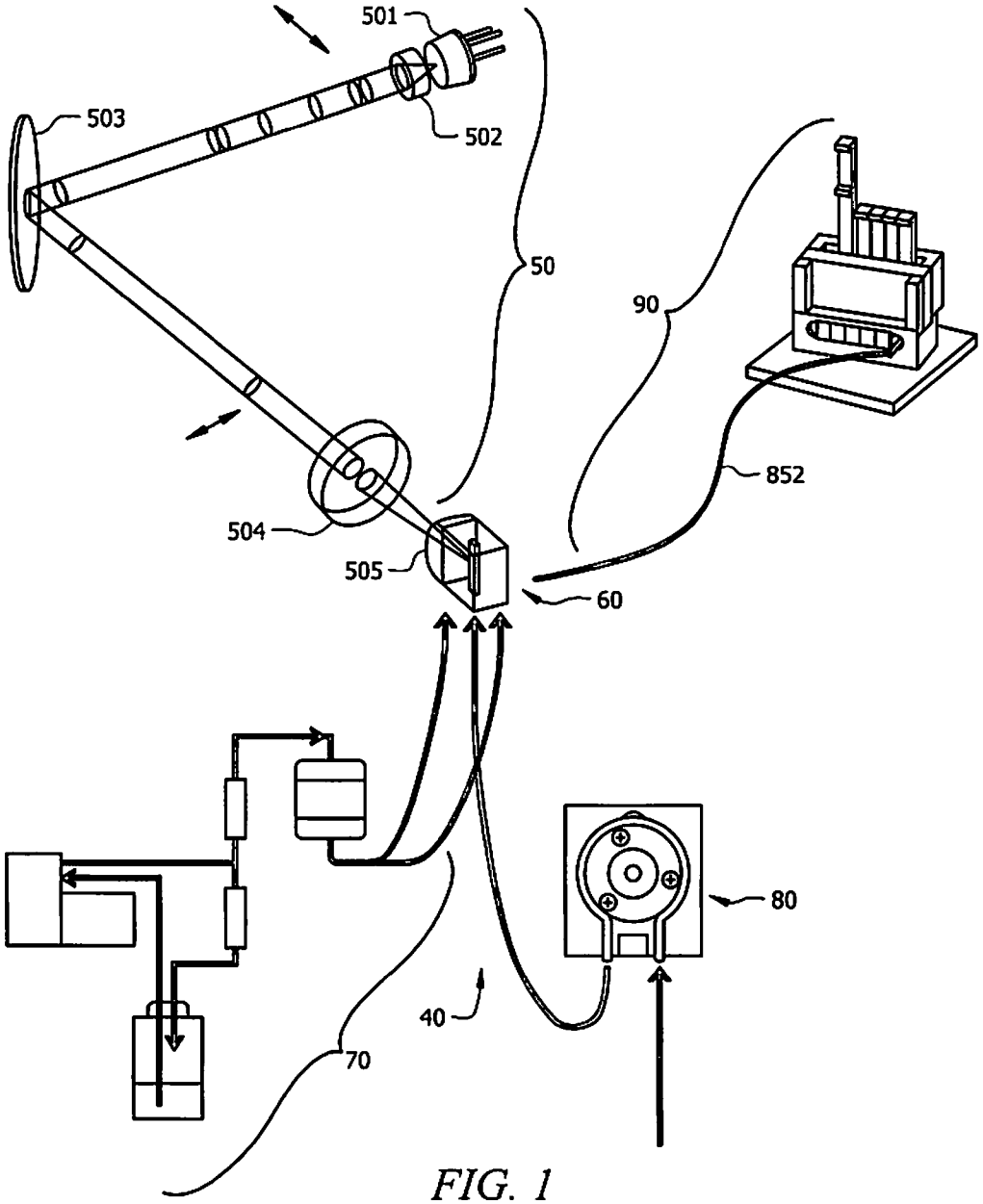


FIG. 1

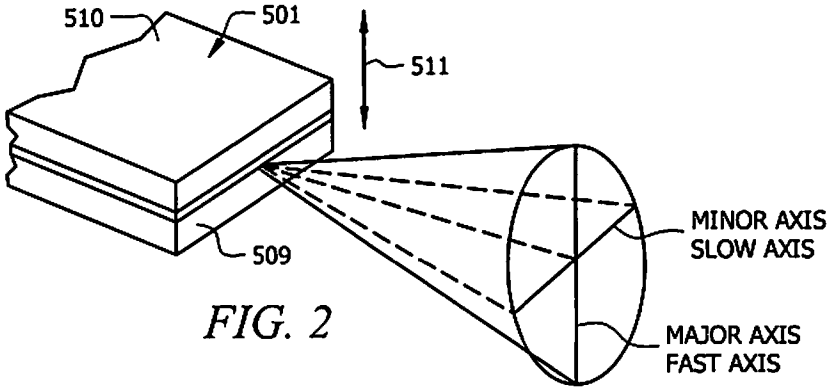


FIG. 2

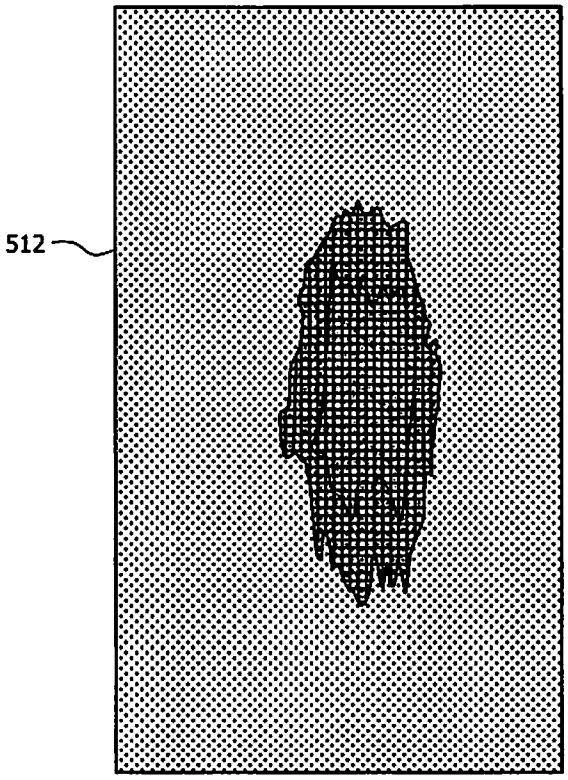


FIG. 2A

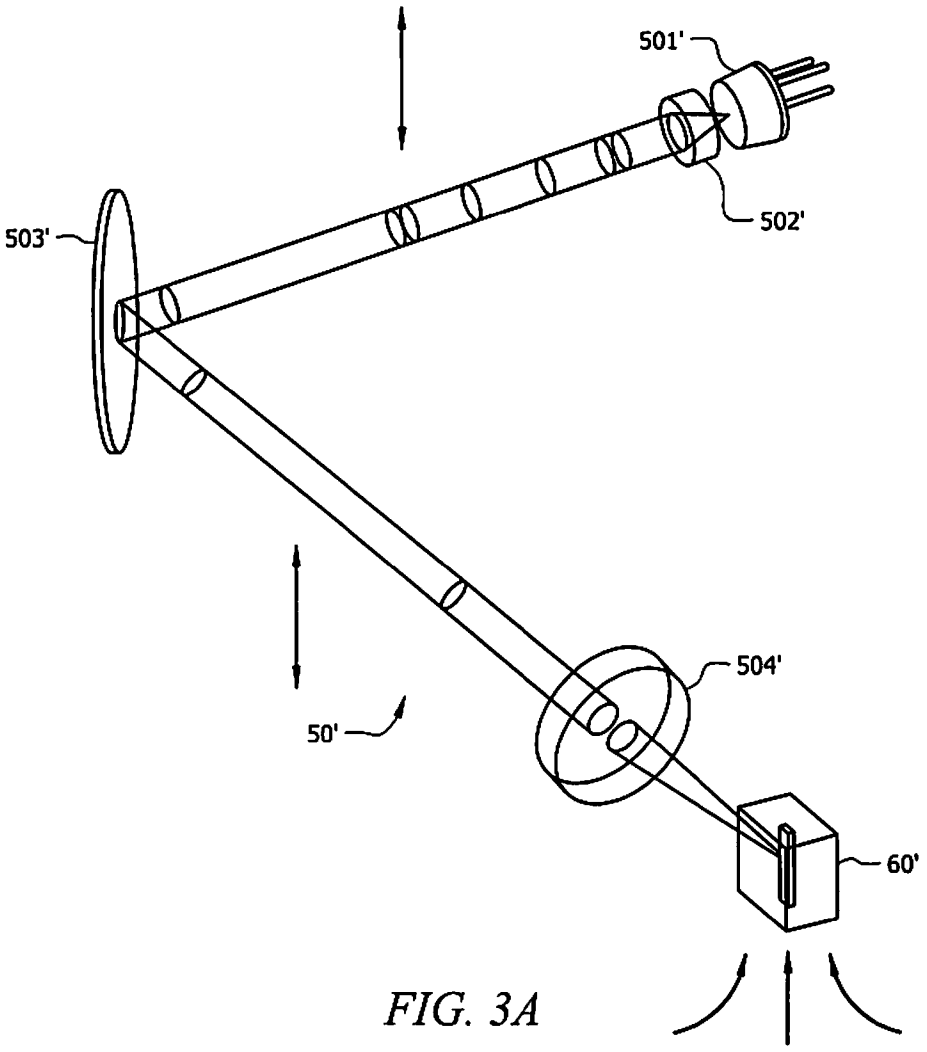


FIG. 3A

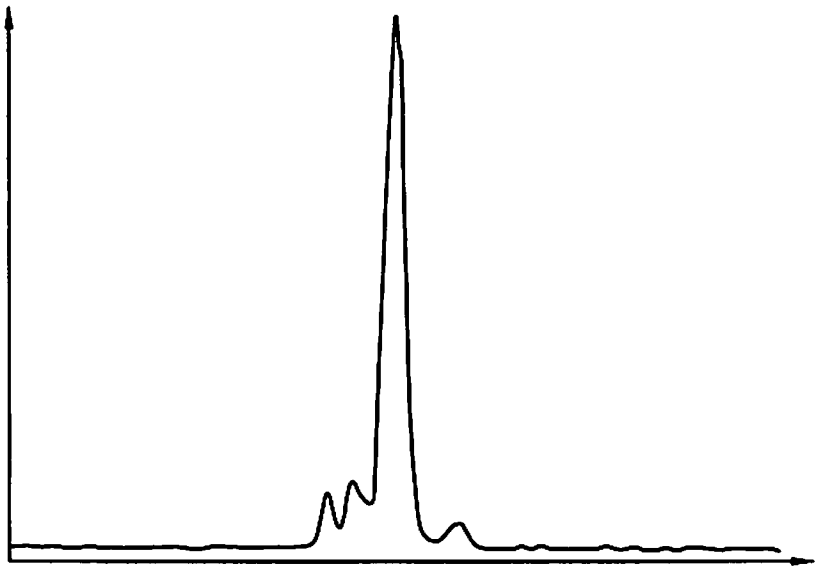


FIG. 3B

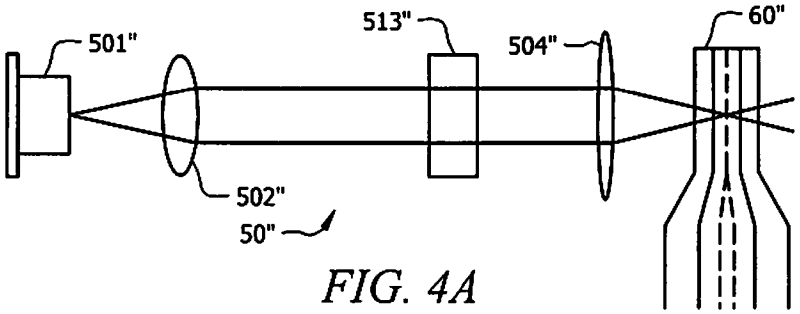


FIG. 4A

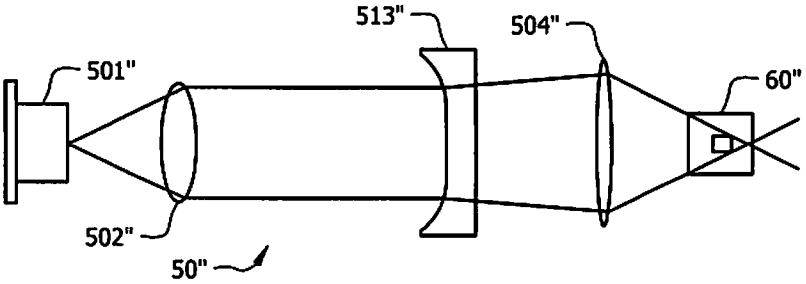


FIG. 4B

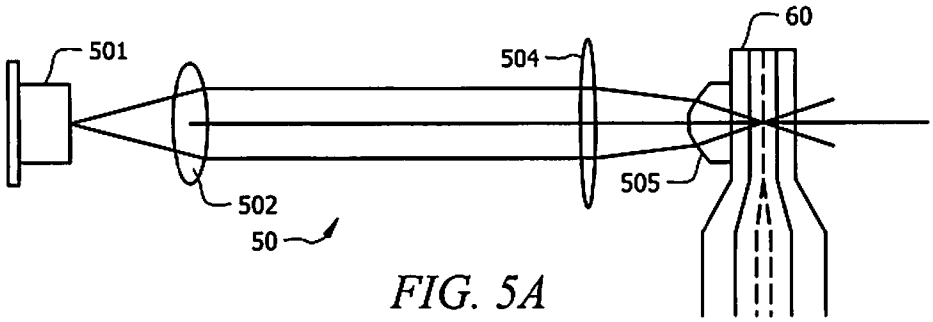


FIG. 5A

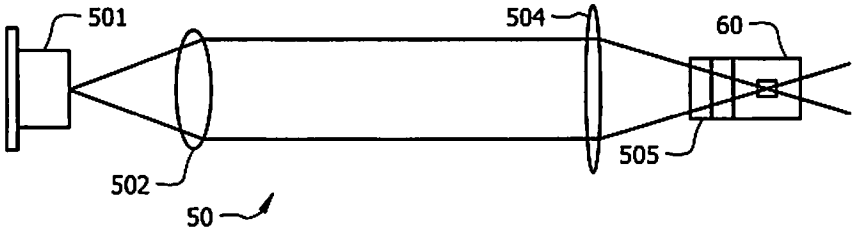


FIG. 5B

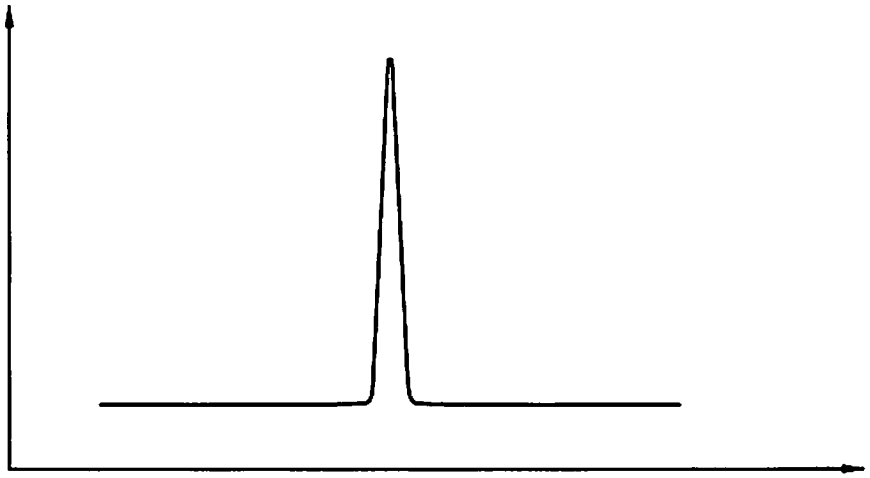


FIG. 5C

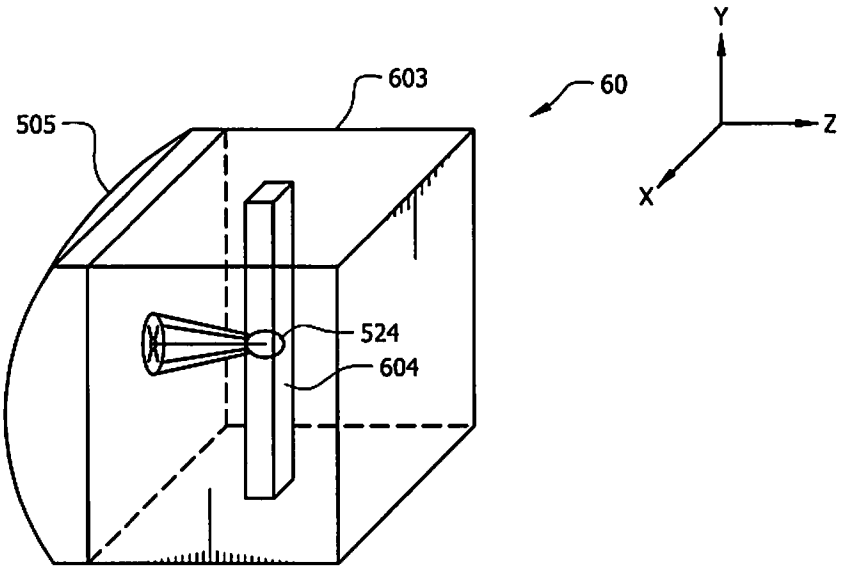


FIG. 5D

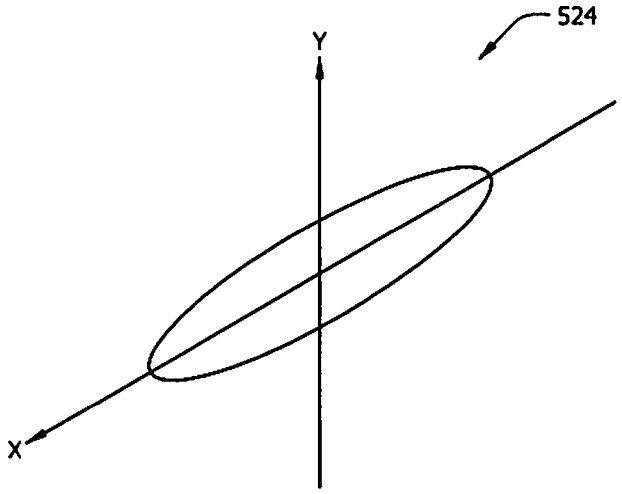


FIG. 5E

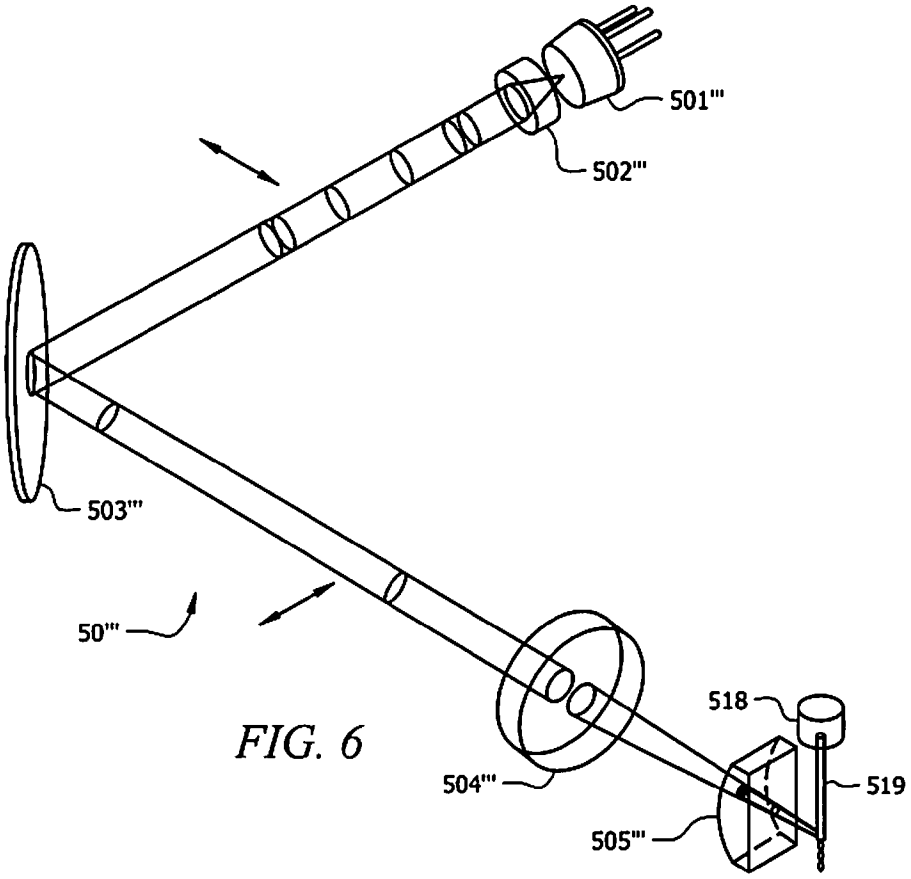


FIG. 6

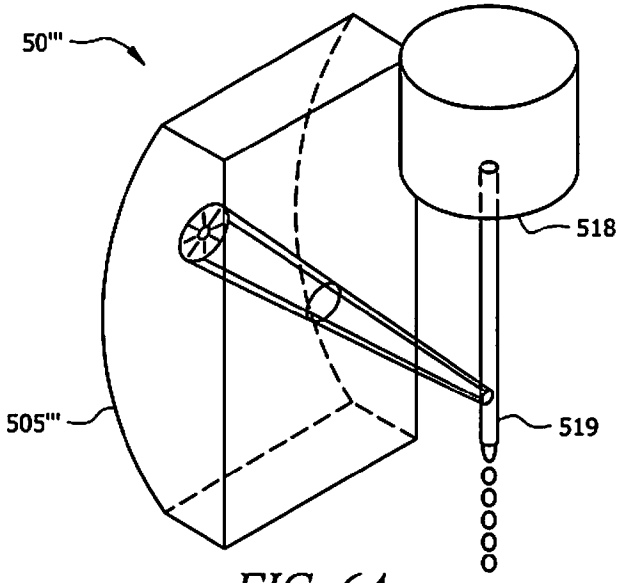


FIG. 6A

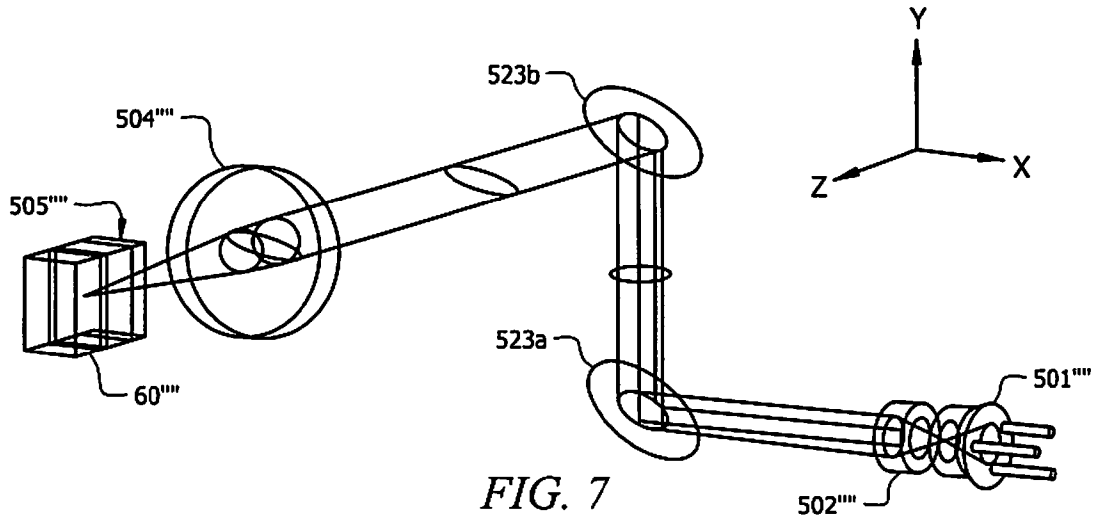


FIG. 7

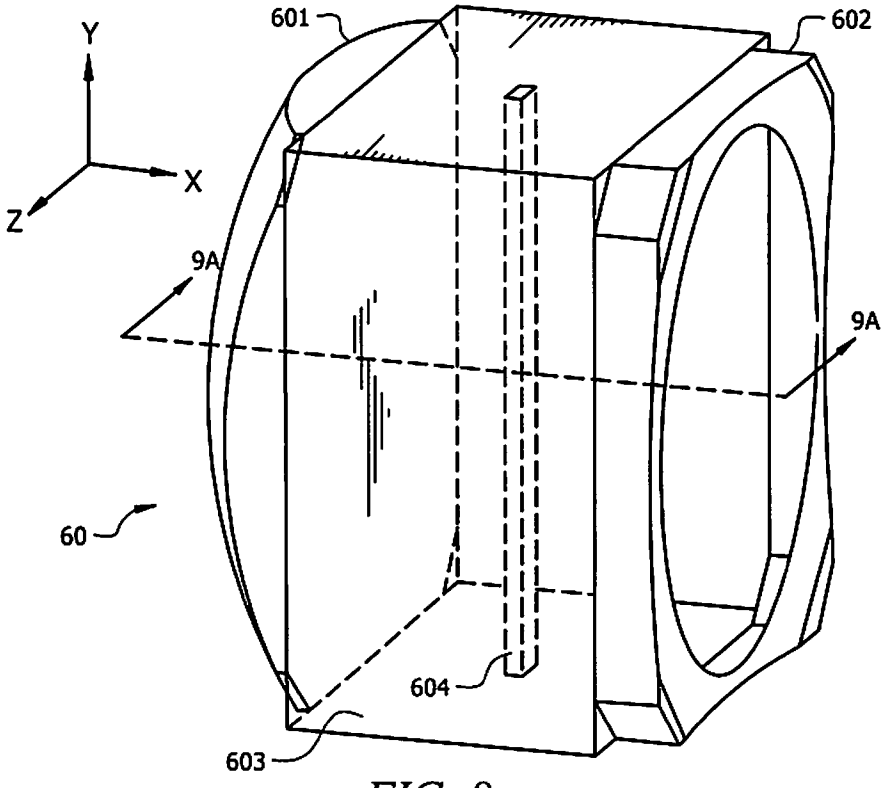


FIG. 8

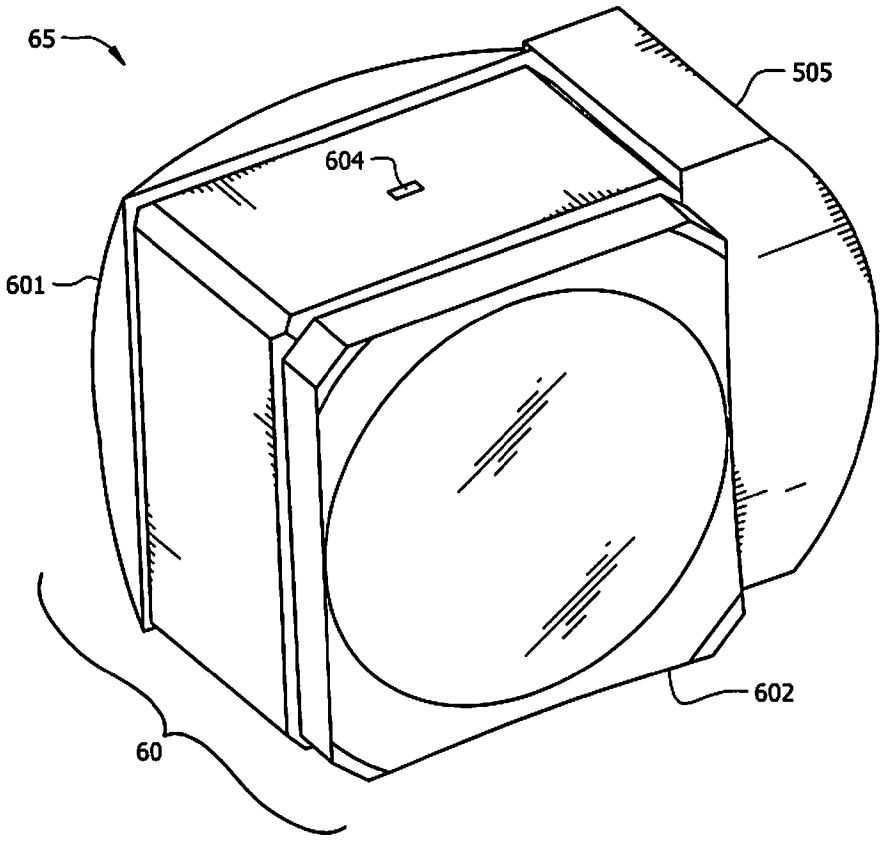


FIG. 8A

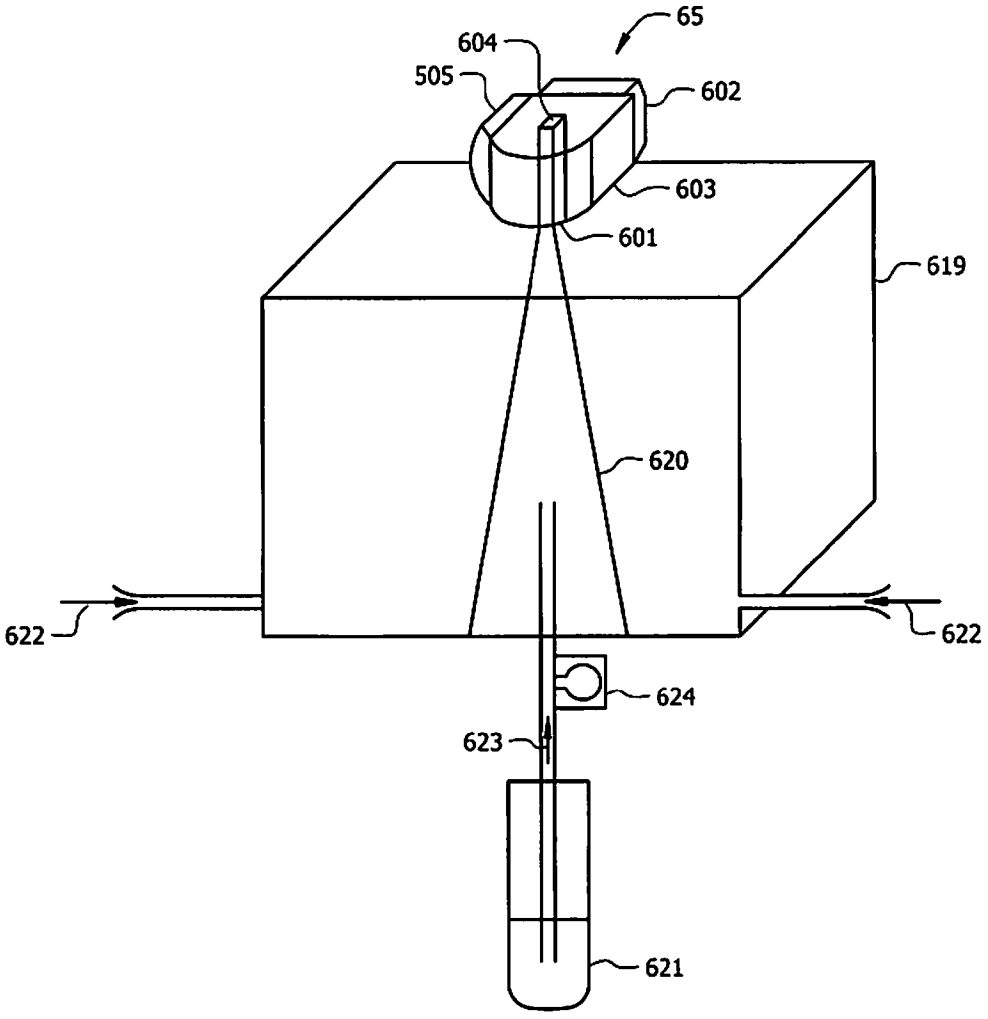


FIG. 8B

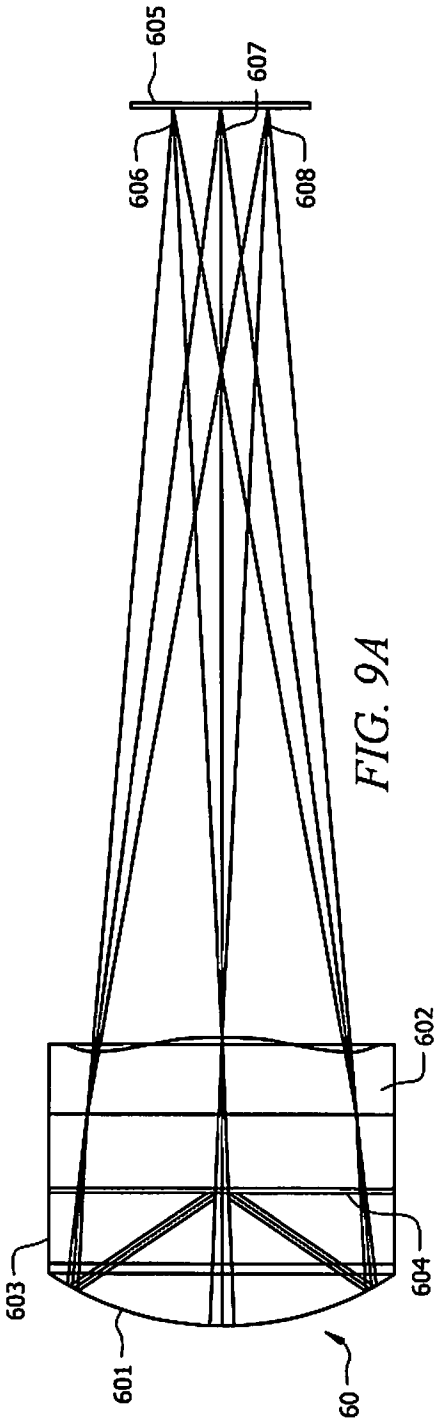


FIG. 9A

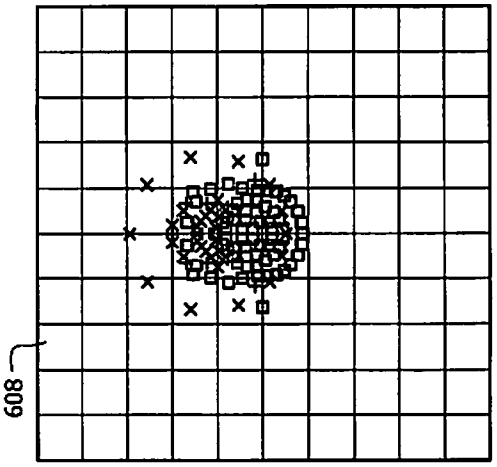


FIG. 9B3

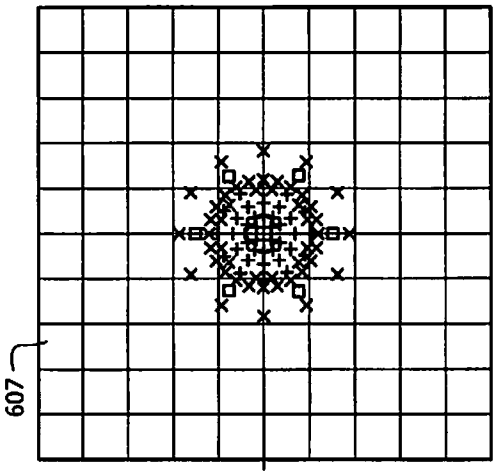


FIG. 9B2

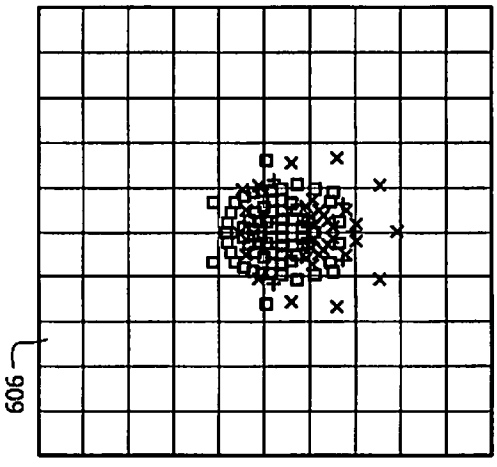


FIG. 9B1

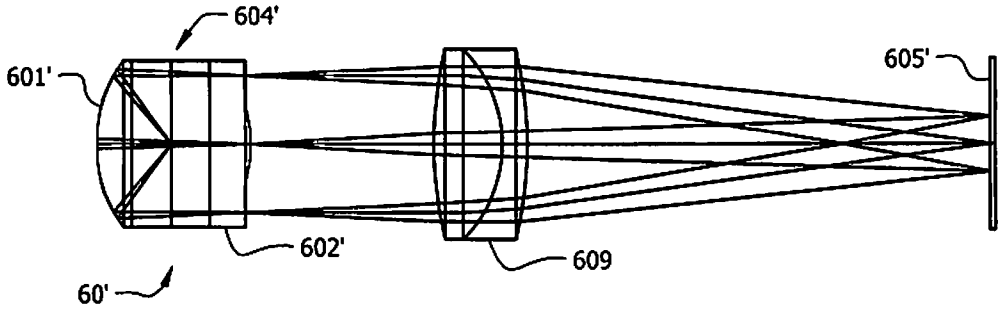


FIG. 10

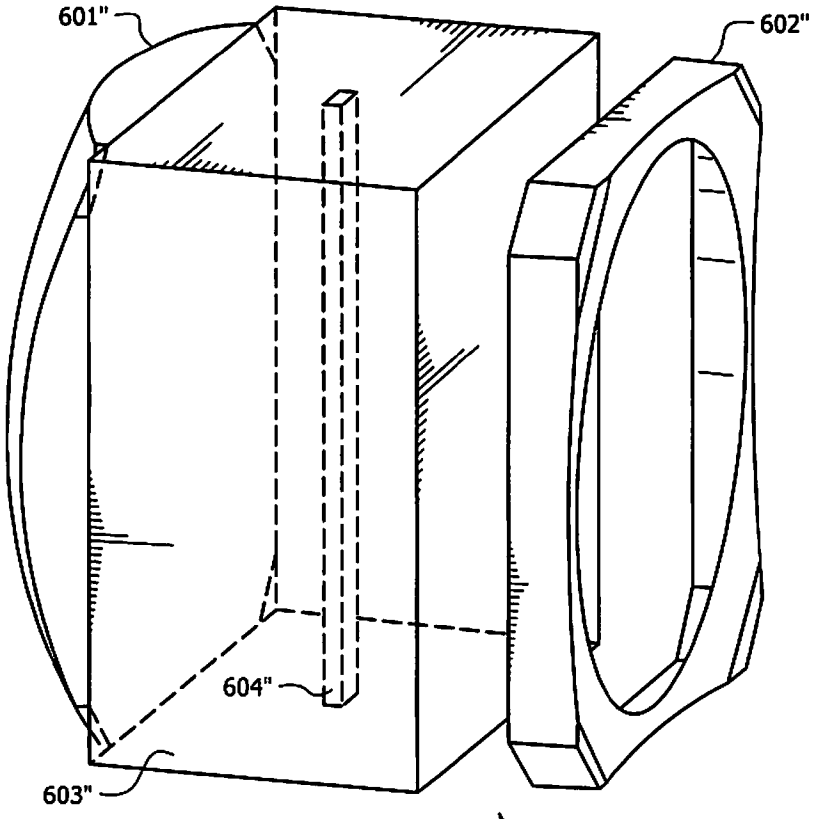


FIG. 11

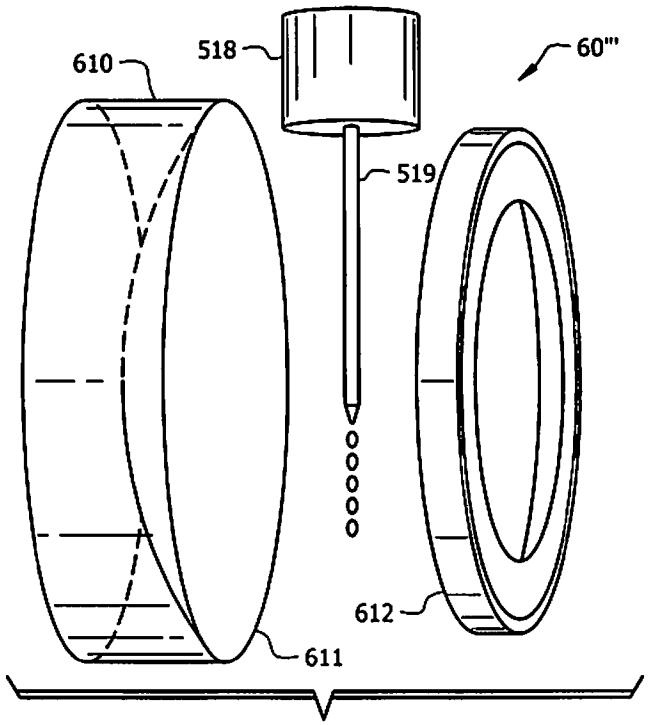


FIG. 12

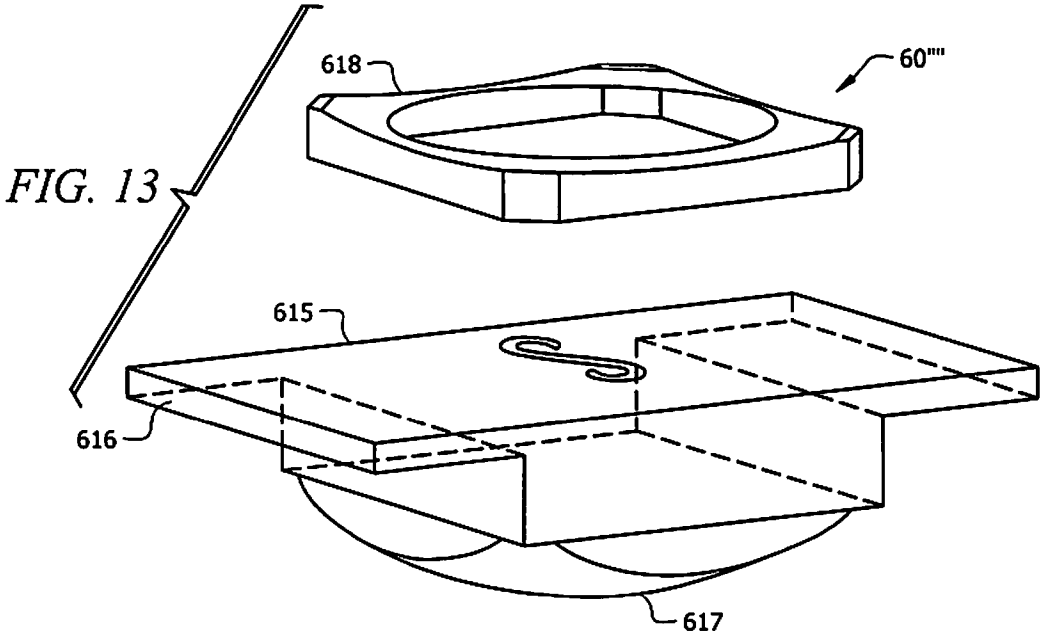


FIG. 13

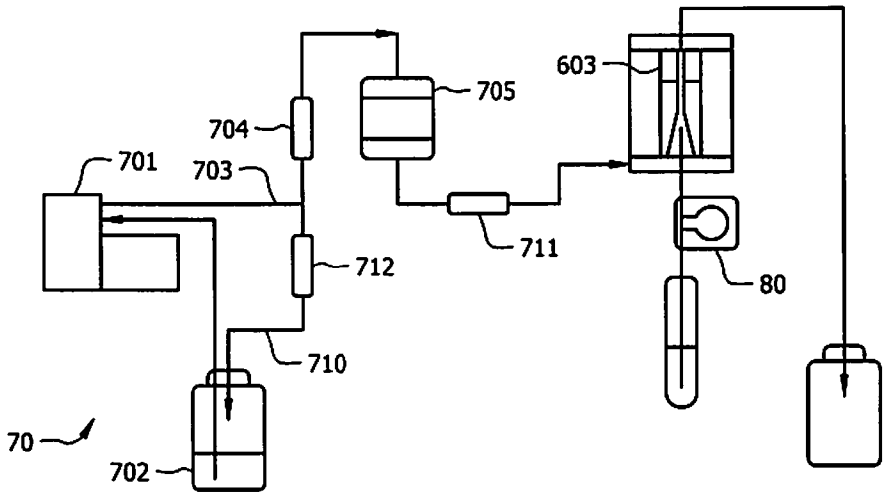

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FIG. 14

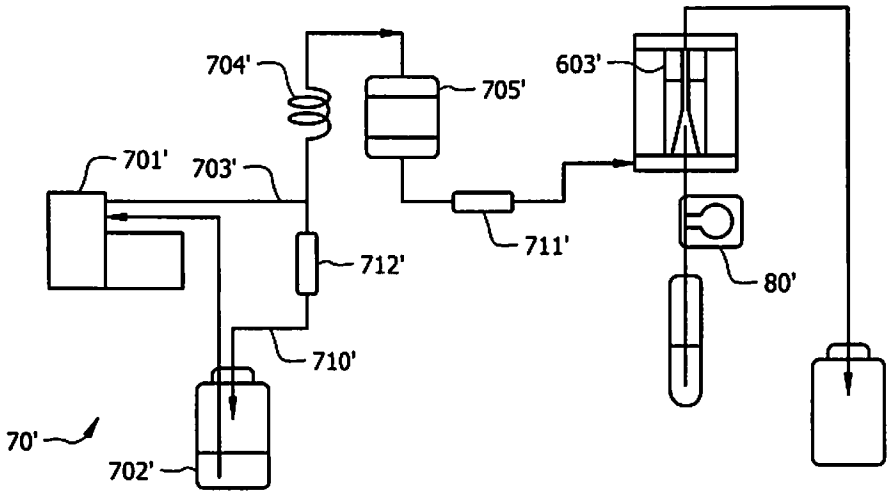

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710'
70'
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FIG. 15

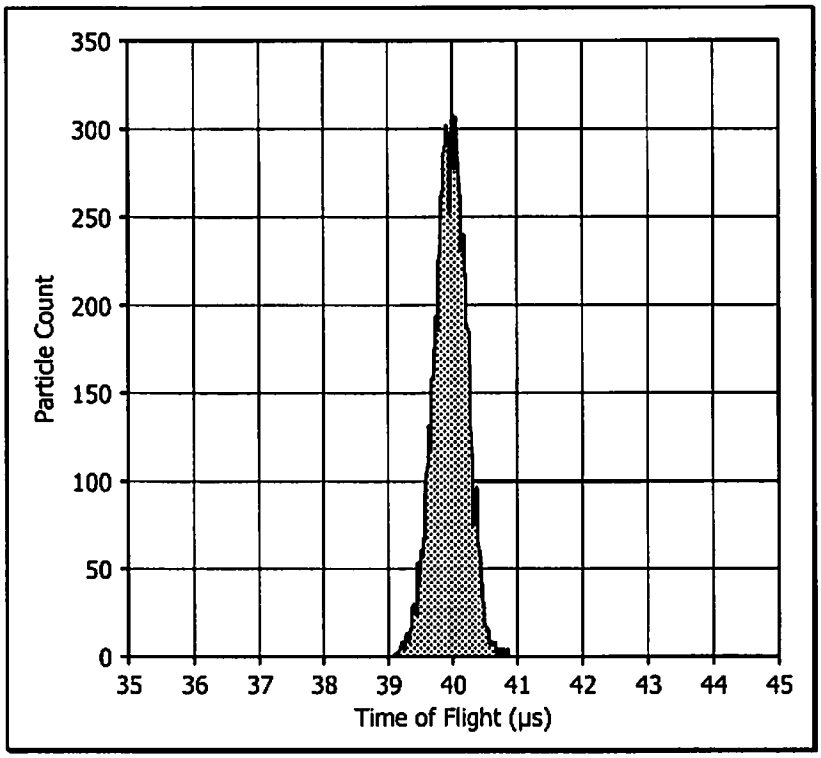


FIG. 16A

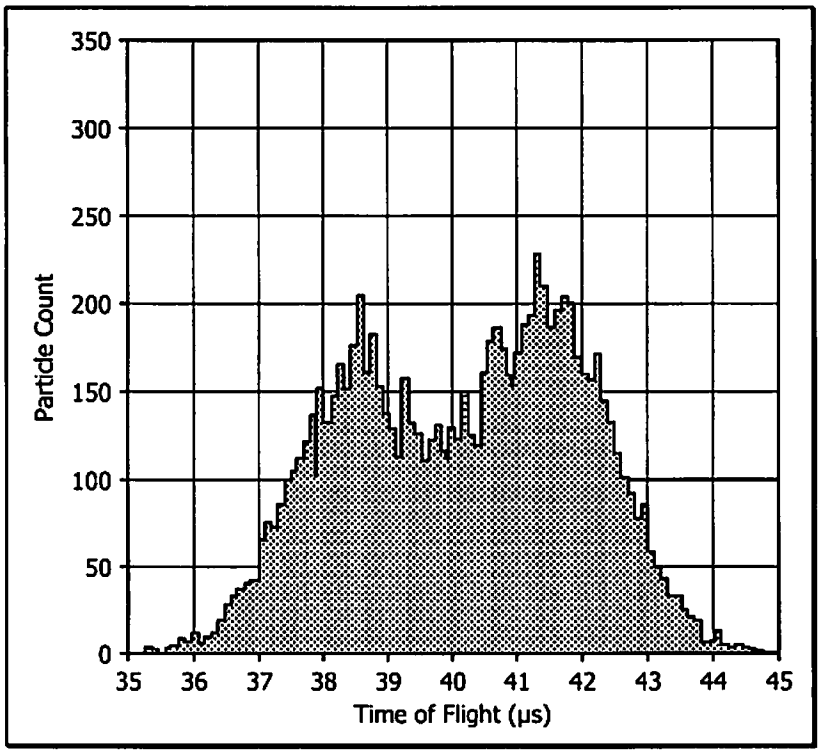


FIG. 16B

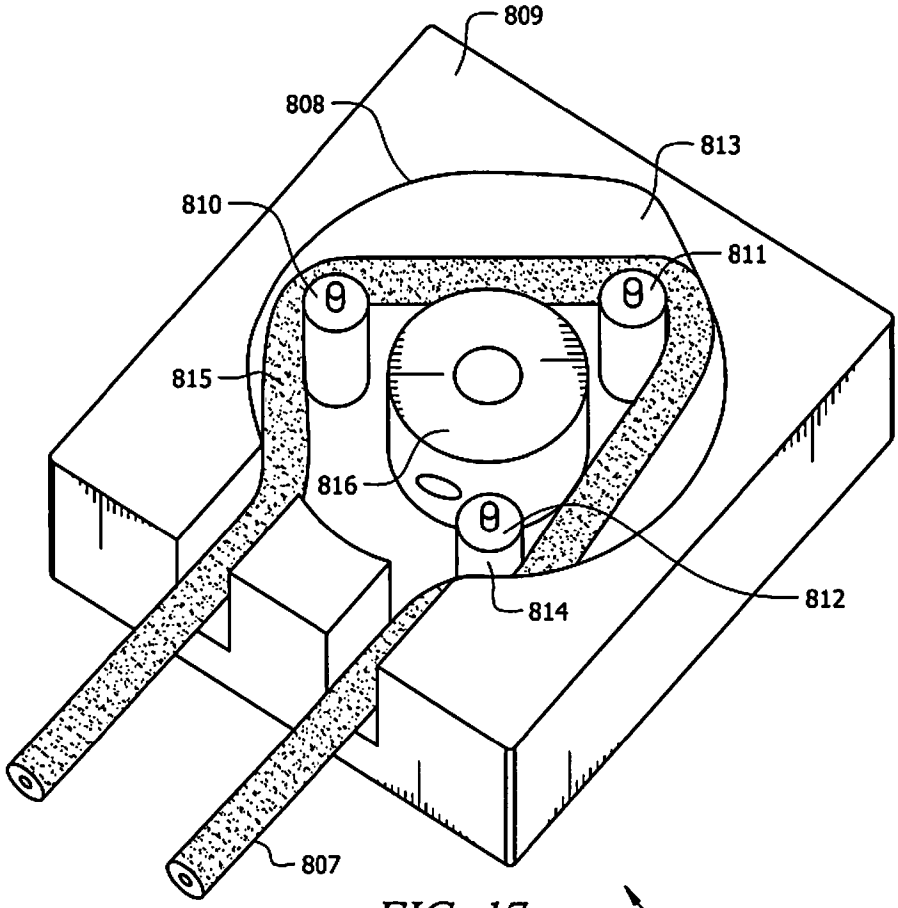


FIG. 17

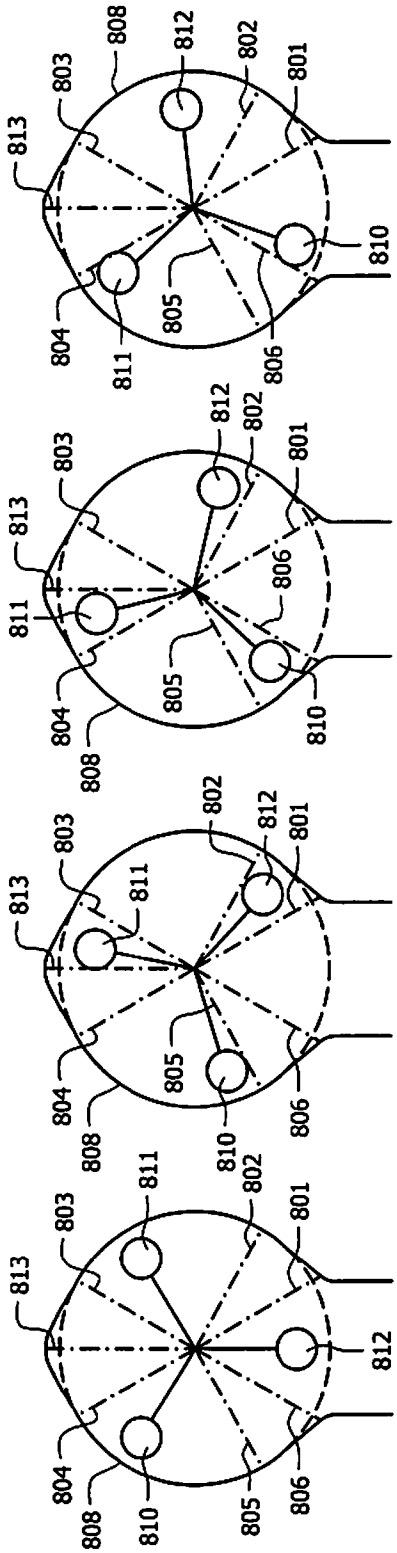


FIG. 18D

FIG. 18C

FIG. 18B

FIG. 18A

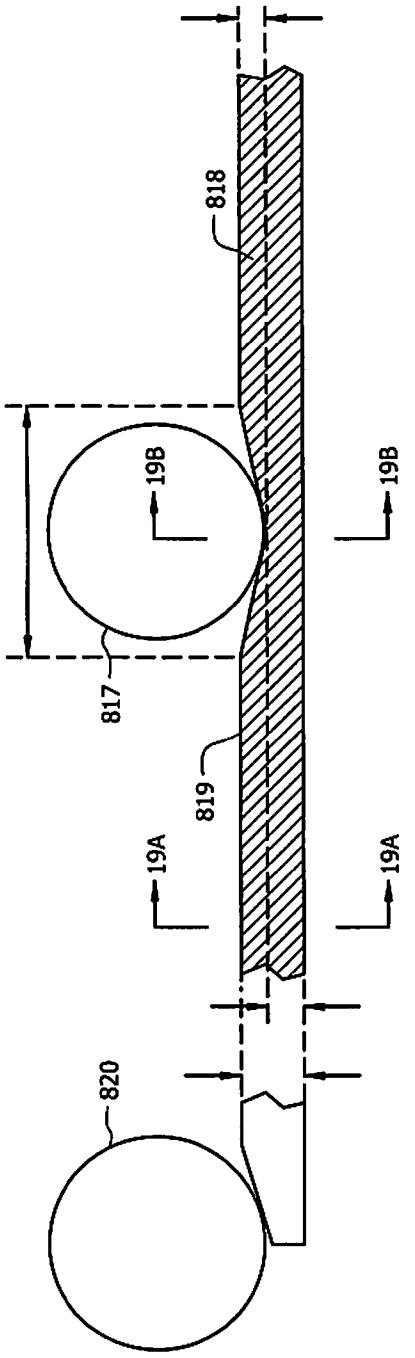


FIG. 19

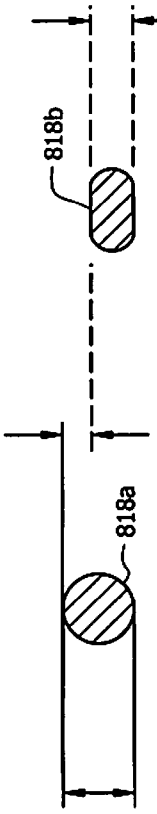


FIG. 19A

FIG. 19B

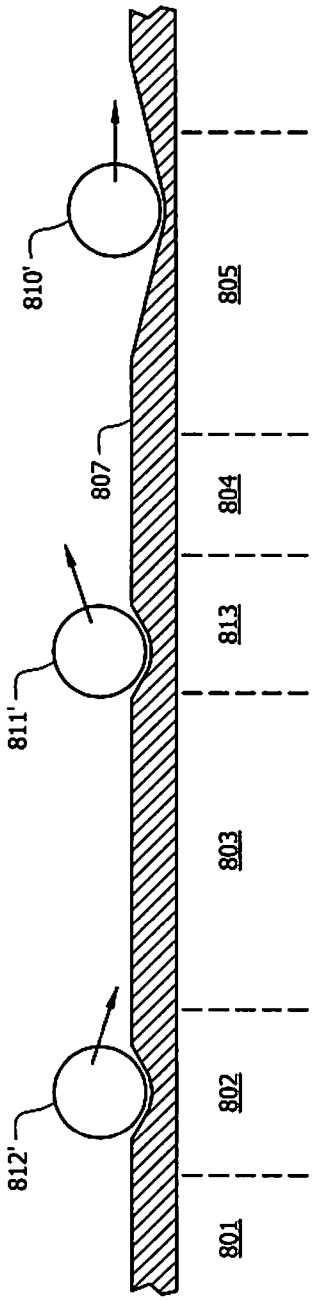


FIG. 20A

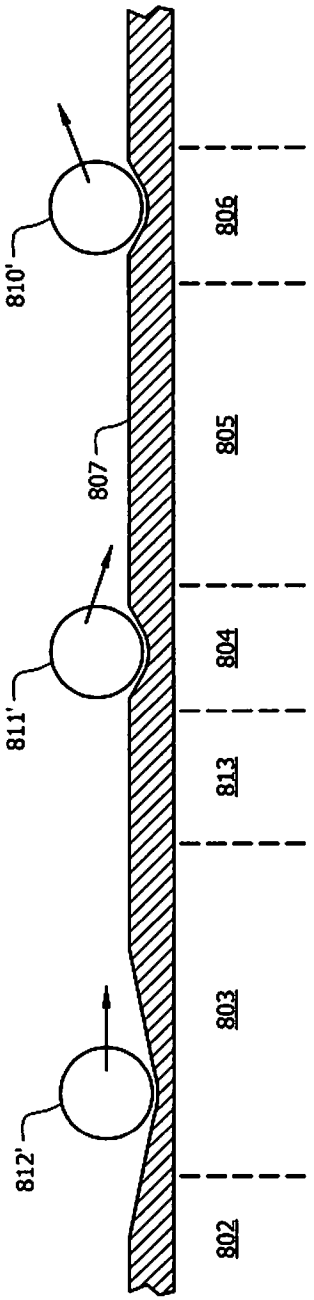


FIG. 20B

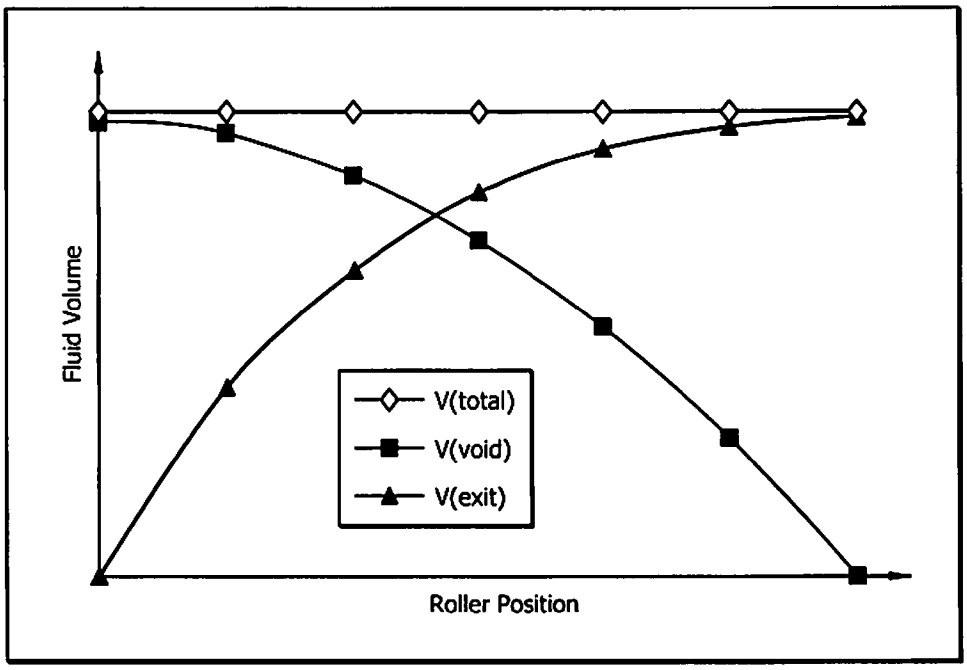


FIG. 21

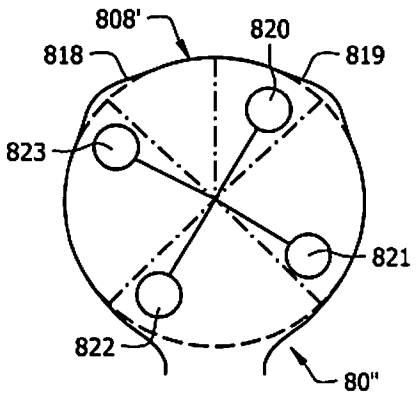


FIG. 22

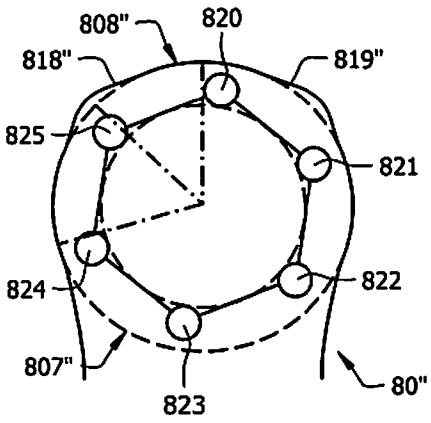


FIG. 23

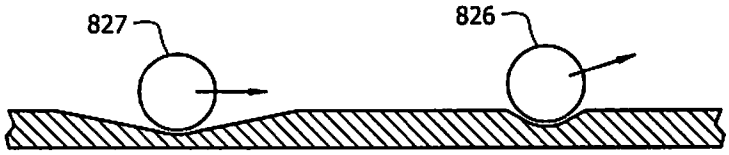


FIG. 24A

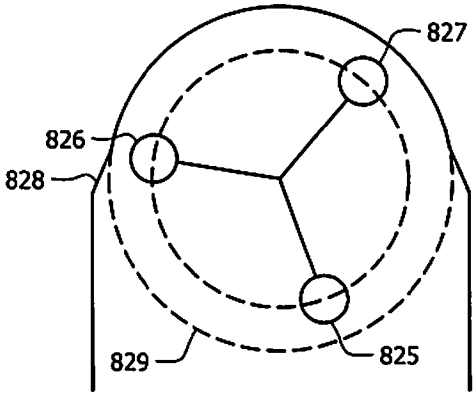


FIG. 24B

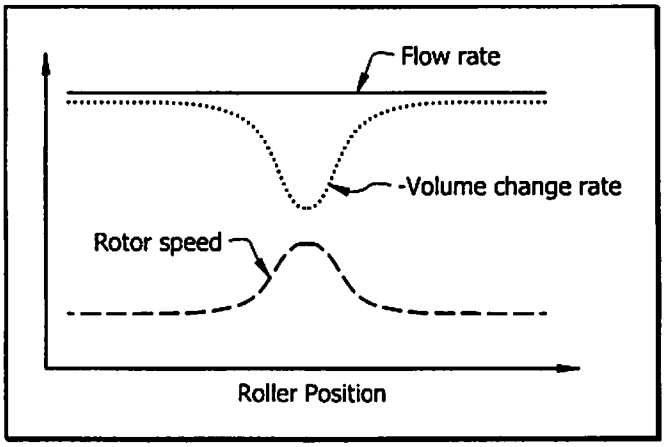


FIG. 24C

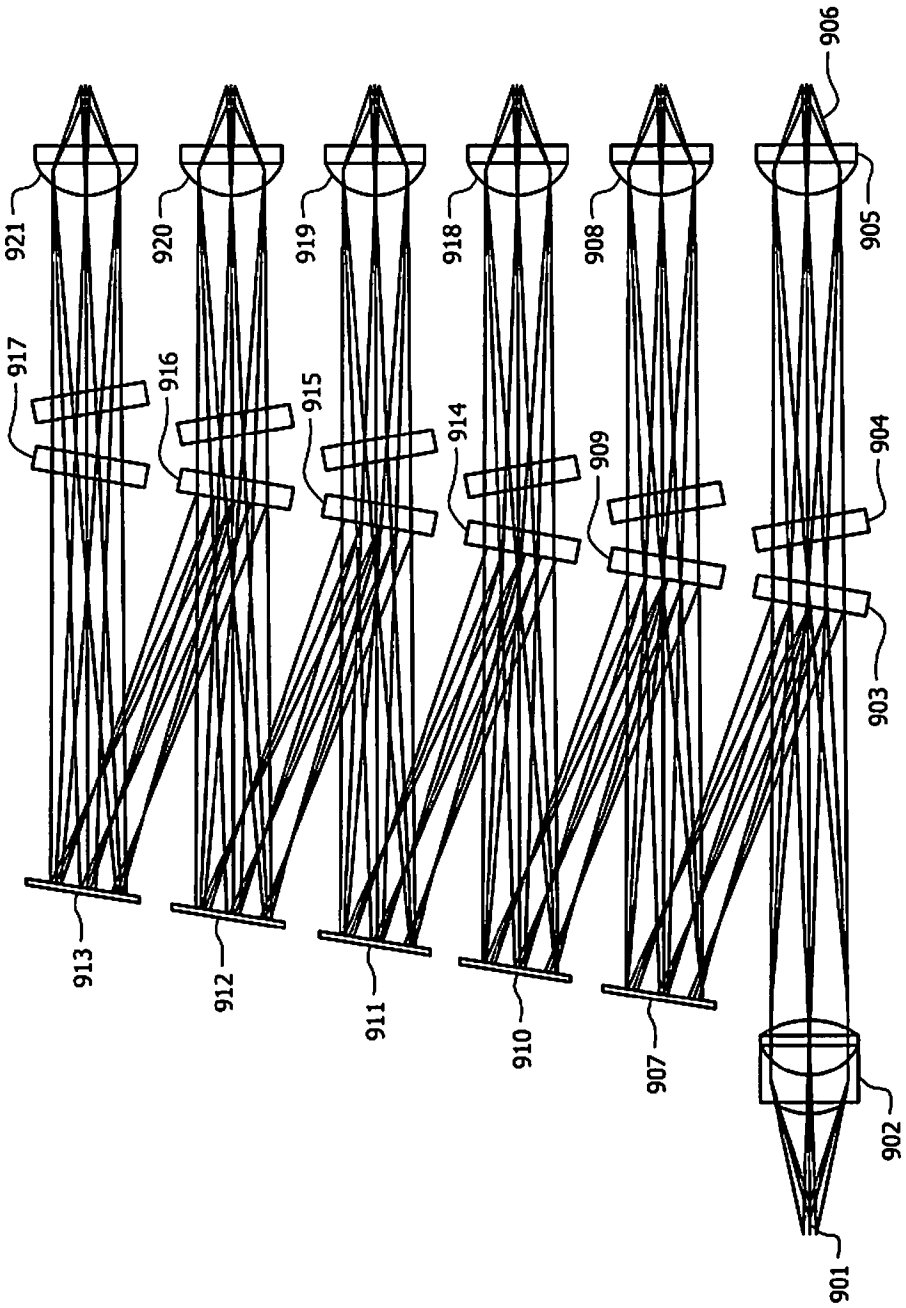

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FIG. 25

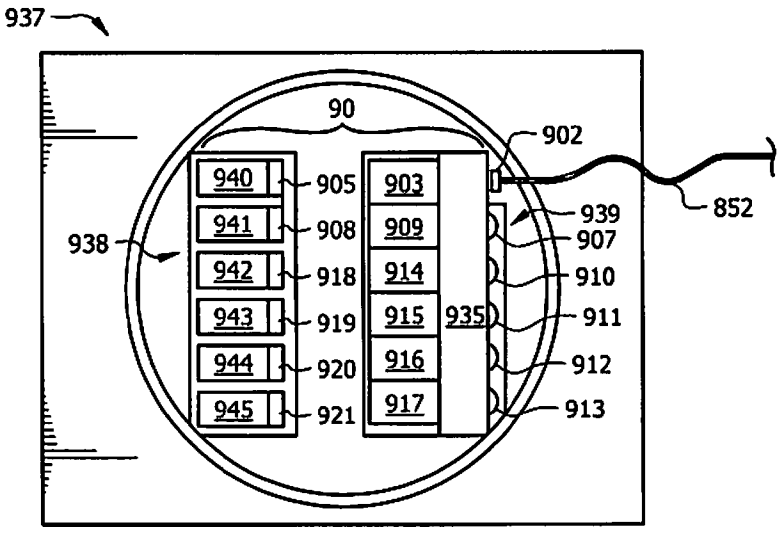


FIG. 25A

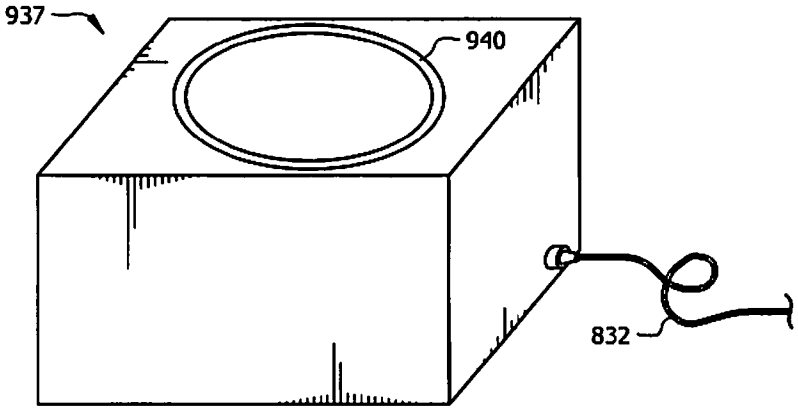


FIG. 25B

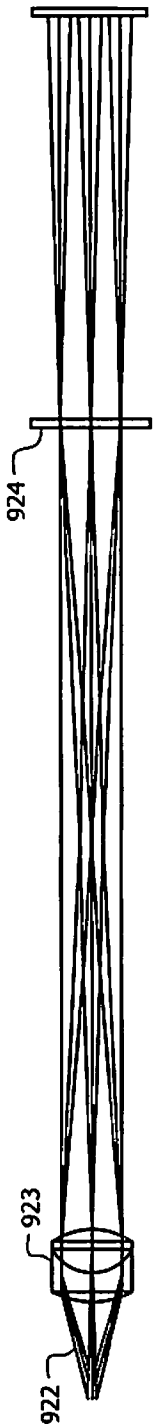


FIG. 26

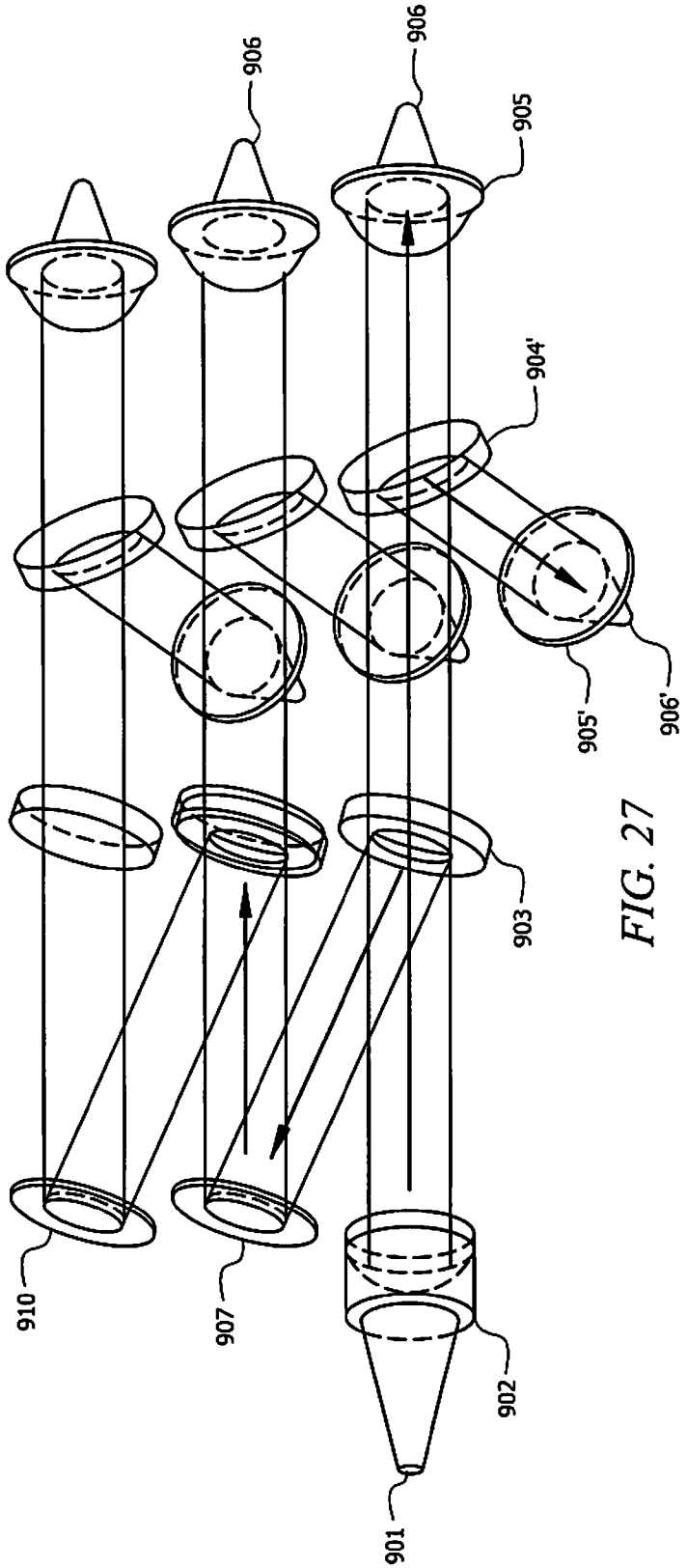


FIG. 27

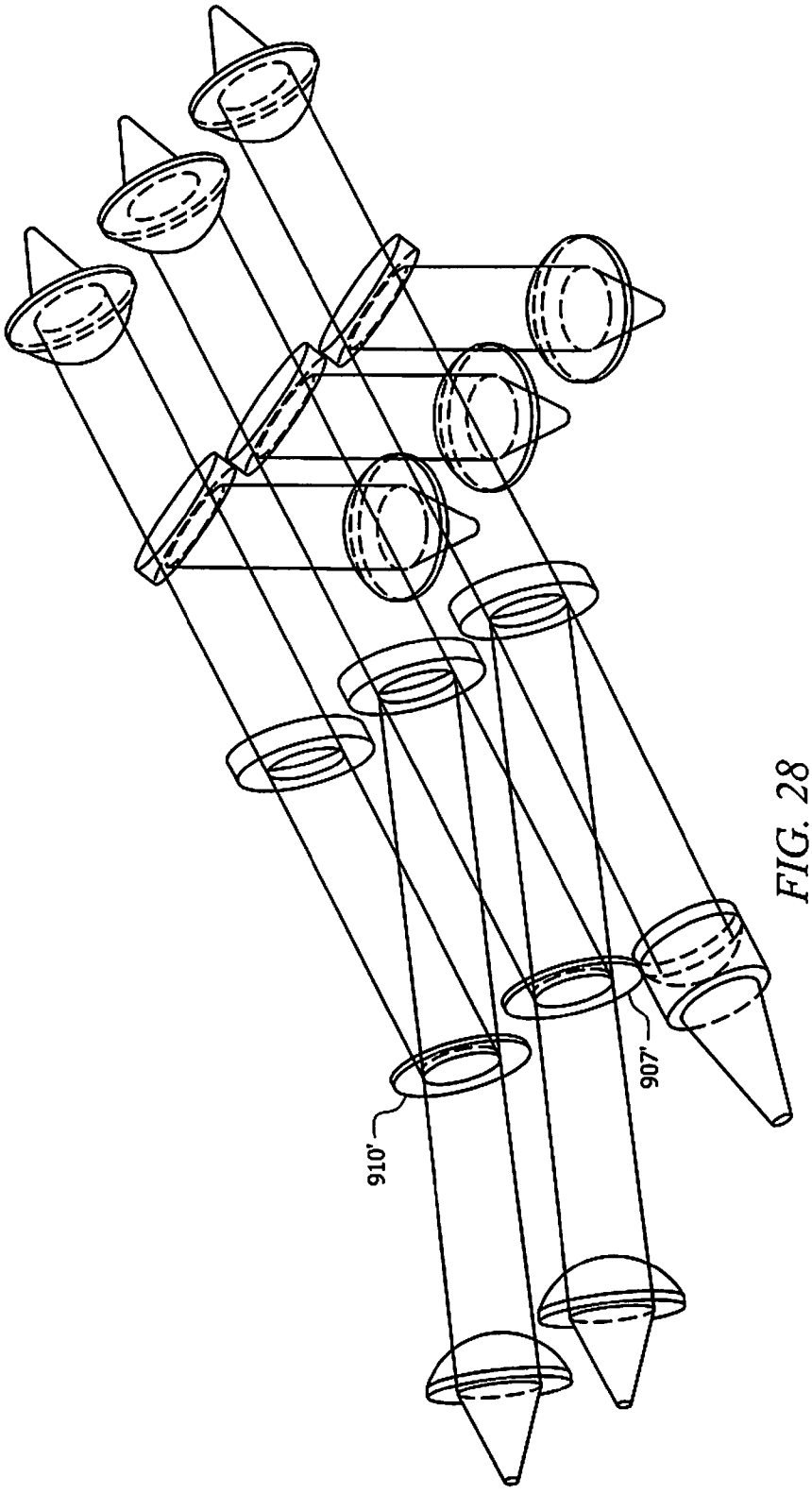


FIG. 28

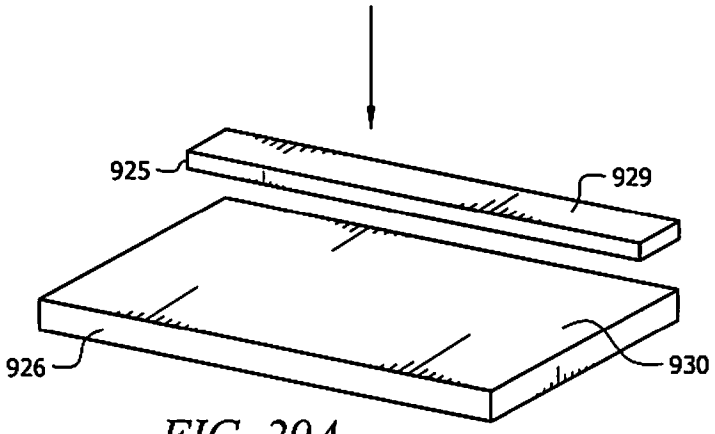


FIG. 29A

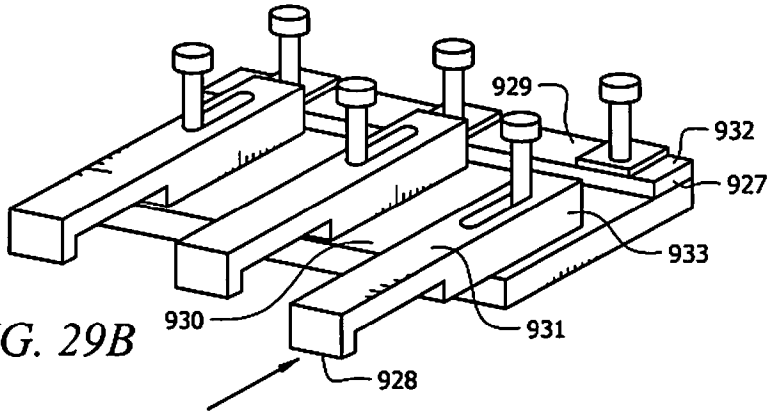


FIG. 29B

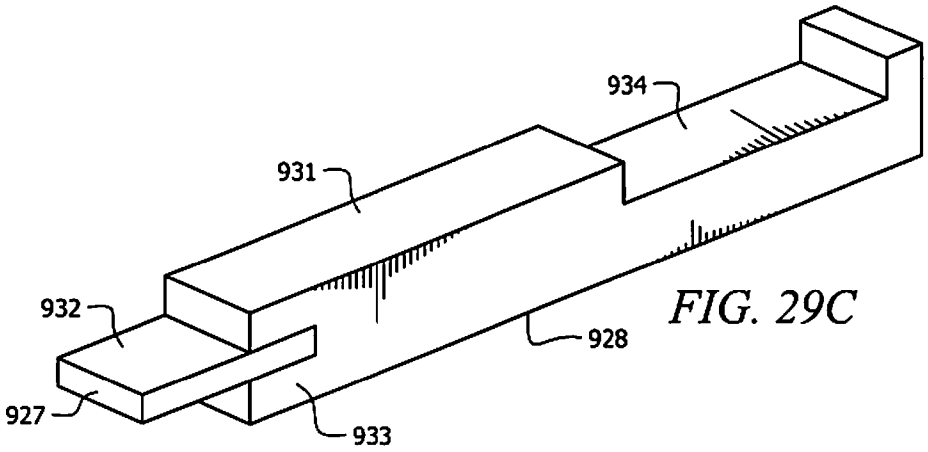


FIG. 29C

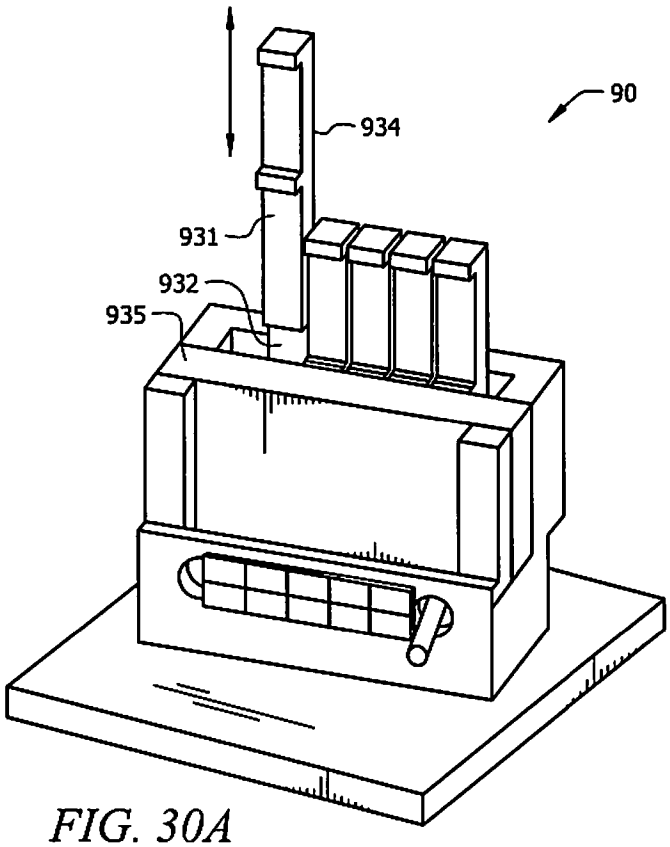


FIG. 30A

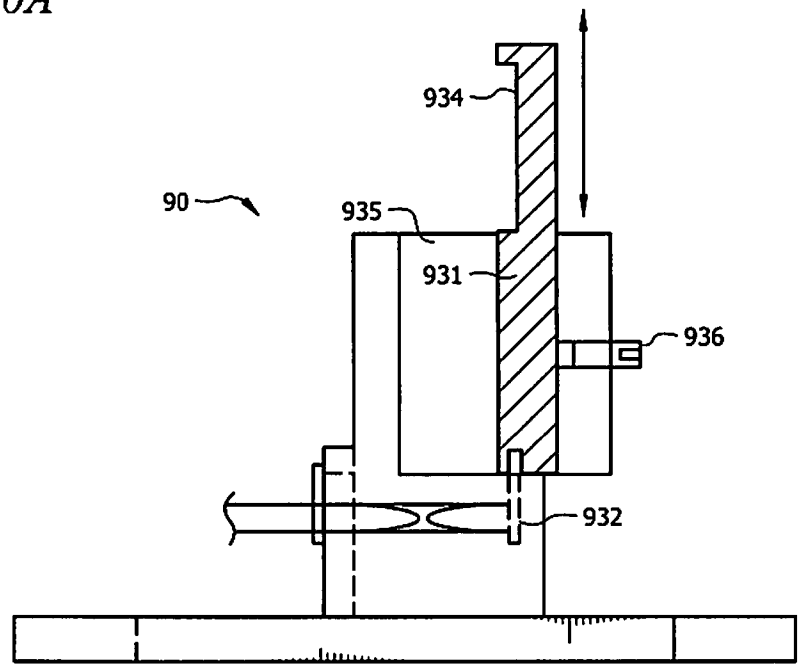


FIG. 30B

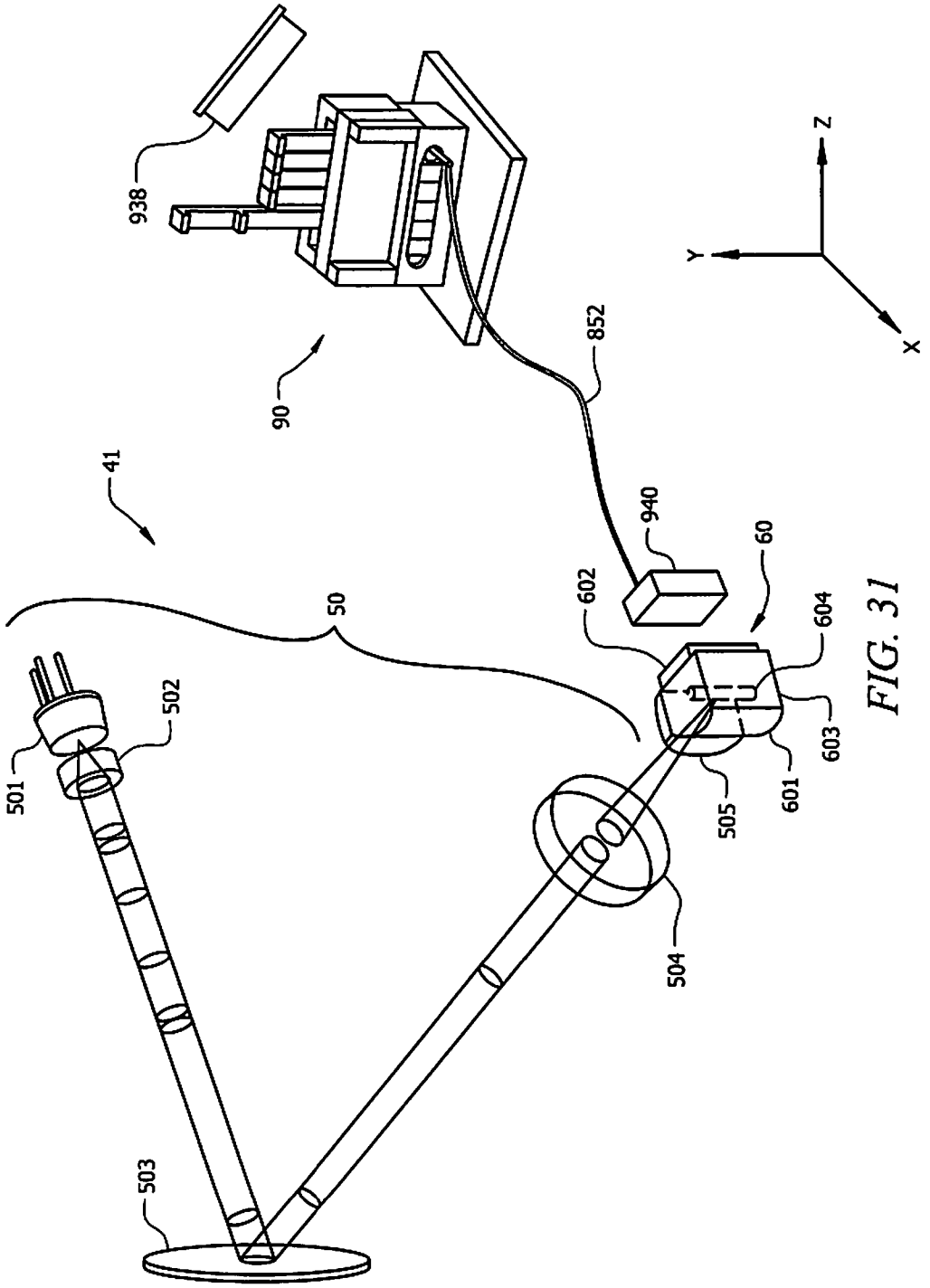


FIG. 31

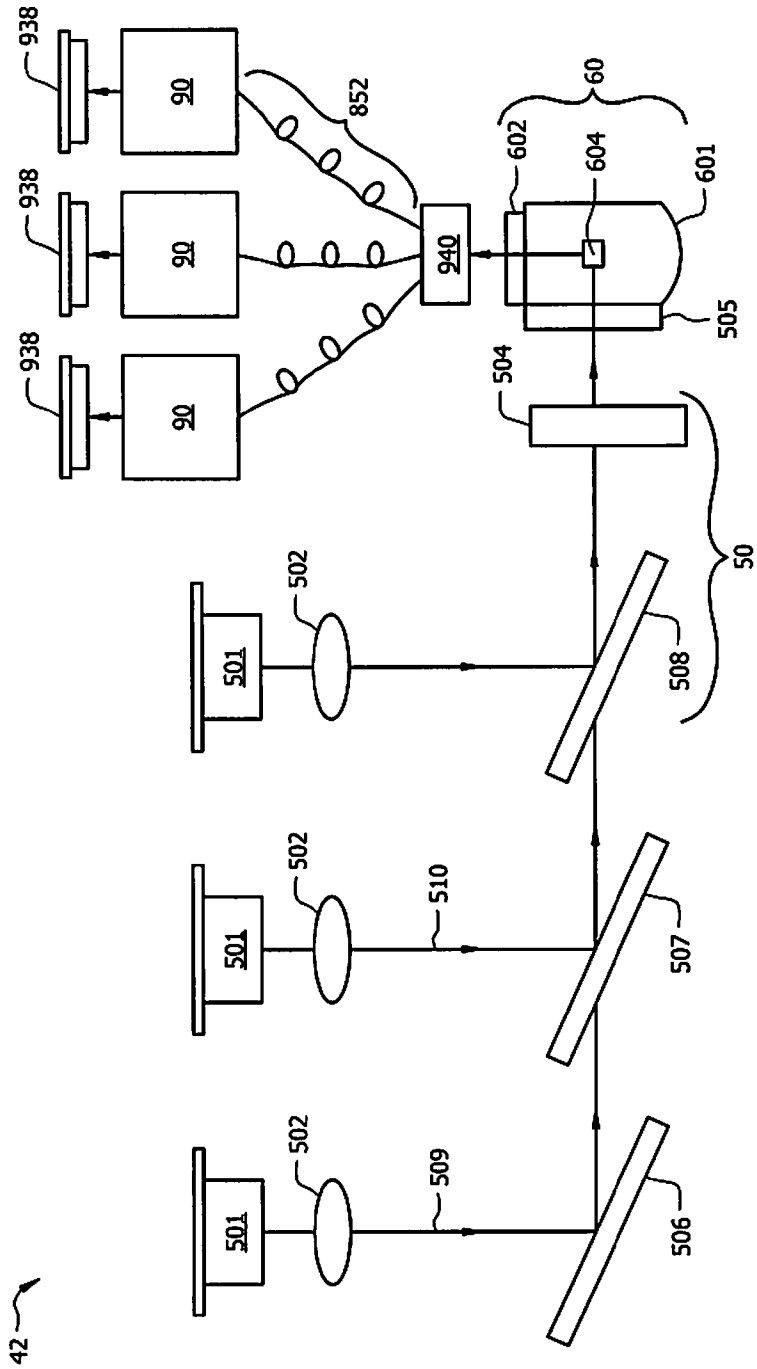

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FIG. 32

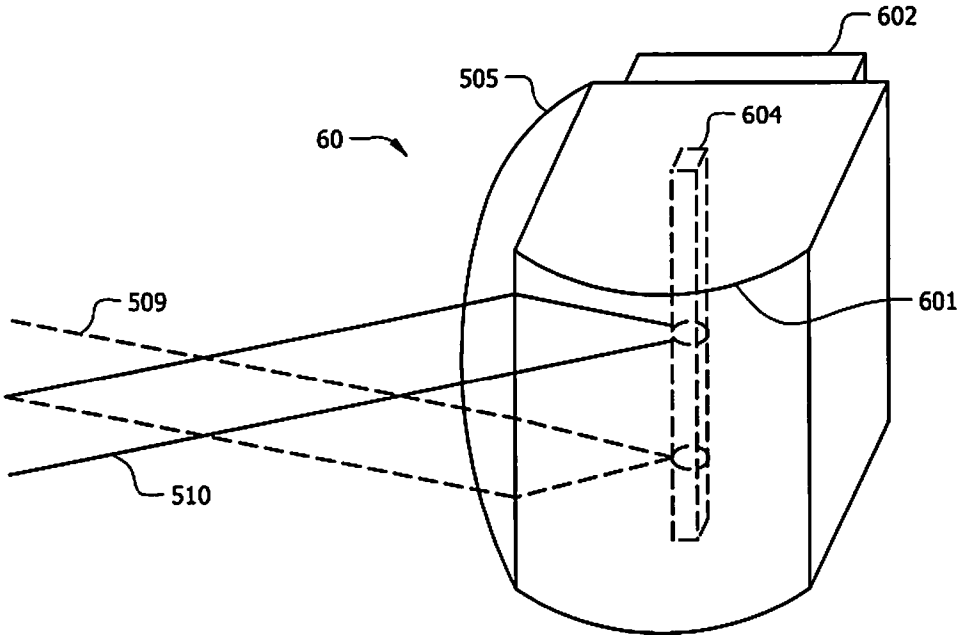


FIG. 33

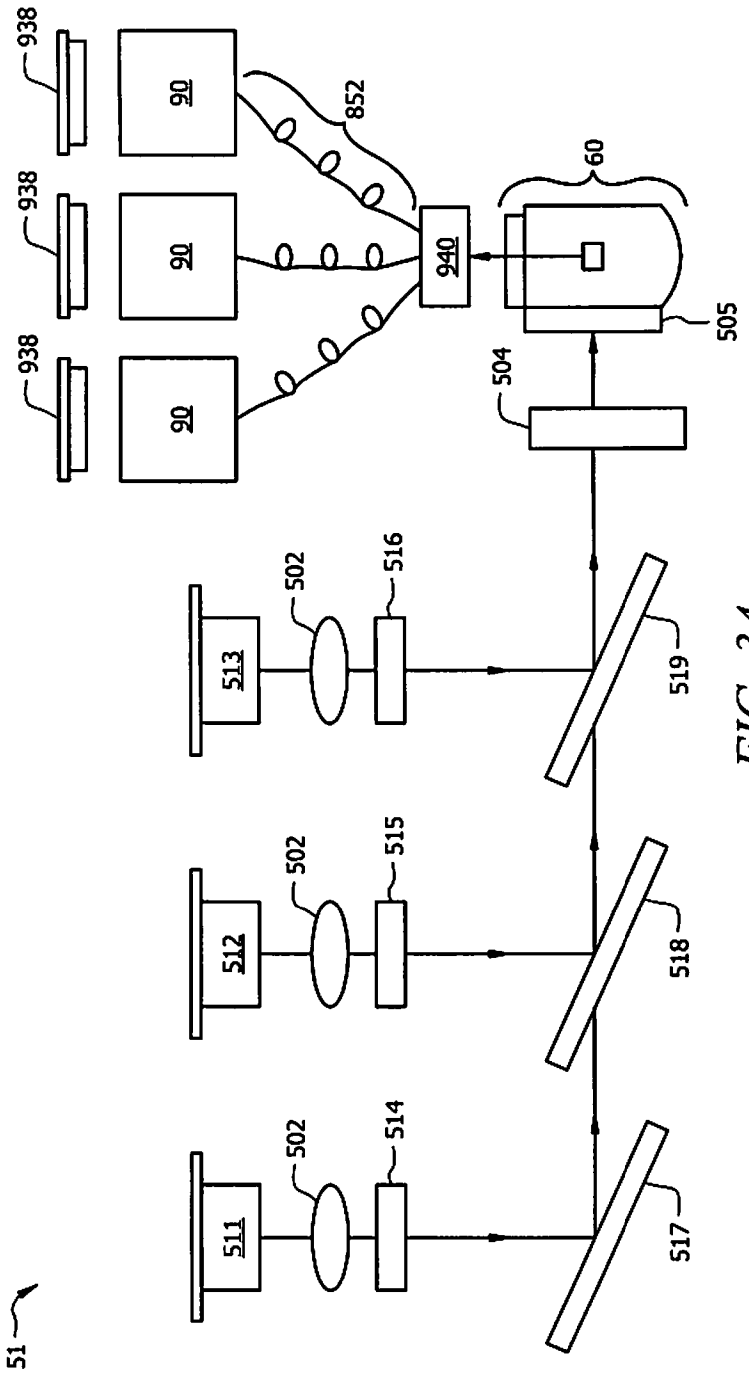

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FIG. 34

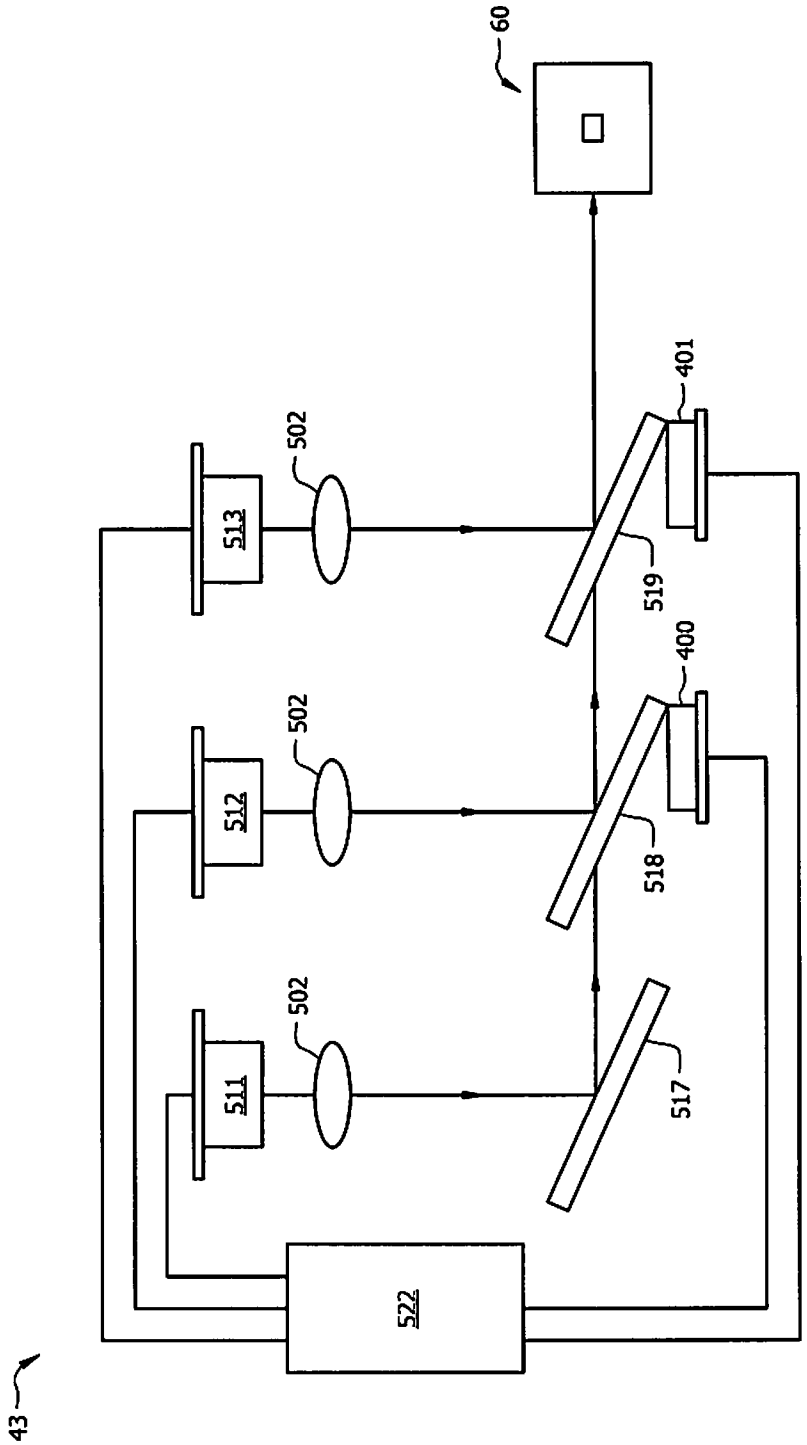


FIG. 35

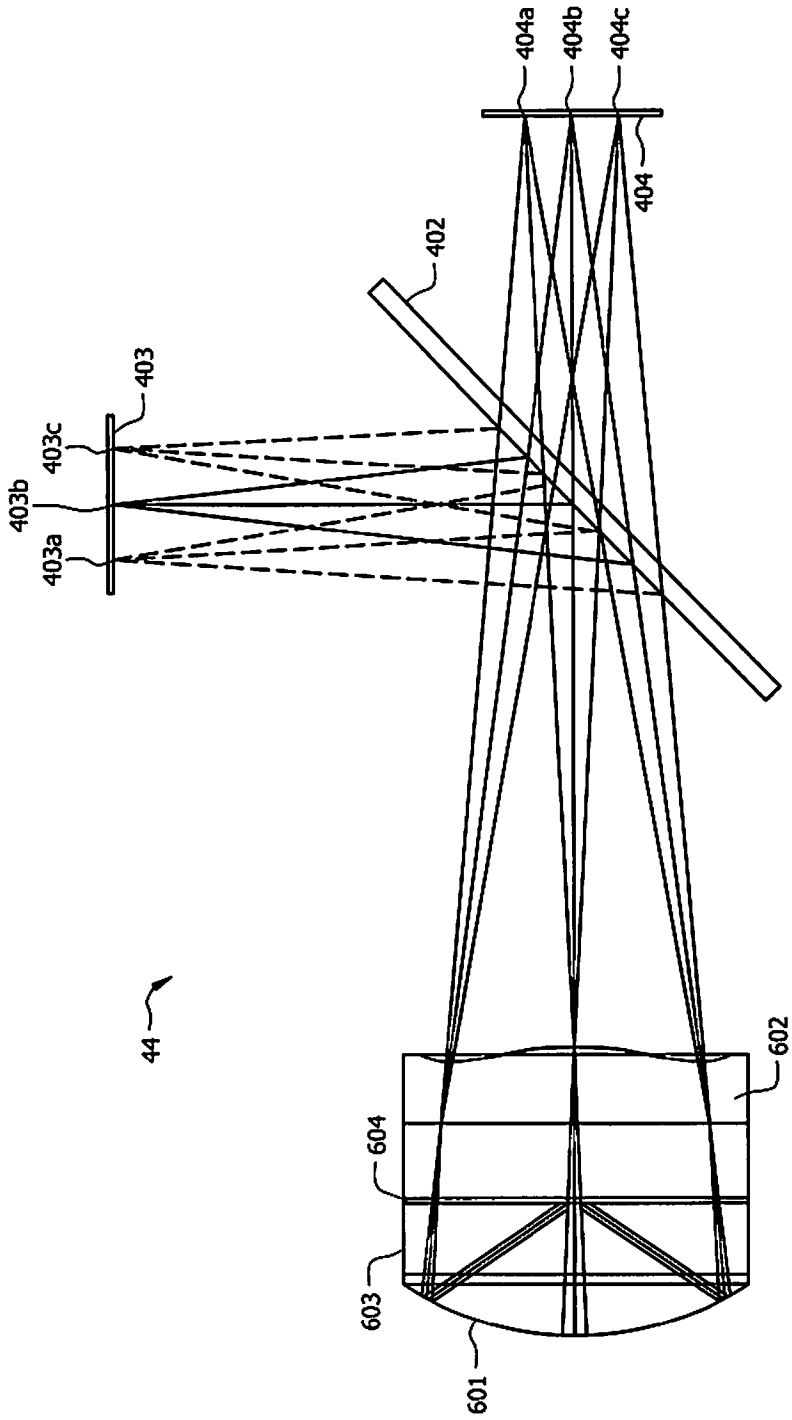


FIG. 36

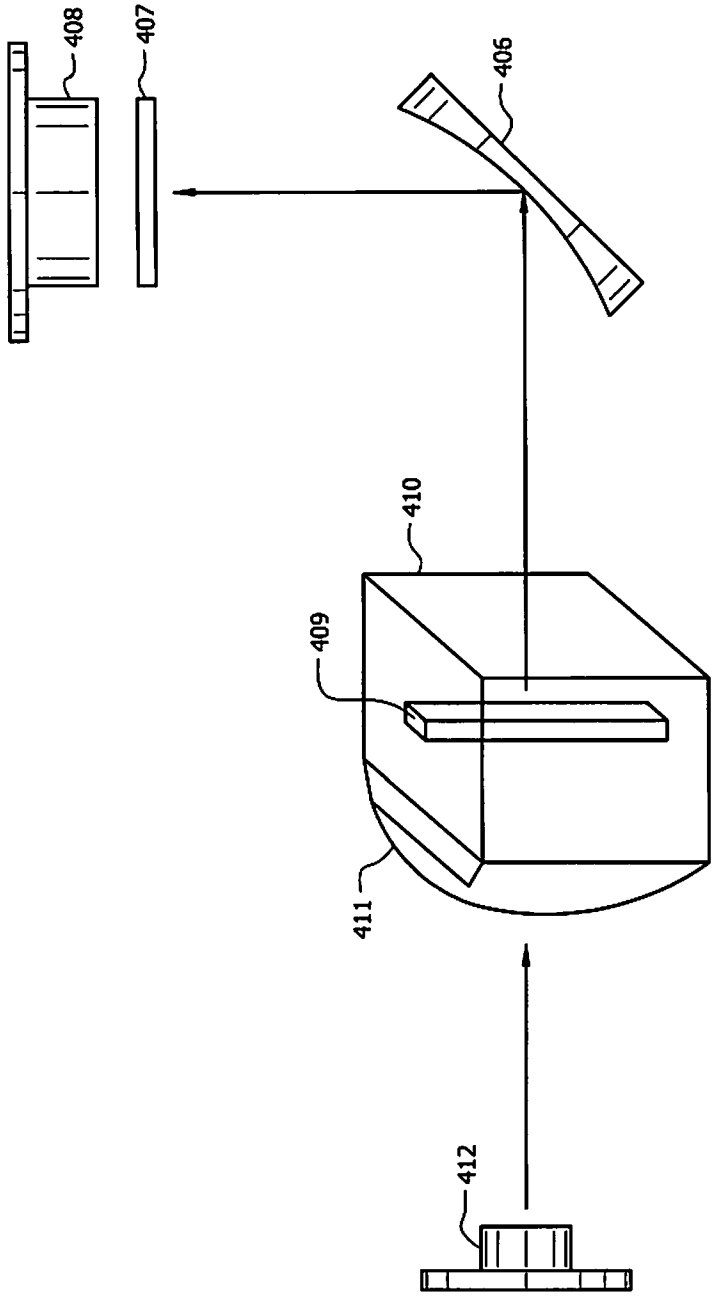


FIG. 37

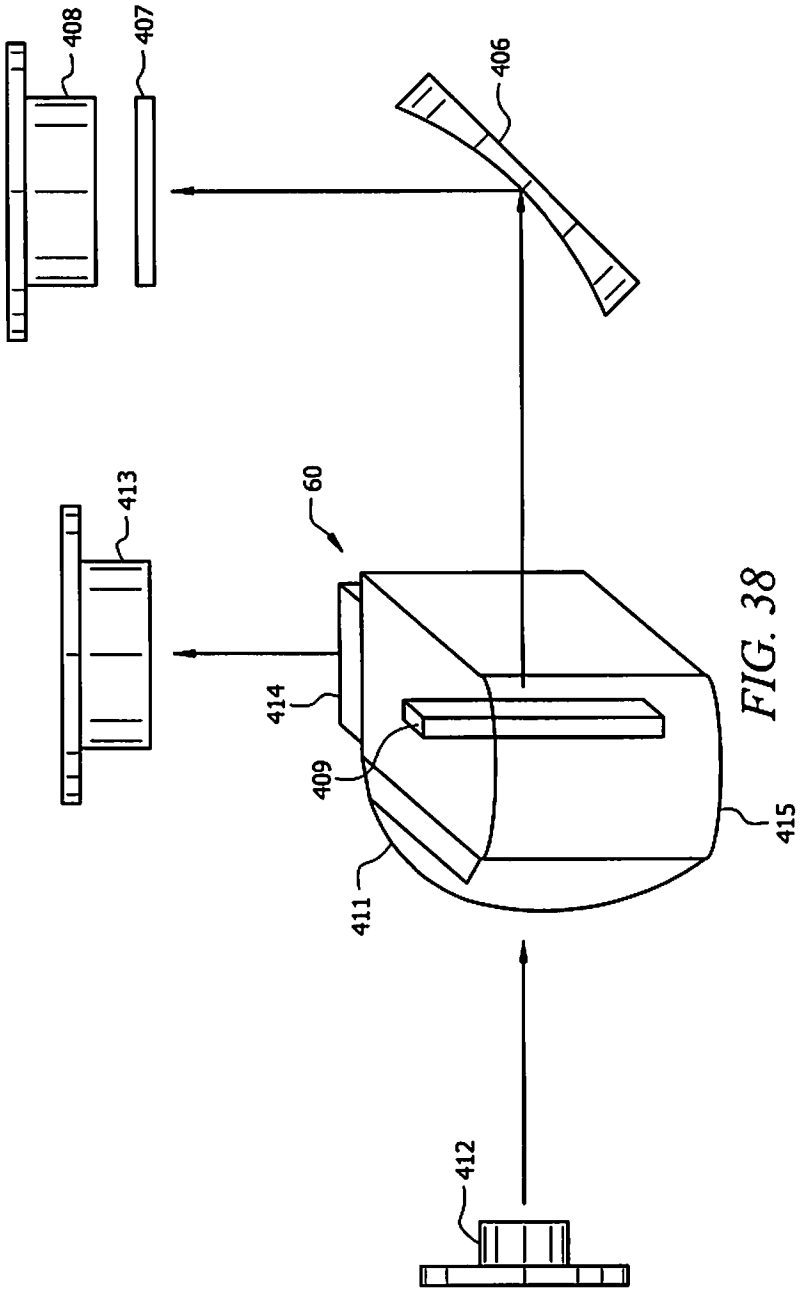


FIG. 38

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 17/645,727

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	700
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*				x 480 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1820

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
17/645,727	12/22/2021	1797	1820	BECC.P0002US.CIP.D2C1	20	3

CONFIRMATION NO. 1145

FILING RECEIPT

32425
NORTON ROSE FULBRIGHT US LLP
98 SAN JACINTO BOULEVARD
SUITE 1100
AUSTIN, TX 78701-4255

OC000000130902268

Date Mailed: 01/06/2022

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Yong Qin Chen, San Jose, CA;

Applicant(s)

IRIS INTERNATIONAL, INC., Chatsworth, CA;

Assignment For Published Patent Application

IRIS INTERNATIONAL, INC., Chatsworth, CA

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 15/638,477 06/30/2017
which is a DIV of 14/555,102 11/26/2014 PAT 9746412
which claims benefit of 61/911,859 12/04/2013
and is a CIP of PCT/US2013/043453 05/30/2013
which claims benefit of 61/653,245 05/30/2012
and claims benefit of 61/653,328 05/30/2012
and claims benefit of 61/715,819 10/18/2012
and claims benefit of 61/715,836 10/19/2012
and claims benefit of 61/816,819 04/29/2013

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 01/05/2022

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/645,727**

Projected Publication Date: 04/14/2022

Non-Publication Request: No

Early Publication Request: No

Title

FLOW CYTOMETER

Preliminary Class

436

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT	Applicant: IRIS INTERNATIONAL, INC.	
(Use several sheets if necessary)	Filing Date: December 22, 2021	Group: 3746

U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1-9	*See Page 9-12*	*See Page 12-13*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A1	2385495	9/25/45	Brian
	A2	2669709	2/16/54	Glancy et al.
	A3	2764147	9/25/56	Brunner
	A4	315667	4/14/85	Serdinko
	A5	3199341	08/10/65	Heuer Jr. et al.
	A6	3411293	11/19/68	Akins
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	A8	3661460	5/9/72	Elking et al.
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	A19	4482994	11/13/84	Ishikawa
	A20	4515274	5/7/85	Hollinger et al.
	A21	4564342	1/14/86	Weber et al.
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Exam. Init.	Ref. Des.	Document Number	Date	Name
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	A24	4673289	06/16/87	Gaucher
	A25	4727020	2/23/88	Recktenwald
	A26	4745285	5/17/88	Recktenwald et al.
	A27	4778253	10/18/88	Siga et al.
	A28	4834630	5/30/89	Godwin
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	A31	4950136	8/21/90	Haas et al.
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	A50	5548395	8/20/96	Kosaka
	A51	5583683	12/10/96	Scobey
	A52	5615200	3/25/97	Hoshino et al.
	A53	5746585	5/5/98	McDunn et al.
	A54	5748372	5/5/98	Kitagawa
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	A63	6008920	12/28/99	Hendrix
	A64	6017194	1/25/00	North Jr.
	A65	6102678	8/15/00	Peclat
	A66	6135734	10/24/00	Isozumi et al.

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	A70	6315952	11/13/01	Sklar et al.
	A71	6510007	1/21/03	Blasenheim
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	A77	6647175	11/11/03	LoRegio et al.
	A78	6683314	1/27/04	Oostman Jr. et al.
	A79	6713019	3/30/04	Ozasa et al.
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	A87	6870679	3/22/05	Randall et al.
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U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A89	6897954	5/24/05	Bishop et al.
	A90	6941047	9/6/05	Capewell et al.
	A91	6954722	10/11/05	Parks et al.
	A92	6975400	12/13/05	Ortyn et al.
	A93	7038778	5/2/06	Yamauchi
	A94	7072540	7/4/06	Szapiel et al.
	A95	7110192	9/19/06	Sauter et al.
	A96	7113266	9/26/06	Wells
	A97	7127356	10/24/06	Nicoli et al.
	A98	7129505	10/31/06	Oostman Jr. et al.
	A99	7212343	5/1/07	He et al.
	A100	7260328	8/21/07	Kropp
	A101	7262838	8/28/07	Fritz
	A102	7268953	9/11/07	Matthae et al.
	A103	7305018	12/4/07	Otoma
	A104	7381565	6/3/08	Kurabayashi et al.
	A105	7385682	6/10/08	Chu et al.
	A106	7430048	9/30/08	Reel et al.
	A107	7450229	11/11/08	Ortyn et al.
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	A109	7456960	11/25/08	Cerni et al.
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U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A111	7505131	3/17/09	Roth
	A112	7507588	3/24/09	Mehrpouyan et al.
	A113	7561267	7/14/09	Luo et al.
	A114	7580120	8/25/09	Hamada et al.
	A115	7623243	11/24/09	Kato
	A116	7630147	12/08/09	Kar et al.
	A117	7645127	1/12/10	Hagen et al.
	A118	7668422	2/23/10	Kropp
	A119	7758324	6/20/10	Baumann et al.
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	A121	7781227	8/24/10	Mehrpouyan et al.
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	A123	7835000	11/16/10	Graves et al.
	A124	7876436	1/25/11	Chu
	A125	7889263	02/15/11	Ortyn et al.
	A126	7894047	2/22/11	Hamada et al.
	A127	7952981	3/31/11	Suzuki
	A128	7981661	7/19/11	Rich
	A129	8009189	8/30/11	Ortyn et al.
	A130	8049185	11/1/11	Hayashi et al.
	A131	8149525	4/3/12	Do
	A132	8157547	4/17/12	Vrielink

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U.S. Patent Documents	Foreign Patent Documents	Other Art
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U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
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	A134	8213472	7/3/12	Hirai et al.
	A135	8229707	7/24/12	Olson et al.
	A136	8233146	7/31/12	Chen
	A137	8253938	8/28/12	Vacca et al.
	A138	8270098	9/18/12	Fukuta et al.
	A139	8284402	10/9/12	Frazier et al.
	A140	8337096	12/25/12	Shen et al.
	A141	8345237	1/1/13	Tsukii et al.
	A142	8405048	3/26/13	Hayashi
	A143	8432541	4/30/13	Rich
	A144	8436371	5/7/13	Medendorp Jr., et al.
	A145	8436993	5/7/13	Kaduchak et al.
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	A150	20020141902	10/3/02	Ozasa et al.
	A151	20030142720	7/31/03	Bradburn et al.
	A152	20040031521	02/19/04	Vrane et al.
	A153	20040218184	11/4/04	Joregenson et al.
	A154	2004165828	08/26/04	Capewell et al.

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EXAMINER:	DATE CONSIDERED:

EXAMINER: INITIAL IF REFERENCE CONSIDERED, WHETHER OR NOT CITATION IS IN CONFORMANCE WITH MPEP609; DRAW LINE THROUGH CITATION IF NOT IN CONFORMANCE AND NOT CONSIDERED. INCLUDE COPY OF THIS FORM WITH NEXT COMMUNICATION TO APPLICANT.

Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's	**Applicant:** IRIS INTERNATIONAL, INC.	
INFORMATION DISCLOSURE STATEMENT		
(Use several sheets if necessary)	**Filing Date:** December 22, 2021	**Group:** 3746

U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1-9	*See Page 9-12*	*See Page 12-13*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A155	20050084402	4/21/05	Vanek
	A156	20050134836	06/23/05	Paldus et al.
	A157	20060221325	10/5/06	Wells
	A158	20060245964	11/2/06	Koslov
	A159	20060256333	11/16/06	Bloom et al.
	A160	20060256335	11/16/06	Chen
	A161	20060292021	12/28/06	Tu
	A162	20070124947	6/7/07	Munroe et al.
	A163	20070212784	09/13/07	Okun
	A164	20070296744	12/27/07	Kubota et al.
	A165	20080024758	1/31/08	Tabata
	A166	20080241911	10/2/08	Ueno et al.
	A167	20090091746	4/9/09	Fukuda et al.
	A168	20090131859	05/21/09	DelCastillo et al.
	A169	20090174881	07/09/09	Rich
	A170	20090190128	7/30/09	Cerni et al.
	A171	20090310122	12/17/09	Hamada et al.
	A172	20100165341	07/01/10	Babico et al.
	A173	20100188559	07/29/10	Ortyn et al.
	A174	20110014075	1/20/11	Reif et al.
	A175	20110032522	2/10/11	Graves et al.
	A176	20120156074	6/21/12	Kusch et al.

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See Page 1-9	*See Page 9-12*	*See Page 12-13*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A177	20120211679	08/23/12	Heng et al.
	A178	20120274925	11/1/12	Chen et al.
	A179	20120281204	11/8/12	Hoshishima et al.
	A180	20120282126	11/8/12	Brandt et al.
	A181	20120287419	11/15/12	Sharpe et al.
	A182	20130010181	1/10/13	Baba
	A183	20130020498	1/24/13	Ebi et al.
	A184	20130050782	2/28/13	Heng et al.
	A185	20130070243	3/21/13	Goehde
	A186	20130094102	4/18/13	Baba
	A187	20130204538	8/8/13	Rich
	A188	20130214176	08/22/13	Graves et al.

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language
	B1	CN 102087198	6/8/11	China	Chinese (English abstract)
	B2	CN 102087198	06/08/11	China	Chinese (English Abstract)
	B3	CN 102282453	12/14/11	China	Chinese (English Abstract)
	B4	CN 102449525	05/09/12	China	Chinese (English Abstract)
	B5	CN 102818794	12/12/12	China	Chinese (English abstract)
	B6	CN 102818794	12/12/12	China	Chinese (English Abstract)

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List of Patents and Publications for Applicant's	**Applicant:** IRIS INTERNATIONAL, INC.	
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U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1-9	*See Page 9-12*	*See Page 12-13*

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language
	B7	CN 102818795	12/12/12	China	Chinese (English abstract)
	B8	CN 102818795	12/12/12	China	Chinese (English Abstract)
	B9	CN 102818796	12/12/12	China	Chinese (English abstract)
	B10	CN 102818796	12/12/12	China	Chinese (English Abstract)
	B11	CN 1199177	11/18/98	China	Chinese (English Abstract)
	B12	CN 201917509U	8/3/11	China	Chinese (English abstract)
	B13	CN 201936066U	8/17/11	China	Chinese (English abstract)
	B14	CN 201984209U	9/21/11	China	Chinese (English abstract)
	B15	EP 0889319	1/7/99	EPO	German (English abstract)
	B16	EP 1004907	4/22/09	EPO	English
	B17	EP 1953526	8/6/08	EPO	English
	B18	EP 2381475	3/4/15	EPO	English
	B19	EP 459764A2	12/4/91	EPO	English
	B20	EP 459764B1	12/11/96	EPO	English
	B21	EP 757346A1	2/5/97	EPO	English
	B22	EP 757346B1	11/14/01	EPO	English
	B23	EP 758755A2	2/19/97	EPO	English
	B24	JP 05333245	12/17/93	Japan	Japanese (English abstract)
	B25	JP 2003-505707	02/12/03	Japan	Japanese (English Abstract)
	B26	JP 2004-341204	12/02/04	Japan	Japanese (English Abstract)
	B27	JP 2004-500572	01/08/04	Japan	Japanese (English Abstract)
	B28	JP 2008-534960	08/28/08	Japan	Japanese (English Abstract)

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U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1-9	*See Page 9-12*	*See Page 12-13*

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language
	B29	JP 2010-085194	04/15/10	Japan	Japanese (English Abstract)
	B30	JP 2012-026837	02/09/12	Japan	Japanese (English Abstract)
	B31	JP 829726	2/2/96	Japan	Japanese (English translation)
	B32	JP H03-197641	08/29/91	Japan	Japanese (English Abstract)
	B33	JP H04-184241	07/01/92	Japan	Japanese (English Abstract)
	B34	JP H05-119035	05/14/93	Japan	Japanese (English Abstract)
	B35	JP H09-502794	03/18/97	Japan	Japanese (English Abstract)
	B36	JP HI0-73528	03/17/98	Japan	Japanese (English Abstract)
	B37	JP S55-144226	11/11/80	Japan	Japanese (English Abstract)
	B38	JP S61-184427	08/18/86	Japan	Japanese (English Abstract)
	B39	WO 0057173	9/28/00	WIPO	English
	B40	WO 0127590	4/19/01	WIPO	English
	B41	WO 0140764	6/7/01	WIPO	English
	B42	WO 03012403	2/13/03	WIPO	French (English abstract)
	B43	WO 2005033654	4/14/05	WIPO	English
	B44	WO 2006013316	2/9/06	WIPO	English
	B45	WO 2009095358	8/6/09	WIPO	German (English abstract)
	B46	WO 2009098867	8/13/09	WIPO	Japanese (English abstract)
	B47	WO 2011026942	3/10/11	WIPO	English
	B48	WO 2012056217	5/3/12	WIPO	English
	B49	WO 2012177367	12/27/12	WIPO	English

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Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT	Applicant: IRIS INTERNATIONAL, INC.	
(Use several sheets if necessary)	Filing Date: December 22, 2021	Group: 3746

U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1-9	*See Page 9-12*	*See Page 12-13*

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language
	B50	WO 2013/181453	12/05/13	WIPO	English
	B51	WO 2013013229	1/24/13	WIPO	English
	B52	WO 2013093035	6/27/13	WIPO	English
	B53	WO 9307471	4/15/93	WIPO	English
	B54	WO 9316368	8/16/93	WIPO	English
	B55	WO 9429695	12/22/94	WIPO	English
	B56	WO 9714066A2	4/17/97	WIPO	English

Other Art (Including Author, Title, Date Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C1	Brogioli et al., "Heterodyne near-field scattering," *Applied Physics Letters* 81(22):4109-4111, 2002.
	C2	Extended European Search Report for EP 13796734.5, mailed March 18, 2016
	C3	Goda et al., "Serial time-encoded amplified imaging for observation of fast dynamic phenomena," *Nature* 458:1145-1149. 2009
	C4	International Search Report and Written Opinion for PCT/US2013/043453 mailed December 20, 2013.
	C5	International Search Report and Written Opinion for PCT/US2014/067682 mailed April 9, 2015.
	C6	Office Action issued in Chinese Patent Application No. 201380039184.6, dated February 12, 2018 (Attorney Docket No. BECC.P0002CN)

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List of Patents and Publications for Applicant's	**Applicant:** IRIS INTERNATIONAL, INC.	
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U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1-9	*See Page 9-12*	*See Page 12-13*

Other Art (Including Author, Title, Date Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C7	Office Action issued in Corresponding Chinese Application No. 201611102428.2, dated May 18, 2020 (English Translation provided) (Attorney Docket No. BECC.P0002CN.D1).
	C8	Office Action issued in Corresponding Chinese Patent Application No. 201480074396, dated June 10, 2019 (English Translation) (Attorney Docket No. BECC.P0003CN)
	C9	Office Action issued in corresponding Chinses application no. 201611102428.2, dated September 30, 2019 (Attorney Docket no. BECC.P0002CN.D1).
	C10	Office Action issued in Japanese Patent Application No. 2015-515208, issued May 29, 2017 (English Translation Provided) (Attorney Docket No. BECC.P0002JP)
	C11	Office Action issued in Japanese Patent Application No. 2015-515208, dated May 02, 2018 (Attorney Docket No. BECC.P0002JP)
	C12	Office Action issued in Japanese Patent Application No. 2016-216891, dated December 04, 2017 (English Translation) (Attorney Docket No. BECC.P0002JP.D1)
	C13	Schmidt, B., "Ein lichtstarkes komafreies Spiegelsystem," *Mitteilungen der Haburger Sternwarte in Bergedorf* 7(36):15-17, 1932.
	C14	Smiley, C. H., "The Schmidt Camera," *Popular Astronomy* 44:415-421, 1936.

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Electronic Acknowledgement Receipt

EFS ID:	45187156
Application Number:	17645727
International Application Number:	
Confirmation Number:	1145
Title of Invention:	FLOW CYTOMETER
First Named Inventor/Applicant Name:	Yong Qin Chen
Customer Number:	32425
Filer:	Mark G Tison/Ashley Overton
Filer Authorized By:	Mark G Tison
Attorney Docket Number:	BECC.P0002US.CIP.D2C1
Receipt Date:	09-MAR-2022
Filing Date:	22-DEC-2021
Time Stamp:	16:10:02
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		BECCP0002USCIPD2C1_IDS.pdf	126230 afb9d4fd4521cb0d41e24f6eefebc26916984fa8	yes	16

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Transmittal Letter	1	3
	Information Disclosure Statement (IDS) Form (SB08)	4	16
Warnings:			
Information:			
	Total Files Size (in bytes):	126230	

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor: Yong Qin Chen	Group Art Unit: 3746
Serial No.: 17/645,727	Examiner: Not yet assigned
Filed: December 22, 2021	Atty. Dkt. No.: BECC.P0002US.CIP.D2C1
For: FLOW CYTOMETER	Confirmation No.: 1145

CERTIFICATE OF ELECTRONIC TRANSMISSION (37 C.F.R. § 1.8)
I, Ashley Overton, hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office via EFS-Web on March 9, 2022. Signed: /Ashley Overton/

INFORMATION DISCLOSURE STATEMENT

In compliance with the duty of disclosure under 37 C.F.R. § 1.56, it is respectfully requested that this Information Disclosure Statement be entered and the documents listed on attached Form PTO-1449 be considered by the Examiner and made of record.

In accordance with 37 C.F.R §§ 1.97(g), (h), this Information Disclosure Statement is not to be construed as a representation that a search has been made, and is not to be construed to be an admission that the information cited is, or is considered to be, material to patentability as defined in 37 C.F.R. § 1.56(b).

Timing and Fees

☒ Under 37 C.F.R. § 1.97(b), **no fee or statement is required** for filing this Information Disclosure Statement because it is filed:

- ☒ within three months of the filing date of a national application other than a CPA under § 1.53(d); **OR**
- ☐ within three months of the actual filing date of the national phase of a PCT application; **OR**
- ☐ before the mailing of a first substantive office action (including after filing of an RCE).

☐ Under 37 C.F.R. § 1.97(c), this Information Disclosure Statement is filed after the periods specified in 37 C.F.R. § 1.97(b), but **before** the mailing date of:

- ☐ a final rejection under 37 C.F.R. § 1.113; **OR**
- ☐ termination of prosecution, e.g. Ex Parte Quayle, M.P.E.P. § 609(B)(2); **OR**
- ☐ a notice of allowance under 37 C.F.R. § 1.311;

AND is accompanied by:

☐ the statement as specified in 37 C.F.R. § 1.97(e) set out below; **OR**

☐ payment covering the fee of $_____ under 37 C.F.R. § 1.17(p).

☐ Under 37 C.F.R. § 1.97(d), this Information Disclosure Statement is filed **after** the mailing date of the following actions which have not been withdrawn:

☐ a final action under 37 C.F.R. § 1.113; **OR**

☐ termination of prosecution; e.g. Ex Parte Quayle, M.P.E.P. § 609(B)(2); **OR**

☐ a notice of allowance under 37 C.F.R. § 1.311 and is filed on or before payment of the issue fee;

AND is accompanied by:

the statement as specified in 37 C.F.R. § 1.97(e) as set forth below, **AND** payment covering the fee of $_____ under 37 C.F.R. § 1.17(p).

Statements Under 37 C.F.R. § 1.97(e) (if applicable)

☐ Each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the present Information Disclosure Statement; **OR**

☐ No item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application, and to the knowledge of the undersigned attorney after making reasonable inquiry, no item of information contained in this Information Disclosure Statement was known to any individual designated in 37 C.F.R. § 1.56(c) more than three months prior to the filing date of the Information Disclosure Statement.

Statement Under 37 C.F.R. § 1.704(d) (if applicable)

☐ Each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application and that this communication was not received by any individual designated in 37 C.F.R. § 1.56(c) more than thirty days prior to the filing of this Information Disclosure Statement.

Copies of Cited Materials (if applicable)

☒ Copies of materials listed but not attached were cited in benefit (35 U.S.C. § 120) ancestor application Serial No. 15/638,477 and Serial No. 14/555,102 on Form 892 by the Examiner and/or Form 1449 by the applicant; see 37 C.F.R. § 1.98(d).

☐ This application may be related by inventorship and/or subject matter to co-pending U.S. application Serial No. _____, filed _____.

Payment of Fees Due (if applicable)

☐ Payment is made by credit card via EFS-Web for $_____ covering the fee identified above.

☐ Please charge Deposit Account No. 50-1212/_____ $_____ for the fee identified above.

☒ The Commissioner is hereby authorized to charge or credit any overpayment to Deposit Account 50-1212/BECC.P0002US.CIP.D2C.

Respectfully submitted,

/Mark G. Tison/

Mark G. Tison
Reg. No. 65,985
Attorney for Applicant

NORTON ROSE FULBRIGHT US LLP
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701
(512) 474-5201

Date: March 9, 2022

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 11/30/2014. OMB 0651-0051
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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date
14/555,102	November 26, 2014

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 129381

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number: 129381

OR

Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

IRIS INTERNATIONAL, INC.

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature		Date (Optional)	
Name	Daniel B. Kim		
Title	Assistant Secretary, Iris International, Inc.		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**03/22/2022 01:43:12 PM ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Richard Ortiz
PATENT CENTER #	60583779	FILING DATE	12/22/2021
CUSTOMER #	32425	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Mark Tison

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
BECCP0002USCIPD2C1_POA.pdf	1	Power of Attorney	113 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
BECCP0002USCIPD2C1_POA.pdf	D6A38323D4712CE707AF3FBFE7C1E8B27FBB732E99DD82FA5A53C9671D5DB75895E7B0413C3DB3976AFED44ED1FD1065F85B9B3CCDE1806AD19E343B95F77DF3

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized

by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1

CONFIRMATION NO. 1145

129381
NORTON ROSE FULBRIGHT US LLP - BCI
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

POA ACCEPTANCE LETTER

OC000000132656952

Date Mailed: 03/24/2022

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 03/22/2022.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/dtdinh/

Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT	Applicant: IRIS INTERNATIONAL, INC.	
(Use several sheets if necessary)	Filing Date: December 22, 2021	Group: 3746

U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1	*See Page 1*	*See Page 1*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A189	2003/0044967	03/06/2003	Heffelfinger et al.
	A190	2011/0089328	04/21/2011	Li

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language
	B57	JP 2005-315799	11/10/2005	Japan	Japanese (with Corresponding US 2007/0195310)
	B58	JP S57-116215	07/19/1982	Japan	Japanese (with Machine Translation)

Other Art (Including Author, Title, Date Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C15	English translation of Office Action issued in corresponding Japanese Patent Application No. 2020-206548 on dated November 29, 2021. (Attorney Docket No. BECC.P0002JP.D3)

105301082.1

EXAMINER:	DATE CONSIDERED:

EXAMINER: INITIAL IF REFERENCE CONSIDERED, WHETHER OR NOT CITATION IS IN CONFORMANCE WITH MPEP609; DRAW LINE THROUGH CITATION IF NOT IN CONFORMANCE AND NOT CONSIDERED. INCLUDE COPY OF THIS FORM WITH NEXT COMMUNICATION TO APPLICANT.

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**03/25/2022 02:35:31 PM ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Richard Ortiz
PATENT CENTER #	60590629	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Mark Tison

Documents

TOTAL DOCUMENTS: 2

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
BECCP0002USCIPD2C1_SIDS.pdf		4	-	228 KB
BECCP0002USCIPD2C1_SIDS-TRAN.LET.pdf	(1-3)	3	Transmittal Letter	162 KB
BECCP0002USCIPD2C1_SIDS-IDS.pdf	(4-4)	1	Information Disclosure Statement (IDS) Form (SB08)	197 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)

BECCP0002USCIPD2C1_SIDS.pdf	27C401566FD4908D672DB388700288322E25DE71D57530DE00D8A1B3FF5E3B4A37698A10D8CA8AA564D7A0F074D9225289D1124E0E6473B31715773FFD28AFF3
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BECCP0002USCIPD2C1_SIDS-IDS.pdf	35F6A138505E7AD97A8A4CAB268836D844B0E5DEBD9C4DE18665D53C2B90C1405C7D58CCC69D6ED253AEFA3CAB410D92C5C8CFF7F19CF058D256DD2568D6CC88

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor: Yong Qin Chen	Group Art Unit: 3746
Serial No.: 17/645,727	Examiner: Not Yet Assigned
Filed: December 22, 2021	Atty. Dkt. No.: BECC.P0002US.CIP.D2C1
For: FLOW CYTOMETER	Confirmation No.: 1145

CERTIFICATE OF ELECTRONIC TRANSMISSION (37 C.F.R. § 1.8)
I, Richard Ortiz, hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office via EFS-Web on March 25, 2022. Signed: /Richard Ortiz/

INFORMATION DISCLOSURE STATEMENT

In compliance with the duty of disclosure under 37 C.F.R. § 1.56, it is respectfully requested that this Information Disclosure Statement be entered and the documents listed on attached Form PTO-1449 be considered by the Examiner and made of record.

In accordance with 37 C.F.R §§ 1.97(g), (h), this Information Disclosure Statement is not to be construed as a representation that a search has been made, and is not to be construed to be an admission that the information cited is, or is considered to be, material to patentability as defined in 37 C.F.R. § 1.56(b).

Timing and Fees

☒ Under 37 C.F.R. § 1.97(b), **no fee or statement is required** for filing this Information Disclosure Statement because it is filed:

- ☐ within three months of the filing date of a national application other than a CPA under § 1.53(d); **OR**
- ☐ within three months of the actual filing date of the national phase of a PCT application; **OR**
- ☒ before the mailing of a first substantive office action (including after filing of an RCE).

☐ Under 37 C.F.R. § 1.97(c), this Information Disclosure Statement is filed after the periods specified in 37 C.F.R. § 1.97(b), but **before** the mailing date of:

- ☐ a final rejection under 37 C.F.R. § 1.113; **OR**
- ☐ termination of prosecution, e.g. Ex Parte Quayle, M.P.E.P. § 609(B)(2); **OR**
- ☐ a notice of allowance under 37 C.F.R. § 1.311;

AND is accompanied by:

☐ the statement as specified in 37 C.F.R. § 1.97(e) set out below; **OR**

☐ payment covering the fee of $_____ under 37 C.F.R. § 1.17(p).

☐ Under 37 C.F.R. § 1.97(d), this Information Disclosure Statement is filed **after** the mailing date of the following actions which have not been withdrawn:

☐ a final action under 37 C.F.R. § 1.113; **OR**

☐ termination of prosecution; e.g. Ex Parte Quayle, M.P.E.P. § 609(B)(2); **OR**

☐ a notice of allowance under 37 C.F.R. § 1.311 and is filed on or before payment of the issue fee;

AND is accompanied by:

the statement as specified in 37 C.F.R. § 1.97(e) as set forth below, **AND** payment covering the fee of $_____ under 37 C.F.R. § 1.17(p).

Statements Under 37 C.F.R. § 1.97(e) (if applicable)

☐ Each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the present Information Disclosure Statement; **OR**

☐ No item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application, and to the knowledge of the undersigned attorney after making reasonable inquiry, no item of information contained in this Information Disclosure Statement was known to any individual designated in 37 C.F.R. § 1.56(c) more than three months prior to the filing date of the Information Disclosure Statement.

Statement Under 37 C.F.R. § 1.704(d) (if applicable)

☐ Each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application and that this communication was not received by any individual designated in 37 C.F.R. § 1.56(c) more than thirty days prior to the filing of this Information Disclosure Statement.

Copies of Cited Materials (if applicable)

☒ Copies of materials listed but not attached were cited in benefit (35 U.S.C. § 120) ancestor application Serial No. 15/638,477 on Form 892 by the Examiner and/or Form 1449 by the applicant; see 37 C.F.R. § 1.98(d).

☐ This application may be related by inventorship and/or subject matter to co-pending U.S. application Serial No. _____, filed _____.

Payment of Fees Due (if applicable)

☐ Payment is made by credit card via EFS-Web for $_____ covering the fee identified above.

☐ Please charge Deposit Account No. 50-1212/_____ $_____ for the fee identified above.

☒ The Commissioner is hereby authorized to charge or credit any overpayment to Deposit Account 50-1212/BECC.P0002US.CIP.D2C1.

Respectfully submitted,

/Mark G. Tison/

Mark G. Tison
Reg. No. 65,985
Attorney for Applicant

NORTON ROSE FULBRIGHT US LLP
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701
(512) 474-5201

Date: March 25, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1

CONFIRMATION NO. 1145

129381
NORTON ROSE FULBRIGHT US LLP - BCI
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

PUBLICATION NOTICE

OC00000133172637

Title:FLOW CYTOMETER

Publication No.US-2022-0113241-A1
Publication Date:04/14/2022

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT (Use several sheets if necessary)	Applicant: IRIS INTERNATIONAL, INC.	
	Filing Date: December 22, 2021	Group: 3746

U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1	*See Page 1*	*See Page 1*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A1	2004/0033010	12/19/2004	McGuire, Jr.
	A2	2005/0002425	01/06/2005	Govorkov et al.
	A3	2005/0274890	12/15/2005	Anderton et al.
	A4	2007/0195310	08/03/2007	Kanda
	A5	2010/0067079	03/18/2010	Rathjen
	A6	2011/0216401	09/08/2011	Curry
	A7	8,928,881	01/06/2015	Swalwell

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language

Other Art (Including Author, Title, Date Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation

135055193.1

EXAMINER:	DATE CONSIDERED:

EXAMINER: INITIAL IF REFERENCE CONSIDERED, WHETHER OR NOT CITATION IS IN CONFORMANCE WITH MPEP609; DRAW LINE THROUGH CITATION IF NOT IN CONFORMANCE AND NOT CONSIDERED. INCLUDE COPY OF THIS FORM WITH NEXT COMMUNICATION TO APPLICANT.

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**03/13/2023 10:03:17 AM ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Richard Ortiz
PATENT CENTER #	61727766	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Mark Tison

Documents

TOTAL DOCUMENTS: 2

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
BECCP0002USCIPD2C1-IDS-1449.pdf		4	-	229 KB
BECCP0002USCIPD2C1-IDS-1449-IDS.R197.REL.pdf	(1-3)	3	Letter specifying the conditions for filing under 37 CFR 1.97	162 KB
BECCP0002USCIPD2C1-IDS-1449-IDS.pdf	(4-4)	1	Information Disclosure Statement (IDS) Form (SB08)	198 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)

BECCP0002USCIPD2C1-IDS-1449.pdf	51F9D66CC7656D8DDD56584A0C84CECF995DCD2EEF063541 23FBB8C7F02E05F037195DCAAEA78B7E2F7692C937C2F0DD A749D512D86FA0C220E317AD44A9737F
BECCP0002USCIPD2C1-IDS-1449-IDS.R197.REL.pdf	B1072A68BE7F5C313F0C5084FB20AD11A0622B32BABDE6B9E 2A93C26065AD3B7ABFDEAB4BFC40B3A767E91B1DC2F1A7EA 1AC27B13CC337DA3825548B9C70E41
BECCP0002USCIPD2C1-IDS-1449-IDS.pdf	1BAA9A506FB69B3C3CC2987E2040730A40F04A1D4D8D087F8 6356F70201AEBD00EE5831EC2F8CA71F1A6AB630260B3A0D0 838100094A2B4ECCF89ADC26DABBB0

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

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New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor: Yong Qin Chen	Group Art Unit: OPAP
Serial No.: 17/645,727	Examiner: Not Yet Assigned
Filed: December 22, 2021	Atty. Dkt. No.: BECC.P0002US.CIP.D2C1
For: FLOW CYTOMETER	Confirmation No.: 1145

CERTIFICATE OF ELECTRONIC TRANSMISSION (37 C.F.R. § 1.8)
I, Richard Ortiz, hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office via EFS-Web on March 13, 2023. Signed: /Richard Ortiz/

INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

In compliance with the duty of disclosure under 37 C.F.R. § 1.56, it is respectfully requested that this Information Disclosure Statement be entered and the documents listed on attached Form PTO-1449 be considered by the Examiner and made of record.

In accordance with 37 C.F.R §§ 1.97(g), (h), this Information Disclosure Statement is not to be construed as a representation that a search has been made, and is not to be construed to be an admission that the information cited is, or is considered to be, material to patentability as defined in 37 C.F.R. § 1.56(b).

Timing and Fees

☒ Under 37 C.F.R. § 1.97(b), **no fee or statement is required** for filing this Information Disclosure Statement because it is filed:

- ☐ within three months of the filing date of a national application other than a CPA under § 1.53(d); **OR**
- ☐ within three months of the actual filing date of the national phase of a PCT application; **OR**
- ☒ before the mailing of a first substantive office action (including after filing of an RCE).

☐ Under 37 C.F.R. § 1.97(c), this Information Disclosure Statement is filed after the periods specified in 37 C.F.R. § 1.97(b), but **before** the mailing date of:

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☐ termination of prosecution, e.g. Ex Parte Quayle, M.P.E.P. § 609(B)(2); **OR**

☐ a notice of allowance under 37 C.F.R. § 1.311;

AND is accompanied by:

☐ the statement as specified in 37 C.F.R. § 1.97(e) set out below; **OR**

☐ payment covering the fee of $_____ under 37 C.F.R. § 1.17(p).

☐ Under 37 C.F.R. § 1.97(d), this Information Disclosure Statement is filed **after** the mailing date of the following actions which have not been withdrawn:

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☐ a notice of allowance under 37 C.F.R. § 1.311 and is filed on or before payment of the issue fee;

AND is accompanied by:

the statement as specified in 37 C.F.R. § 1.97(e) as set forth below, **AND** payment covering the fee of $_____ under 37 C.F.R. § 1.17(p).

Statements Under 37 C.F.R. § 1.97(e) (if applicable)

☐ Each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the present Information Disclosure Statement; **OR**

☐ No item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application, and to the knowledge of the undersigned attorney after making reasonable inquiry, no item of information contained in this Information Disclosure Statement was known to any individual designated in 37 C.F.R. § 1.56(c) more than three months prior to the filing date of the Information Disclosure Statement.

Statement Under 37 C.F.R. § 1.704(d) (if applicable)

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Copies of Cited Materials (if applicable)

☐ Copies of materials listed but not attached were cited in benefit (35 U.S.C. § 120) ancestor application Serial No. 15/638,477 on Form 892 by the Examiner and/or Form 1449 by the applicant; see 37 C.F.R. § 1.98(d).

☐ This application may be related by inventorship and/or subject matter to co-pending U.S. application Serial No. _____, filed _____.

Payment of Fees Due (if applicable)

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☐ Please charge Deposit Account No. 50-1212/_____ $_____ for the fee identified above.

☒ The Commissioner is hereby authorized to charge or credit any overpayment to Deposit Account 50-1212/BECC.P0002US.CIP.D2C1.

Respectfully submitted,

/Mark G. Tison/

Mark G. Tison
Reg. No. 65,985
Attorney for Applicant

NORTON ROSE FULBRIGHT US LLP
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701
(512) 474-5201

Date: March 13, 2023

Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's	**Applicant:** IRIS INTERNATIONAL, INC.	
INFORMATION DISCLOSURE STATEMENT		
(Use several sheets if necessary)	**Filing Date:** December 22, 2021	**Group:** 3746

U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1	*See Page 1*	*See Page 1*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A1	9,746,412	08/29/2017	Chen
	A2	11,255,772	02/02/2022	Chen
	A3	11,333,597	05/17/2022	Yan et al.

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language

Other Art (Including Author, Title, Date Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C1	Office Communication issued in U.S. Patent Application No. 17/980,669, dated March 27, 2023. (Attorney Docket No. BECC.P0002US.CIP.D2C)

135269291.1

EXAMINER:	DATE CONSIDERED:

EXAMINER: INITIAL IF REFERENCE CONSIDERED, WHETHER OR NOT CITATION IS IN CONFORMANCE WITH MPEP609; DRAW LINE THROUGH CITATION IF NOT IN CONFORMANCE AND NOT CONSIDERED. INCLUDE COPY OF THIS FORM WITH NEXT COMMUNICATION TO APPLICANT.

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PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**03/28/2023 02:34:10 PM ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Richard Ortiz
PATENT CENTER #	61825549	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Mark Tison

Documents

TOTAL DOCUMENTS: 3

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
BECCP0002USCIPD2C1_IDS-1449.pdf		4	-	236 KB
BECCP0002USCIPD2C1_IDS-1449-IDS.R197.REL.pdf	(1-3)	3	Letter specifying the conditions for filing under 37 CFR 1.97	162 KB
BECCP0002USCIPD2C1_IDS-1449-IDS.pdf	(4-4)	1	Information Disclosure Statement (IDS) Form (SB08)	188 KB
BECCP0002USCIPD2C1-REFC1-OTH.pdf		11	Other reference-Patent/Application/Search Documents	491 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
BECCP0002USCIPD2C1_IDS-1449.pdf	54FC2952D2641B98813AE2666D4610343FEE5D51F8BA726687E03682A3E2A81171794267691A149A1C4830E484B4C659AB4D6818D81EC60C8311A9448ACD3930
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If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor: Yong Qin Chen	Group Art Unit: OPAP
Serial No.: 17/645,727	Examiner: Not Yet Assigned
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CERTIFICATE OF ELECTRONIC TRANSMISSION (37 C.F.R. § 1.8)
I, Richard Ortiz, hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office via EFS-Web on March 28, 2023. Signed: /Richard Ortiz/

INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

In compliance with the duty of disclosure under 37 C.F.R. § 1.56, it is respectfully requested that this Information Disclosure Statement be entered and the documents listed on attached Form PTO-1449 be considered by the Examiner and made of record.

In accordance with 37 C.F.R §§ 1.97(g), (h), this Information Disclosure Statement is not to be construed as a representation that a search has been made, and is not to be construed to be an admission that the information cited is, or is considered to be, material to patentability as defined in 37 C.F.R. § 1.56(b).

Timing and Fees

☒ Under 37 C.F.R. § 1.97(b), **no fee or statement is required** for filing this Information Disclosure Statement because it is filed:

- ☐ within three months of the filing date of a national application other than a CPA under § 1.53(d); **OR**
- ☐ within three months of the actual filing date of the national phase of a PCT application; **OR**
- ☒ before the mailing of a first substantive office action (including after filing of an RCE).

☐ Under 37 C.F.R. § 1.97(c), this Information Disclosure Statement is filed after the periods specified in 37 C.F.R. § 1.97(b), but **before** the mailing date of:

- ☐ a final rejection under 37 C.F.R. § 1.113; **OR**

☐ termination of prosecution, e.g. Ex Parte Quayle, M.P.E.P. § 609(B)(2); **OR**

☐ a notice of allowance under 37 C.F.R. § 1.311;

AND is accompanied by:

☐ the statement as specified in 37 C.F.R. § 1.97(e) set out below; **OR**

☐ payment covering the fee of $_____ under 37 C.F.R. § 1.17(p).

☐ Under 37 C.F.R. § 1.97(d), this Information Disclosure Statement is filed **after** the mailing date of the following actions which have not been withdrawn:

☐ a final action under 37 C.F.R. § 1.113; **OR**

☐ termination of prosecution; e.g. Ex Parte Quayle, M.P.E.P. § 609(B)(2); **OR**

☐ a notice of allowance under 37 C.F.R. § 1.311 and is filed on or before payment of the issue fee;

AND is accompanied by:

the statement as specified in 37 C.F.R. § 1.97(e) as set forth below, **AND** payment covering the fee of $_____ under 37 C.F.R. § 1.17(p).

Statements Under 37 C.F.R. § 1.97(e) (if applicable)

☐ Each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the present Information Disclosure Statement; **OR**

☐ No item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application, and to the knowledge of the undersigned attorney after making reasonable inquiry, no item of information contained in this Information Disclosure Statement was known to any individual designated in 37 C.F.R. § 1.56(c) more than three months prior to the filing date of the Information Disclosure Statement.

Statement Under 37 C.F.R. § 1.704(d) (if applicable)

☐ Each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application and that this communication was not received by any individual designated in 37 C.F.R. § 1.56(c) more than thirty days prior to the filing of this Information Disclosure Statement.

Copies of Cited Materials (if applicable)

☐ Copies of materials listed but not attached were cited in benefit (35 U.S.C. § 120) ancestor application Serial No. _____ on Form 892 by the Examiner and/or Form 1449 by the applicant; see 37 C.F.R. § 1.98(d).

☐ This application may be related by inventorship and/or subject matter to co-pending U.S. application Serial No. _____, filed _____.

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☐ Payment is made by credit card via EFS-Web for $_____ covering the fee identified above.

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Respectfully submitted,

/Mark G. Tison/

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Date: March 28, 2023

Espacenet

JP2005017683A OPTICAL MULTIPLEXER/DEMULTIPLEXER

Applicants: NIPPON TELEGRAPH & TELEPHONE

Inventors: HADAMA KOICHI,SAKAMOTO TAKESHI,ARAI YOSHIMITSU

Classifications:
IPC ***G02B6/293;*** (IPC1-7): G02B6/293;

Priorities: JP2003182335A 2003-06-26

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OPTICAL MULTIPLEXER/DEMULTIPLEXER

Abstract

PROBLEM TO BE SOLVED: To reduce the mounting cost for alignment by unifying or equalizing the installation angle of channel ports and common ports relative to input and output. SOLUTION: A plurality of wavelength selection elements 106 to 109 which passes a light beam having a specified wavelength band and reflect the light beams having other wavelength bands are arranged in an array on a first virtual plane 113, and a plurality of light reflection and condensation elements 110 to 112, which reflects inputted light beams and form a beam waist of the reflected light beams at a specific position, are arranged in an array on a second virtual plane 114 which is in parallel to the first virtual plane 113. The light beams are alternately reflected on the wavelength selection elements 106 to 109 and the light reflection and condensation elements 110 to 112, and are made to perform a multiple reflection between the virtual planes 113 and 114. The optical axes of the light beams passing through the respective wavelength selection elements 106 to 109 are orthogonal to the virtual planes 113 and 114. Thus, the ports 101 through 105 are easily aligned with respect to an optical multiplexer/demultiplexer 100. COPYRIGHT: (C)2005,JPO&NCIPI

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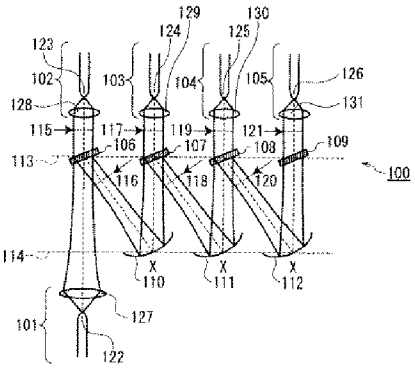
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最終頁に続く

(54)【発明の名称】光合分波器

(57)【要約】
【課題】入出力にかかわるチャネルポートやコモンポートの設置角度を、単一化・同一化して、アライメントのための実装コストを低減する。
【解決手段】特定波長域の光線を透過させそれ以外の波長域の光線を反射させる複数の波長選択素子１０６～１０９が、第１の仮想平面１１３上にアレイ状に配置され、入力された光線を反射して特定の位置に当該反射光線によるビームウエストを形成する複数の光反射集光素子１１０～１１２が、第１の仮想平面１１３に平行な第２の仮想平面１１４上にアレイ状に配置されている。光線は、波長選択素子１０６～１０９と光反射集光素子１１０～１１２とで交互に反射され、仮想平面１１３，１１４間で多重反射する。各波長選択素子１０６～１０９を透過する光線の光軸は、仮想平面１１３，１１４に対して直交している。このため、ポート１０１～１０５を光合分波器１００に対して簡単にアライメントすることができる。
【選択図】　図１



【特許請求の範囲】
【請求項1】
光合分波器の内部に一本の波長多重光線が送られると共に、光合分波器の内部から複数の単一波長光線が取り出される機能、または、光合分波器の内部に複数の単一波長光線が送られると共に、光合分波器の内部から一本の波長多重光線が取り出される機能を有する光合分波器であって、
特定の波長域の光線を透過させそれ以外の波長域の光線を反射させる複数の波長選択素子と、
前記波長選択素子により反射された光線または前記波長選択素子を透過した光線が入力されると共に、入力された光線を反射して特定の位置に当該反射光線によるビームウエストを形成する複数の光反射集光素子とを有し、
複数の前記波長選択素子が、第１の仮想平面上に並んで配置され、複数の前記光反射集光素子が、第１の仮想平面に対して平行に対向する第２の仮想平面上に並んで配置されており、
各光反射集光素子は、相対的に前側に並んだ波長選択素子から入力された光線を、当該波長選択素子よりも相対的に後側に並んだ隣接する波長選択素子に向けて反射し、しかも、各波長選択素子は、相対的に前側に並んだ光反射集光素子から入力された光線を、当該光反射集光素子よりも相対的に後側に並んだ隣接する光反射集光素子に向けて反射させるように、各光反射集光素子及び各波長選択素子の配置位置及び配置向きが設定されており、更に、光合分波器に対して入出力されて各波長選択素子を透過する光線の光軸が、第１及び第２の仮想平面に直交するように、各波長選択素子の配置位置及び配置向きが設定されていることを特徴とする光合分波器。
【請求項2】
請求項１に記載の光合分波器において、
前記光線がガウシアンビームであることを特徴とする光合分波器。
【請求項3】
請求項１または請求項２に記載の光合分波器において、
前記波長選択素子と前記光反射集光素子とにより交互に反射されて、第１の仮想平面と第２の仮想平面との間で多重反射する光線の光路の中で、相対的に前側に並んだ波長選択素子から、当該波長選択素子よりも相対的に後側に並んだ隣接する波長選択素子に至るまでの光路長が、すべて等しくなっており、
各波長選択素子に到達する光線の複素ビームパラメータが、すべての波長選択素子上で同一になるように前記光反射集光素子の光学パラメータが光学設計されていることを特徴とする光合分波器。
【請求項4】
請求項１または請求項２に記載の光合分波器において、
前記波長選択素子と前記光反射集光素子とにより交互に反射されて、第１の仮想平面と第２の仮想平面との間で多重反射する光線の光路の中で、相対的に前側に並んだ波長選択素子から、当該波長選択素子よりも相対的に後側に並んだ隣接する波長選択素子に至るまでの光路長が、すべて等しくなっており、
各波長選択素子に到達する光線のスポットサイズが、すべての波長選択素子上で同一になるように前記光反射集光素子の光学パラメータが光学設計されていることを特徴とする光合分波器。
【請求項5】
請求項１ないし請求項４のいずれか１項に記載の光合分波器において、
前記光反射集光素子の少なくとも一つが、球面状のミラーであることを特徴とする光合分波器。

【発明の詳細な説明】
【０００１】
【発明の属する技術分野】

本発明は、光通信に用いられる光合分波器に関するものであり、より詳細には、波長多重光伝送などで利用され、複数の光伝送路を有する装置において、特定の波長の光信号を、各光伝送路に対して抽出または挿入することを可能とする光合分波器に関する。

【０００２】

【従来の技術】

近年の、波長多重伝送技術の発展に伴い、複数の光伝送路（ポート）をもつ機能デバイスに注目が集まっている。とくに、一つの共通ポート（コモンポート）と複数の入出力ポート（チャネルポート）を有し、それぞれのチャネルポートから、特定の波長の光信号を抽出または挿入することができる光合分波素子は、小型低コスト化、低損失化などの特性を実現するために、多様な方式および構造のものが提案されている。

【０００３】

［従来例１］

下記特許文献１は、光分波素子に関する技術文献の例である。

この特許文献１における光分波素子は、図４（この図４は特許文献１の図１と同じであるが、符号は変更している）に示すように、特定の波長の光線のみを透過させ、それ以外の波長の光線を反射させる波長フィルタ０１～０４を複数配置し、リレー集束鏡０５～０７を利用して各波長フィルタ０１～０４から反射される波長の光線を、リレー式に伝播させる方式を採用している。各波長フィルタ０１～０４を透過した光線は、各波長フィルタ０１～０４ごとに用意された検出器０８～０１１において、単一波長の光信号として検出される構成となっている。なお０１２が入射光である。

【０００４】

［従来例２］

下記特許文献２は、光合分波素子または光アドドロップ素子に用いられる、レンズアレイ透明ブロックに関する技術文献の例である。

この特許文献２におけるレンズアレイ透明ブロックは、図５（この図５は特許文献２の図１と同じであるが、符号は変更している）に示すように、透明ブロック００３－１ａ，００３－２ａに、複数の凸レンズ００２－１～００２－８が一体形成されたレンズアレイ透明ブロック００３－１，００３－２を製造し、そのレンズアレイ透明ブロックを、一方の凸レンズアレイブロック００３－１と他方の凸レンズアレイブロック００３－２と平行透明ブロック００４に分割し、これらのレンズアレイ透明ブロック００３－１，００３－２の間に、凸レンズ００２－０を備えた平行透明ブロック００４を挟み込む構成となっている。

【０００５】

平行透明ブロック００４の表面には、特定の波長の光線のみを透過させ、それ以外の波長の光線を反射させる波長フィルタ００６－１～００６－８が複数形成されており、この平行透明ブロック００４の内部を光線が多重反射することにより合分波を行う方式を採用している。

【０００６】

【特許文献１】

特開２０００－１６２４６６

【特許文献２】

特開２００２－４０２８３

【０００７】

【発明が解決しようとする課題】

ところで、特許文献１（図４）に示す従来技術では、各チャネルポートにレンズ系と光ファイバを配置して利用する場合、それぞれのレンズ系と光ファイバの光軸を、波長フィルタが形成されている光学ブロック表面に対して斜めに配置する必要があるため、アライメントのための実装コストが増大するという問題があった。

【０００８】

また、各チャネルポートにレーザダイオードを配置し、光合波器として利用する場合も、

レーザ光軸を波長フィルタが形成されている光学ブロック表面に対して斜めに配置しない場合は大幅に結合効率が低下するという問題があり、レーザ光軸を斜めに配置するためには、レーザダイオード保持具製造コスト、アライメントのための実装コストが増大するという問題があった。

【０００９】

また、特許文献２（図５）に示す従来技術では、各チャネルにおける波長フィルタとレンズとの光路長が異なるため、各チャネルポートにおける損失の、チャネルポート間ばらつきを抑止するためには、各チャネルポートに配置する光学部品の位置、または、各チャネルポートのレンズアレイ透明ブロックに形成する凸レンズ形状を最適化する必要が発生し、量産、組立てなどのコスト低減効果が失われるという問題があった。

【００１０】

本発明は、以上述べたような課題、すなわち、

１）部品コスト増大

２）実装コスト増大

などの課題を解決することを目的としている。

【００１１】

【課題を解決するための手段】

上記課題を解決する第１の本発明は、光合分波器の内部に一本の波長多重光線が送られると共に、光合分波器の内部から複数の単一波長光線が取り出される機能、または、光合分波器の内部に複数の単一波長光線が送られると共に、光合分波器の内部から一本の波長多重光線が取り出される機能を有する光合分波器であって、

特定の波長域の光線を透過させそれ以外の波長域の光線を反射させる複数の波長選択素子と、

前記波長選択素子により反射された光線または前記波長選択素子を透過した光線が入力されると共に、入力された光線を反射して特定の位置に当該反射光線によるビームウエストを形成する複数の光反射集光素子とを有し、

複数の前記波長選択素子が、第１の仮想平面上に並んで配置され、複数の前記光反射集光素子が、第１の仮想平面に対して平行に対向する第２の仮想平面上に並んで配置されており、

各光反射集光素子は、相対的に前側に並んだ波長選択素子から入力された光線を、当該波長選択素子よりも相対的に後側に並んだ隣接する波長選択素子に向けて反射し、しかも、各波長選択素子は、相対的に前側に並んだ光反射集光素子から入力された光線を、当該光反射集光素子よりも相対的に後側に並んだ隣接する光反射集光素子に向けて反射させるように、各光反射集光素子及び各波長選択素子の配置位置及び配置向きが設定されており、更に、光合分波器に対して入出力されて各波長選択素子を透過する光線の光軸が、第１及び第２の仮想平面に直交するように、各波長選択素子の配置位置及び配置向きが設定されていることを特徴とする光合分波器である。

また第２の本発明は、光線をガウシアンビームとしていることを特徴とする光合分波器である。

【００１２】

ガウシアンビームの複素ビームパラメータ（ｑ）とは、波長（λ）、円周率（π）、ビームウエストからの距離（ｚ）、スポットサイズ　（ｗ（ｚ））、ビーム波面曲率半径　（Ｒ（ｚ））を用いて

$1/q = 1/R(z) - i\lambda/(\pi \cdot w(z)^2)$

と表現され、ガウシアンビームの特性を示すｗ（ｚ）　とＲ（ｚ）　を、一つの複素数（ｑ）で表示することができるものとして知られている。

【００１３】

以降の詳細説明の便宜のため、光合分波器外部からの信号を、ガウシアンビームとして内部に出射する部分を「発光点」、

光合分波器内部の伝播ビームを受光し、外部に信号として伝える部分を「受光点」、

発光点、および、発光点からのビームを効率よく光合分波器内部に伝播させるためのレンズ系から構成される部品を「送信ポート」、
受光点、および、光合分波器内部の伝播ビームを効率よく受光点に結合させるためのレンズ系から構成される部品を「受信ポート」、
単一波長の光信号を入出力するための送信または受信ポートを「チャネルポート」、
波長多重化された光信号を入出力するための送信または受信ポートを「コモンポート」
と定義する。

【００１４】

発光点または受光点の具体例としては、シングルモードファイバの端面、マルチモードファイバの端面、先球ファイバの端面など、各種光ファイバの端面が考えられる。

【００１５】

また、発光点にはレーザダイオード、受光点にはフォトダイオードを利用し、光合分波器外部に入出力する信号を電気信号とすることもできる。

【００１６】

送信ポートまたは受信ポートを構成するレンズ系の具体例としては、ボールレンズ、平凸レンズ、両凸レンズ、非球面レンズ、ＧＲＩＮレンズなどの光学レンズ、および、それらの光学レンズが複数組み合わせられたものが考えられる。

【００１７】

波長選択素子の具体例としては、特定の波長を固定して利用する場合は、多層膜を利用したバンドパスフィルタ、ローパスフィルタ、ハイパスフィルタなどが考えられる。また、透過させる波長は外部からの制御によりそれぞれ独立に変化させてもよい。その場合は、電気光学効果または熱光学効果を利用した波長可変フィルタ、ＭＥＭＳ技術を利用したエタロンフィルタなどが考えられる。

【００１８】

また、波長選択素子が透過させる波長帯が、入射光線の全ての波長帯を含む場合も考えられ、その場合は光学的な透過窓に相当する。逆に、入射光線の全ての波長帯を透過させない場合は、平面ミラーと同等の機能を有する。

【００１９】

光反射集光素子の具体例としては、凹面ミラー、平凸レンズの平面状の表面に反射膜が形成されたもの、フレネルレンズの原理を応用したフレネルミラーなどが考えられる。

【００２０】

上記の部品群の配置を決定するため、平行に対向させられた二つの平面を「仮想平面」と定義すると、送信ポートから出射されたビームが、仮想平面を透過し、受信ポートに伝播されるように、送信ポート、受信ポートが配置されており、少なくとも一組の送信ポートと受信ポートについて、ポート間を伝播するビームは二つの仮想平面の間をジグザグ状に反射する「多重反射ビーム」となるように配置されており、
多重反射ビームの仮想平面における反射点には、波長選択素子、光反射集光素子、平面状の反射面のいずれかの「制御素子」が配置されており、
波長選択素子を透過するビームの光軸が仮想平面と直交するように、制御素子の設置角度が設計されている。

【００２１】

また、多重反射ビームの光路上において、隣接する波長選択素子の間に配置されている制御素子の全体を「リレイ光学系」、
制御素子に入反射するビームの、入射光軸と反射光軸の交点を「素子反射点」、
制御素子に入射するビームから、反射光軸を決定する微小平面を「素子反射面」、
と定義する。

【００２２】

対向させられた二つの仮想平面の間の領域は、伝播ビームが多重反射する領域であるが、空間中をビームが多重反射する場合は、複数の制御素子が表面に形成されたアレイ素子搭載ブロックを二つ用意し、それらを平行に対向させる構成が考えられる。

【００２３】
ガラスまたは透明樹脂などの媒質中をビームが多重反射する場合は、ガラスまたは透明樹脂などで形成された平板状の光導波ブロックの両方の表面に、複数の制御素子を形成する構成が考えられる。
【００２４】
本発明の分波動作の原理は以下のとおりである。
送信ポートから出射されたビームは、第一の仮想平面を通過して、第一の波長選択素子に到達する。ビームが第一の波長選択素子に到達するまでに、複数の制御素子からの反射を経ることもある。
【００２５】
第一の波長選択素子において、特定の波長域のビームは透過し、受信ポートに向けて出射される。それ以外の波長域のビームは反射され、対向する第二の仮想平面の別の制御素子に届けられ、さらに反射を繰り返すことで第二の波長選択素子に到達する。
【００２６】
以上のような動作を繰り返し行うように、送受信ポートの設置位置と設置角度、仮想平面に配置された制御素子の素子反射点と素子反射面を光学設計する。
【００２７】
この場合、送信ポートがコモンポートであり、複数の受信ポートがチャネルポートとなり、コモンポートから出力された波長多重光信号が、それぞれの波長選択素子が透過させる波長域に応じて、複数のチャネルポートに分波される。
【００２８】
また、本発明の合波動作の原理は以下のとおりである。
第一の送信ポートから出射されたビームは、第一の仮想平面上に形成された第一の波長選択素子に到達する。第一の波長選択素子において、特定の波長域のビームは透過し、第二の仮想平面上に形成された制御素子に向けて出射される。それ以外の波長域のビームは反射され合波されることはない。
【００２９】
第二の仮想平面に到達した前記透過ビームは多重反射ビームとなり、第二の波長選択素子に到達するが、到達するまでに、少なくとも一つの光反射集光素子からの反射を経る。前記多重反射ビームは、第二の送信ポートから出射され第二の波長選択素子を透過するビームと合波され、再び多重反射ビームとなり、第三の波長選択素子に到達する。
【００３０】
以上のような動作を繰り返し行うように、送受信ポートの設置位置と設置角度、仮想平面に配置された制御素子の素子反射点と素子反射面を光学設計する。
【００３１】
この場合、複数の送信ポートがチャネルポートであり、受信ポートがコモンポートとなり、チャネルポートから出力された複数の単一波長の光信号が、それぞれの波長選択素子が透過させる波長域に応じて、コモンポートに合波される。
【００３２】
第１及び第２の発明が有する効果は以下の（１－１）～（１－３）のとおりである。
【００３３】
（１－１）チャネルポートから入出力されるビーム光軸の設置角度を仮想平面に対して直交させることができる。したがって、チャネルポートやコモンポートの設置角度を単純化・同一化することができ、アライメントのための実装コストを低減することができる。また、複数のチャネルポートの設置密度を高めることが可能であり、実装スペースを節約することができる。
【００３４】
（１－２）上記の効果により、一つの仮想平面とチャネルポートとの間で複数のビームが入出力される場合、複数のチャネルポートを、レンズアレイ、ファイバアレイ、ＬＤアレイ、ＰＤアレイやそれらを組合せたブロックなどから一括して構成することができ、仮想

平面と平行に設置することができる。したがって、複数のチャネルポートの位置および角度あわせを一括して行うことが可能であり、アライメントのための実装コストを低減することができる。

【００３５】

（１－３）リレイ光学系を経て多重反射ビームを伝搬させることで、ビームの拡散を防ぐことができ、光路長増大や伝播光軸ずれに対する損失増大を抑えることができる。したがって、チャネルポートの数を増やすことができる。

【００３６】

また、第３の本発明は、

請求項１または請求項２に記載の光合分波器において、

前記波長選択素子と前記光反射集光素子とにより交互に反射されて、第１の仮想平面と第２の仮想平面との間で多重反射する光線の光路の中で、相対的に前側に並んだ波長選択素子から、当該波長選択素子よりも相対的に後側に並んだ隣接する波長選択素子に至るまでの光路長が、すべて等しくなっており、

各波長選択素子に到達する光線の複素ビームパラメータが、すべての波長選択素子上で同一になるように前記光反射集光素子の光学パラメータが光学設計されていることを特徴とする光合分波器である。

【００３７】

第３の発明が有する効果は以下の（２－１）～（２－４）のとおりである。

【００３８】

（２－１）チャネルポートから出射、または、チャネルポートに入射するビームの、チャネルポート直近の波長選択素子における複素ビームパラメータを「チャネルビームパラメータ」、

コモンポートから出射、または、コモンポートに入射するビームの、コモンポート直近の仮想平面における複素ビームパラメータを「コモンビームパラメータ」とすると、

全てのチャネルビームパラメータが同一になるように、制御素子が配置および光学設計されているので、受光または発光点、受信または送信レンズ系、波長選択素子のそれぞれの素子について、素子間距離の組合せを全てのチャネルポートで同一化し、チャネルポートの送信または受信レンズ系を全てのチャネルポートで同一化しても、各チャネルポートにおける光損失のポート間ばらつきが発生しない。

したがって、各チャネルポートのそれぞれについて、光損失を低減し、ポート間ばらつきをなくすための光学設計コスト、設計どおりの部品を入手するための部品コストを低減できる。

【００３９】

（２－２）上記の効果により、レンズアレイ、ファイバアレイ、ＬＤアレイ、ＰＤアレイなどの、同一の出射または受光点、同一のレンズ系がアレイ状に一体形成されてある部品を利用することが可能である。

したがって、設計どおりの部品を入手する際の製造公差低減、各チャネルポートごとに部品を位置決めするための実装コストを低減できる。

【００４０】

（２－３）上記の効果により、レンズファイバモジュール、ＬＤレンズ内蔵型ＣＡＮパッケージモジュールなどの、送信または受信レンズ系と、出射または受光点が一体形成されてある同一部品を複数利用することが可能である。

したがって、市販の部品を利用することで光学設計コスト、部品コストが低減でき、各チャネルポート内部の、送信または受信レンズ系と、出射または受光点を位置決めするための実装コストも低減できる。

【００４１】

（２－４）上記の効果により、レンズファイバモジュールとして市販のファイバコリメータなどを利用することができるため、チャネルポートの小型化、高精度化、部品コストの大幅な低減が可能である。

【００４２】
また第４の本発明は、
請求項１または請求項２に記載の光合分波器において、
前記波長選択素子と前記光反射集光素子とにより交互に反射されて、第１の仮想平面と第２の仮想平面との間で多重反射する光線の光路の中で、相対的に前側に並んだ波長選択素子から、当該波長選択素子よりも相対的に後側に並んだ隣接する波長選択素子に至るまでの光路長が、すべて等しくなっており、
各波長選択素子に到達する光線のスポットサイズが、すべての波長選択素子上で同一になるように前記光反射集光素子の光学パラメータが光学設計されていることを特徴とする光合分波器である。
【００４３】
第４の発明が有する効果は以下の（３－１）（３－２）のとおりである。
【００４４】
（３－１）すべての波長選択素子上において、波面曲率半径の符号も含めて同一である場合、第２の発明が有する効果を有する。
【００４５】
（３－２）すべての波長選択素子上のスポットサイズを同一化しているため、フィルタ特性に関するチャネルポート間のばらつきが発生しない。
【００４６】
また第５の本発明は、
請求項１ないし請求項４のいずれか１項に記載の光合分波器において、
前記光反射集光素子の少なくとも一つが、球面状のミラーであることを特徴とする光合分波器である。
【００４７】
第５の発明が有する効果は以下の（４－１）～（４－３）のとおりである。
【００４８】
（４－１）球面ミラーを利用することで、光反射集光素子において反射される光線の波長依存性を無視することができる。したがって、光合分波器内部の伝播ビームの可用波長帯を広帯域化することが可能である。
【００４９】
（４－２）球面ミラーを利用することで、光反射集光素子の光学設計パラメータは曲率半径のみに限られる。したがって、部品製造トレランス設計の容易化が可能であり、設計時間を短縮することが可能であり、これらのことから製造コストを低減できる。
【００５０】
（４－３）ミラー表面に入射するビームを平行移動し、入射位置を微小変化させることで、曲率半径などの光学パラメータを維持しつつ、反射ビームの光軸方向を三次元的に変化させることができる。よって、仮想平面に対して斜め方向に光反射集光素子を配置することなく、送受信ポートに対して入出力するビームの光軸と、仮想平面のなす角度を直交させることができる。
したがって、複数の光反射集光素子の製造コスト、実装コストを大幅に低減できる。
【００５１】
つまり、本発明は、光合分波器内部の伝播ビームを多重反射させる方式により、特定の波長のビームを、複数の光伝送路に対して抽出または挿入する場合に発生する課題を解決することを目的としている。
そして、以上述べたように、本発明によれば
１）アライメントの作業性向上、複数のチャネルポートの一括形成などによる、部品を設計どおりに位置決めするための実装コスト低減
２）光学設計コスト低減
３）市販品利用、製造公差低減などによる、設計どおりの部品を入手するための部品コスト低減

４）伝播ビームの可用波長帯の広帯域化
５）多チャネル化
などの効果を有する光合分波器を提供することができる。
【００５２】
【発明の実施の形態】
以下、図面に基づいて本発明の実施の形態を具体的に説明するが、以下の実施の形態は本発明を限定するものではない。
【００５３】
［第１の実施の形態］
図１は、本発明の第１の実施の形態に係る光合分波器１００を示す概略構成図である。なお、同図には、光合分波器１００の内部を伝播するガウシアンビームを概念的に示してある。
【００５４】
符号１０１が示す部材はコモンポートであり、符号１０２～１０５が示す部材はチャネルポートであり、符号１０６～１０９が示す部材は波長選択素子であり、符号１１０～１１２が示す部材は光反射集光素子であり、符号１１３，１１４は平行に対向させられた仮想平面を意味しており、矢印１１５～１２１はビームウエストの形成位置を意味している。
【００５５】
コモンポート１０１およびチャネルポート１０２～１０５は、発光点または受光点１２２～１２６およびレンズ系１２７～１３１から構成されている。
【００５６】
波長選択素子１０６～１０９は、特定の波長域の光線を透過させそれ以外の波長域の光線を反射させる光学特性を有しており、各波長選択素子１０６～１０９において透過させる、「特定の波長域」は相互に異なっている。光反射集光素子１１０～１１２は、入力された光線を反射して特定の位置に当該反射光線によるビームウエストを形成する光学特性を有している。
【００５７】
第一の仮想平面１１３上には複数の波長選択素子１０６～１０９がアレイ状に（本例では一列に並んで）等間隔に配置されており、第二の仮想平面１１４上には複数の光反射集光素子１１０～１１２がアレイ状に（本例では一列に並んで）等間隔に配置されている。
【００５８】
波長選択素子１０６～１０９および光反射集光素子１１０～１１２の素子反射面は、すべて仮想平面１１３，１１４に対して同一角度をなすように配置されており、チャネルポート１０２～１０５から入出力されるビームの光軸が仮想平面１１３，１１４に対して垂直になるように素子反射面の配置角度が設計されている。
【００５９】
また、波長選択素子１０６～１０９の配置間隔、および光反射集光素子１１０～１１２の配置間隔も同一であり、光反射集光素子１１０～１１２は「リレイ光学系」に相当する。
【００６０】
上記構成としているため、各光反射集光素子１１０～１１２は、相対的に前側に並んだ波長選択素子１０６～１０９から入力された光線を、当該波長選択素子よりも相対的に後側に並んだ隣接する波長選択素子に向けて反射する。具体的に説明すると、光反射集光素子１１０は、波長選択素子１０６から入力された光線（ビーム）を反射して波長選択素子１０７に向けて送り、光反射集光素子１１１は、波長選択素子１０７から入力された光線を反射して波長選択素子１０８に向けて送り、光反射集光素子１１２は、波長選択素子１０８から入力された光線を反射して波長選択素子１０９に向けて送る。
【００６１】
同様に、各波長選択素子１０６～１０９は、相対的に前側に並んだ光反射集光素子１１０～１１２から入力された光を、当該光反射集光素子よりも相対的に後側に並んだ隣接する光反射集光素子に向けて反射させる。具体的に説明すると、波長選択素子１０６はポート

１０１から入力された光線を反射して光反射集光素子１１０に送り、波長選択素子１０７は光反射集光素子１１０から入力された光線を反射して光反射集光素子１１１に向けて送り、波長選択素子１０８は光反射集光素子１１１から入力された光線を反射して光反射集光素子１１２に向けて送る。

【００６２】

また、波長選択素子１０６～１０９と光反射集光素子１１０～１１２とにより交互に反射されて、第１の仮想平面１１３と第２の仮想平面１１４との間でジグザグ状に多重反射する光線の光路の中で、相対的に前側に並んだ波長選択素子から、当該波長選択素子よりも相対的に後側に並んだ隣接する波長選択素子に至るまでの光路長が、すべて等しくなっている。

【００６３】

具体的に説明すると、波長選択素子１０６→光反射集光素子１１０→波長選択素子１０７に沿う光経路の光路長と、波長選択素子１０７→光反射集光素子１１１→波長選択素子１０８に沿う光経路の光路長と、波長選択素子１０８→光反射集光素子１１２→波長選択素子１０９に沿う光経路の光路長とが、等しくなっている。

【００６４】

更に、各ポート１０１～１０５に対して入出力されて各波長選択素子１０６～１０９を透過する光線の光軸が、第１及び第２の仮想平面１１３，１１４に直交するように、各波長選択素子１０６～１０９の配置位置及び配置向きが設定されている。

【００６５】

以下具体例として、本実施の形態に係る光合分波器１００を、光分波器として利用する場合の動作原理を説明する。

【００６６】

送信ポート１０１から出射された波長多重化信号であるガウシアンビームが、仮想平面１１４を透過し、第一の波長選択素子１０６に入射する。第一の波長選択素子１０６において、特定の波長域を含むビームが第一の波長選択素子１０６を透過し、第一の受信ポート（チャネルポート）１０２に伝播される。第一の波長選択素子１０６において透過されない波長域を含むビームは反射され、第一の光反射集光素子１１０に入反射し、隣接する第二の波長選択素子１０７に伝播される。

【００６７】

このように、多重反射ビームは、それぞれの波長選択素子に入射するたびに、特定の波長を含むビームが受信ポートに向けて出射され、それ以外の波長を含むビームは反射され、光反射集光素子を経由して、隣接する波長選択素子に伝播される。これらの過程を繰り返すことにより、伝播ビームが分波される。

【００６８】

上記のように光分波器として利用する場合のビームの進行方向を逆向きにすることで、光合波器として利用することもできる。

【００６９】

すなわち、光合波器として利用するときには、複数の送信ポート（チャネルポート）１０２～１０５から出射されたビームを、複数の波長選択素子１０６～１０９を通過するように互いに平行に入射させる。その際に、波長選択素子１０６～１０９を透過し、内部に入射した特定の波長を含むビームが、光反射集光素子１１０～１１２により反射され、その反射ビームが隣接する波長選択素子に入射するような角度に送信ポート１０２～１０５を設置する。このようにして、複数の送信ポート１０２～１０５からの出射ビームが内部を多重反射することにより重ね合わせられ、受信ポート（コモンポート）１０１にむけて一本の伝播ビームとなって伝播されることにより合波される。

【００７０】

ただし、光合波器としての利用形態の場合は、送信ポート１０２～１０５から波長選択素子１０６～１０９に入射したビームのうち、反射される波長域を含むビーム、および、伝播ビームが内部を多重反射する際に、別の波長選択素子により透過させられ、多重反射ビ

ームとならない波長域のビームは、合波されない。
【００７１】
上記の利用例において、波長選択素子は４個、光反射集光素子は３個存在しているが、これらの数量は限定するものではない。
【００７２】
また、全ての波長選択素子上にビームウエストを形成するように光学設計する場合、リレイ光学系を構成する光反射集光素子１１０～１１２は、それぞれ異なる光学パラメータを持ち、すべての波長選択素子上のスポットサイズを同一化することはできないが、以下の（ａ）～（ｃ）のような効果を有する。
【００７３】
（ａ）波長選択素子の配置点に多重反射ビームのビームウエストを形成することで、波長選択素子に入射するビームはほぼ平面波とみなすことができる。
したがって、波長選択素子に入射するビーム波面はほぼ単一角度で入射するとみなせるため、均質なフィルタ特性を得ることができる。
【００７４】
（ｂ）波長選択素子上に多重反射ビームのビームウエストを形成することで、多重反射ビームの光軸ずれに対して、波長選択素子の表面における面内の光軸位置ずれが低減できる。
したがって、波長選択素子の有効面積を低減し、素子を小型化することが可能であり、フィルタ特性については、波長選択素子の面内依存性の影響を低減することができる。
【００７５】
（ｃ）コモンポートが送信ポートで、複数のチャネルポートを有する場合、チャネル数の増大に伴い、コモンポートからそれぞれの波長選択素子までの光路長が増大する。
このとき、理想的な配置位置からの光軸ずれが発生し、コモンポートからの光路長が増大しても、波長選択素子の配置点に多重反射ビームのビームウエストを形成することで、波長選択素子における光軸位置ずれおよび角度ずれを単調増大させず抑制し、それらのずれを光路長に対して周期的に変動させることができる。
したがって、チャネルポートの数が増大しても、フィルタ特性の劣化、および、結合効率の低下を抑えることが可能である。
【００７６】
一方、全ての波長選択素子に到達する伝播ビームの複素ビームパラメータを同一化するように光学設計する場合、リレイ光学系を構成する全ての光反射集光素子は、同一の光学パラメータを持つため、伝播ビームのビームウエストは隣接する光反射集光素子をむすぶ光路の中間地点に形成される。この場合、第一の光反射集光素子１１０から第二の波長選択素子１０７までの距離よりも、第二の波長選択素子１０７から第二の光反射集光素子１１１までの距離の方が長くなるため、ビームウエストは波長選択素子上には形成されない。また、波長選択素子により光路が分岐されるため、それぞれのチャネルポート１０２～１０５と波長選択手段１０６～１０９の中間にもビームウエストが形成される。
【００７７】
第１の実施の形態は第１、第２、第３、第４の発明の効果を有している。
【００７８】
［第２の実施の形態］
図２は、本発明の第２の実施の形態に係る光合分波器２００の概略構成図であり、図１に示した第１の実施の形態の応用例である。以下、第１の実施の形態の場合と異なる点に限り説明する。
【００７９】
符号２１４～２１８が示す部材はリレイ光学系に相当する光反射集光素子であり、符号２０３，２０５，２０７が示す部材は送信ポート（または受信ポート）に相当するチャネルポートであり、符号２０２，２０４，２０６が示す部材は受信ポート（または送信ポート）に相当するチャネルポートである。リレイ光学系において隣接する光反射集光素子２１

４～２１８は、交番変化する光学パラメータを有している。
なお、２０１はコモンポート、２０８～２１３は波長選択素子、２１９，２２０は仮想平面であり、矢印部分がビームウエスト形成位置である。
上記のような構成により、多チャネル波長多重型の送受信機を構成することができる。
【００８０】
また、本実施の形態において送信ポート（または受信ポート）２０３，２０５，２０７に相当するチャネルポートを省略し、前記送信ポート（または受信ポート）直近に配置されている波長選択素子２０９，２１１，２１３を平面状の反射面に置き換え、通常の合波器または分波器として利用することも可能である。
【００８１】
また、波長選択素子上に形成される伝播ビームの波面曲率半径やスポットサイズを光学設計することができるため、フィルタ特性に最適な伝播ビームを形成することができる。
【００８２】
さらに、波長選択素子上にビームウエストを形成する必要がないので、チャネルポートを構成する部品に市販品などを利用することができるため、部品の入手コストを低減することもできる。
【００８３】
第２の実施の形態は、第１及び第２の発明の効果を有している。
【００８４】
［第３の実施の形態］
図３は、本発明の第３の実施の形態に係る光合分波器３００の概略構成図であり、図１に示した第１の実施の形態の応用例である。以下、第１の実施の形態の場合と異なる点に限り説明する。
【００８５】
符号３１２～３１４が示す部材は球面状の凹面ミラーであることを特徴とする光反射集光素子であり、仮想平面３１０，３１１に対してミラー光軸が垂直になるように配置されている。ただし、素子反射点は凹面ミラー中心から微小距離だけ離れた地点にあり、凹面ミラー３１２～３１４に入反射する光軸のどちらか一方が、仮想平面３１０，３１１に対して垂直になるように光学設計されている。
【００８６】
上記のような構成により、仮想平面３１０，３１１に対して斜めに光反射集光素子３１２～３１４を配置することなく、全ての送受信ポート３０１～３０５を仮想平面３１０，３１１と垂直に配置することができる。
【００８７】
したがって、同一の部品がアレイ状に一体形成されてある部材を利用することが可能であり、チャネルポート３０２～３０５を構成する部品の入手・製造コストを低減することができ、各チャネルポートごとに部品を位置決めするための実装コストを低減できる。
なお、３０６～３０９は波長選択素子であり、矢印部分がビームウエスト形成位置である。
【００８８】
さらに、複数の凹面ミラーをアレイ状に一体形成する際に、ミラー光軸を斜めに形成する必要がないため、その製造コストも低減できる。
【００８９】
第３の実施の形態は、第１、第２、第３、第４、第５の発明の効果を有している。
【００９０】
【発明の効果】
以上説明したように、本発明に係る光合分波器によれば、光合分波器内部の伝播ビームを多重反射させる方式により、特定の波長のビームを、複数の光伝送路に対して抽出または挿入する場合に発生する課題を解決することが可能であり、１）アライメントの作業性向上、複数のチャネルポートの一括形成などによる、部品を設計どおりに位置決めするため

の実装コスト低減
２）光学設計コスト低減
３）市販品利用、製造公差低減などによる、設計どおりの部品を入手するための部品コスト低減
４）波長選択素子の小型化、面内依存性低減、均質なフィルタ特性
５）伝播ビームの可用波長帯の広帯域化
等の効果を提供することができる。

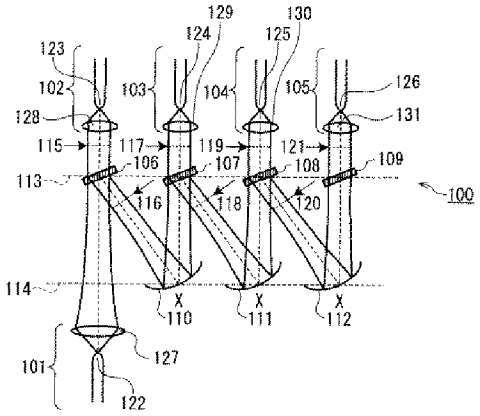
【図面の簡単な説明】

【図１】本発明の第１の実施の形態に係る光合分波器を示す概略構成図である。
【図２】本発明の第２の実施の形態に係る光合分波器を示す概略構成図である。
【図３】本発明の第３の実施の形態に係る光合分波器を示す概略構成図である。
【図４】従来の光分波素子の一例を示す構成図である。
【図５】従来の光合分波素子の他の一例を示す構成図である。

【符号の説明】

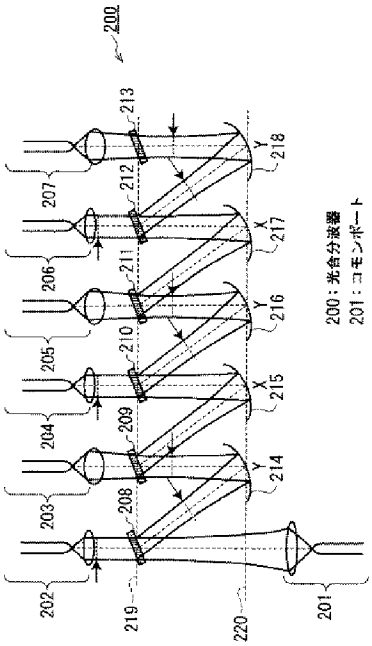
１００，２００，３００　光合分波器
１０１　コモンポート
１０２～１０５　チャネルポート
１０６～１０９　波長選択素子
１１０～１１２　光反射集光素子
１１３，１１４　仮想平面
１１５～１２１　ビームウエスト位置
１２２～１２６　発光点または受光点
１２７～１３１　レンズ系
２０１　コモンポート
２０２～２０７　チャネルポート
２０８～２１３　波長選択素子
２１４～２１８　光反射集光素子
２１９，２２０　仮想平面
３０１　コモンポート
３０２～３０５　チャネルポート
３０６～３０９　波長選択素子
３１０，３１１　仮想平面
３１２～３１４　光反射集光素子（球面状の凹面ミラー）

【図1】



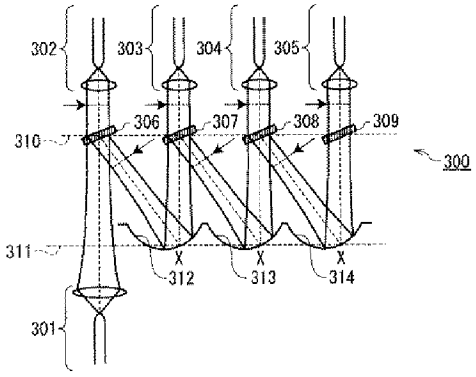
100：光合分波器
101：コモンポート
102～105：チャネルポート
106～109：波長選択素子
110～112：光反射集光素子(リレイ光学系)
113、114：仮想平面
115～121：ビームウエスト形成位置
122～126：発光点または受光点
127～131：レンズ系

【図2】



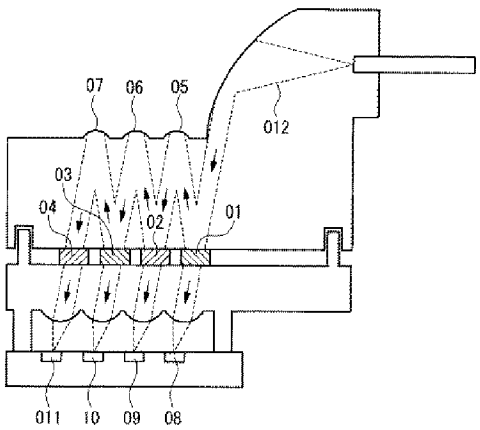
200：光合分波器
201：コモンポート
203、205、207：送信ポート(または受信ポート)
202、204、206：受信ポート(または送信ポート)
208～213：波長選択素子
214～218：光反射集光素子(リレイ光学系)
219、220：仮想平面

【図3】

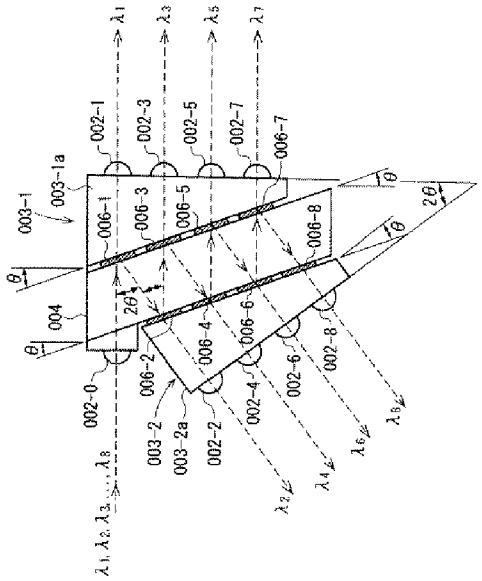


300：光合分波器
301～305：送受信ポート
306～309：波長選択素子
310、311：仮想平面
312～314：光反射集光素子(球面状の凹面ミラー)

【図4】



【図5】


λ1
λ3
λ5
λ7
002-1
002-3
002-5
002-7
006-7
003-1
003-1a
006-1
006-3
006-5
006-8
θ
2θ
004
006-2
006-4
006-6
002-0
002-2
002-4
002-6
002-8
003-2
003-2a
λ1, λ2, λ3, ..., λ8
λ2
λ4
λ6
λ8

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Espacenet

JP2010286381A FLOW CYTOMETER

Applicants: FUJIFILM CORP

Inventors: TAKAHASHI SHUSUKE

Classifications:
IPC ***G01N15/14; G01N21/64;***

Priorities: JP2009140950A 2009-06-12

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Publication: JP2010286381A·2010-12-24

Published as: JP2010286381A

FLOW CYTOMETER

Abstract

PROBLEM TO BE SOLVED: To switch wavelengths of laser beams without causing optical axis deviation. SOLUTION: In an illumination unit 12 of a flow cytometer, first to seventh semiconductor laser modules 25-31 emit light having each different wavelength. First to seventh output units 25a-31a of the first to seventh semiconductor laser modules are detachably connected to incidence side connectors 100-106 of a fiber bundle. Light from the first to seventh semiconductor laser modules 25-31 impinges on incidence units 35a-41a of the fiber bundle. Light impinging on the incidence units 35a-41a is emitted toward an incidence unit 34a of an optical fiber for illumination. Light from the fiber bundle 32 is synthesized in the optical fiber 34 for illumination, and the distribution of the quantity of light is uniformized. Light, where the distribution of the quantity of light has been uniformized, is emitted toward cell particles in a passage pipe from an emission unit 34b of the optical fiber for illumination. COPYRIGHT: (C)2011,JPO&INPIT

(19)日本国特許庁(JP)　(12)公開特許公報(A)　(11)特許出願公開番号
特開2010-286381
(P2010-286381A)
(43)公開日　平成22年12月24日(2010.12.24)

(51)Int.Cl.		F I		テーマコード（参考）
G01N 15/14	(2006.01)	G01N 15/14	P	2G043
G01N 21/64	(2006.01)	G01N 15/14	C	
		G01N 21/64	Z	

審査請求 未請求　請求項の数 2　OL　（全 8 頁）

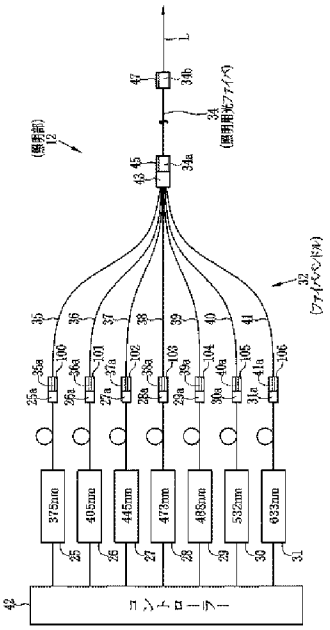
(21)出願番号　特願2009-140950 (P2009-140950)
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Ｆターム(参考)　2G043 BA16 CA04 EA01 EA14 FA06 GA02 GA06 GB01 GB18 HA01 HA05 HA09 JA02 KA02 KA03 KA05 KA09

(54)【発明の名称】フローサイトメーター

(57)【要約】
【課題】光軸ズレを発生させることなくレーザー光の波長の切り替えを行なう。
【解決手段】フローサイトメーターの照明部１２では、第１～７半導体レーザーモジュール２５～３１が、それぞれ波長が異なる光を発する。第１～７半導体レーザーモジュールの第１～７出力部２５ａ～３１ａは、ファイババンドルの入射側コネクタ１００～１０６に着脱自在に接続される。第１～７半導体レーザーモジュール２５～３１からの光は、ファイババンドルの入射部３５ａ～４１ａに入射する。入射部３５ａ～４１ａに入射した光は、照明用光ファイバの入射部３４ａに向けて出射される。照明用光ファイバ３４内では、ファイババンドル３２からの光が合成されるとともに、光量分布が均一化される。光量分布が均一化された光は、照明用光ファイバの出射部３４ｂから流路管内の細胞粒子に向けて出射される。
【選択図】図２

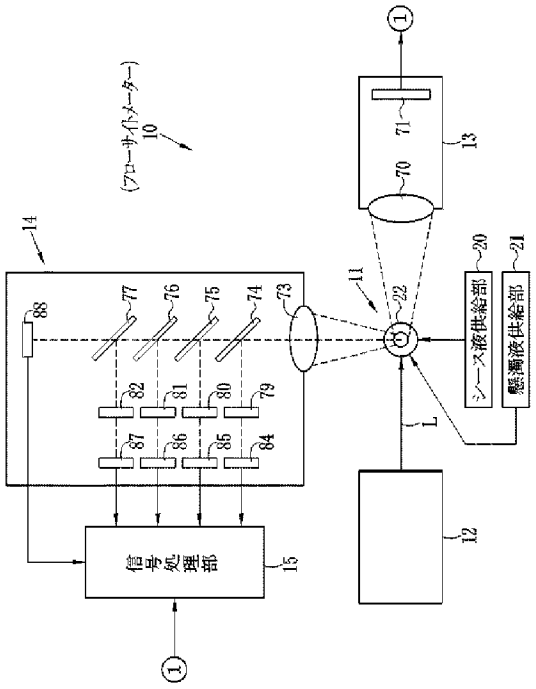


【特許請求の範囲】
【請求項1】
細胞粒子を含む液体に光を照射し、前記細胞粒子から発せられる散乱光及び蛍光に基づいて前記細胞粒子を分析するフローサイトメーターにおいて、
互いに波長が異なる光を発する複数の光源と、
前記光源からの光を入射する第１入射部及び前記第１入射部からの光を出射する第１出射部を有する複数本の光ファイバからなり、前記第１入射部は各光源に対応して分岐しており、前記第１出射部は出射側コネクタ内に束ねられて保持されているファイババンドルと、
前記複数の第１出射部からの光が入る第２入射部及び前記第２入射部からの光を前記液体中の細胞粒子に向けて出射する第２出射部を有し、前記第２入射部は、前記出射側コネクタに連結されるコネクタ受けを介して前記第１出射部に接続する１本の照明用光ファイバとを備えることを特徴とするフローサイトメーター。
【請求項2】
前記第１入射部には、各光源に対して着脱自在な入射側コネクタが設けられていることを特徴とする請求項１記載のフローサイトメーター。

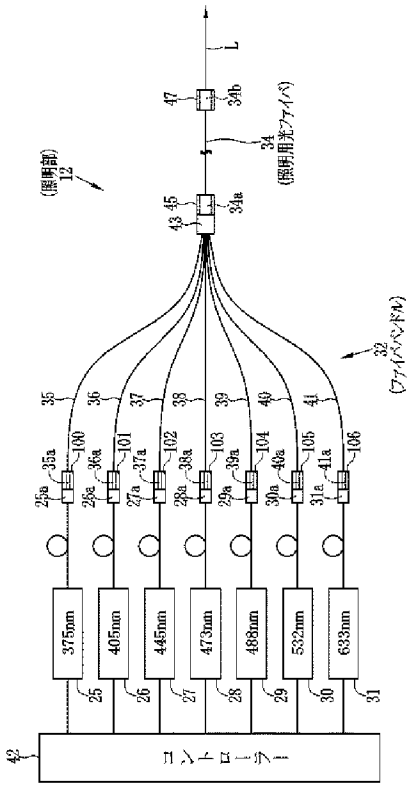
【発明の詳細な説明】
【技術分野】
【0001】
本発明は、細胞粒子などの生物学的性質を分析するフローサイトメーターに関する。
【背景技術】
【0002】
近年では、医学や生物学などの様々な分野において、多数の細胞粒子を自動的に分析するフローサイトメーターの需要が拡大している。フローサイトメーターは、蛍光を測定する標準的な蛍光顕微鏡と比較して、（１）短時間に多くの細胞数を客観的に測定できる（高速性、正確性を有する）、（２）微弱な光でも測定可能である（高感度、定量性）、（３）１回の測定で多くの情報（マルチパラメーター）が取得することができる、（４）目的の細胞集団によるクラスター分析が可能である、（５）同一条件での測定が可能である（高再現性）、（６）特定の細胞の高速分取（ソーティング）ができる、といった優れた特徴を有している。
【0003】
フローサイトメーターで測定可能なサンプルとしては、例えば、（１）血球細胞（白血球、赤血球、血小板など）、（２）動物細胞（培養細胞、単離組織など）、（３）植物細胞、（４）微生物（細菌、原虫など）、（５）海洋生物（プランクトンなど）、（６）精子、酵母など、（７）ラテックスビーズ（マルチプレックスによるサイトカイン定量解析など）などが挙げられるが、細胞や粒子が１個ずつの状態であり、且つシース液などの液体中で浮遊していることが必要とされる。なお、測定可能な大きさは、４０μｍ位である。
【0004】
フローサイトメーターでは、以下のようにして測定が行なわれる。まず、血液などから採取される多数の細胞粒子を蛍光標識試薬で染色し、シース液が流れるシースフロー内に染色した細胞粒子を流す。そして、シースフロー内を流れる細胞粒子に対してレーザー光を照射し、その照射によって細胞粒子から発せられる前方散乱光、側方散乱光、蛍光を光検出器で検出する。そして、光検出器で検出された光の信号に基づいて、細胞粒子の生物学的性質を分析する。
【0005】
蛍光標識試薬で染色された細胞粒子は、照射されるレーザー光の波長によって、様々な蛍光特性を示す。したがって、フローサイトメーターでは、２～４種類のレーザー発生器からそれぞれ波長が異なる光を、シースフロー内の細胞粒子に対して照射している（例えば特許文献１参照）。また、各レーザー発生器から発せられる光は、ハーフミラー等の光

学部材により、同一の光軸上に合成してから、その合成した光を細胞粒子に照射している
。
【図面の簡単な説明】
【0011】
【図1】本発明のフローサイトメーターの概略図である。
【図2】照明部の概略図である。
【図3】ファイババンドル内の各光ファイバの出射部を示す断面図である。
【図4】ファイババンドル内の各光ファイバの出射部から出る光の光量分布を示すグラフ
である。
【符号の説明】
【0036】
１０　フローサイトメーター
１２　照明部
２５～３１　第１～７半導体レーザーモジュール
３２　ファイババンドル
３４　照明用光ファイバ
３４ａ　入射部
３４ｂ　出射部
３５～４１　（ファイババンドル内の）光ファイバ
３５ａ～４１ａ　入射部
３５ｂ～４１ｂ　コア端部
３５ｃ～４１ｃ　クラッド端部
４３　出射側コネクタ
４５　コネクタ受け
４７　保持部
１００～１０６　入射側コネクタ

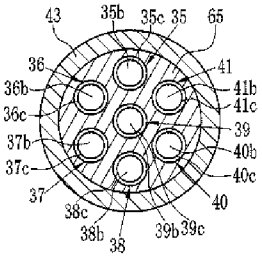
【図1】


(フローサイトメーター)
10
14
88
77
76
75
74
73
82
81
80
79
87
86
85
84
信号処理部
15
①
71
70
13
11
22
シース液供給部
20
懸濁液供給部
21
L
12
①

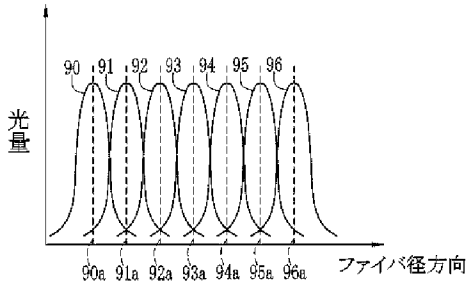
【図2】


L
47
34b
34
(個別用光ファイバ)
(照射部)
12
43
45
34a
32
(ファイババンドル)
35
36
37
38
39
40
41
35a
36a
37a
38a
39a
40a
41a
100
101
102
103
104
105
106
375nm
405nm
445nm
473nm
488nm
532nm
633nm
25
26
27
28
29
30
31
コントローラー
42

【図3】


43
35b
35c
35
65
36
36b
36c
37b
37c
37
38c
38b
38
39b
39c
41
41b
41c
39
40b
40c
40

【図4】



UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**08/23/2023 03:55:38 PM ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Richard Ortiz
PATENT CENTER #	62666502	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Mark Tison

Documents

TOTAL DOCUMENTS: 5

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
BECCP0002USCIPD2C1-IDS-1449.pdf		4	-	228 KB
BECCP0002USCIPD2C1-IDS-1449-IDS.R197.REL.pdf	(1-3)	3	Letter specifying the conditions for filing under 37 CFR 1.97	162 KB
BECCP0002USCIPD2C1-IDS-1449-IDS.pdf	(4-4)	1	Information Disclosure Statement (IDS) Form (SB08)	197 KB
BECCP0002USCIPD2C1-REFB1_FOR.pdf		17	Foreign Reference	1326 KB
BECCP0002USCIPD2C1-		8	Foreign Reference	339 KB

REFB2_FOR.pdf			
BECCP0002USCIPD2C1-REFC1_OTH.pdf	4	Other reference-Patent/Application/Search Documents	93 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor: Yong Qin Chen	Group Art Unit: OPAP
Serial No.: 17/645,727	Examiner: Not Yet Assigned
Filed: December 22, 2021	Atty. Dkt. No.: BECC.P0002US.CIP.D2C1
For: FLOW CYTOMETER	Confirmation No.: 1145

CERTIFICATE OF ELECTRONIC TRANSMISSION (37 C.F.R. § 1.8)
I, Richard Ortiz, hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office via EFS-Web on August 23, 2023. Signed: /Richard Ortiz/

INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

In compliance with the duty of disclosure under 37 C.F.R. § 1.56, it is respectfully requested that this Information Disclosure Statement be entered and the documents listed on attached Form PTO-1449 be considered by the Examiner and made of record.

In accordance with 37 C.F.R §§ 1.97(g), (h), this Information Disclosure Statement is not to be construed as a representation that a search has been made, and is not to be construed to be an admission that the information cited is, or is considered to be, material to patentability as defined in 37 C.F.R. § 1.56(b).

Timing and Fees

☒ Under 37 C.F.R. § 1.97(b), **no fee or statement is required** for filing this Information Disclosure Statement because it is filed:

- ☐ within three months of the filing date of a national application other than a CPA under § 1.53(d); **OR**
- ☐ within three months of the actual filing date of the national phase of a PCT application; **OR**
- ☒ before the mailing of a first substantive office action (including after filing of an RCE).

☐ Under 37 C.F.R. § 1.97(c), this Information Disclosure Statement is filed after the periods specified in 37 C.F.R. § 1.97(b), but **before** the mailing date of:

- ☐ a final rejection under 37 C.F.R. § 1.113; **OR**

☐ termination of prosecution, e.g. Ex Parte Quayle, M.P.E.P. § 609(B)(2); **OR**

☐ a notice of allowance under 37 C.F.R. § 1.311;

AND is accompanied by:

☐ the statement as specified in 37 C.F.R. § 1.97(e) set out below; **OR**

☐ payment covering the fee of $_____ under 37 C.F.R. § 1.17(p).

☐ Under 37 C.F.R. § 1.97(d), this Information Disclosure Statement is filed **after** the mailing date of the following actions which have not been withdrawn:

☐ a final action under 37 C.F.R. § 1.113; **OR**

☐ termination of prosecution; e.g. Ex Parte Quayle, M.P.E.P. § 609(B)(2); **OR**

☐ a notice of allowance under 37 C.F.R. § 1.311 and is filed on or before payment of the issue fee;

AND is accompanied by:

the statement as specified in 37 C.F.R. § 1.97(e) as set forth below, **AND** payment covering the fee of $_____ under 37 C.F.R. § 1.17(p).

Statements Under 37 C.F.R. § 1.97(e) (if applicable)

☒ Each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the present Information Disclosure Statement; **OR**

☐ No item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application, and to the knowledge of the undersigned attorney after making reasonable inquiry, no item of information contained in this Information Disclosure Statement was known to any individual designated in 37 C.F.R. § 1.56(c) more than three months prior to the filing date of the Information Disclosure Statement.

Statement Under 37 C.F.R. § 1.704(d) (if applicable)

☐ Each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application and that this communication was not received by any individual designated in 37 C.F.R. § 1.56(c) more than thirty days prior to the filing of this Information Disclosure Statement.

Copies of Cited Materials (if applicable)

☐ Copies of materials listed but not attached were cited in benefit (35 U.S.C. § 120) ancestor application Serial No. 15/638,477 on Form 892 by the Examiner and/or Form 1449 by the applicant; see 37 C.F.R. § 1.98(d).

☐ This application may be related by inventorship and/or subject matter to co-pending U.S. application Serial No. _____, filed _____.

Payment of Fees Due (if applicable)

☐ Payment is made by credit card via EFS-Web for $_____ covering the fee identified above.

☐ Please charge Deposit Account No. 50-1212/_____ $_____ for the fee identified above.

☒ The Commissioner is hereby authorized to charge or credit any overpayment to Deposit Account 50-1212/BECC.P0002US.CIP.D2C1.

Respectfully submitted,

/Mark G. Tison/

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Date: August 23, 2023

Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT	Applicant: IRIS INTERNATIONAL, INC.	
(Use several sheets if necessary)	Filing Date: December 22, 2021	Group: 3746

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	A1	2003/0048539	03/13/2003	Oostman Jr., et al.

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	B1	JP 2005-017683	01/20/2005	JP	Japanese (English abstract)
	B2	JP 2010-286381	12/24/2010	JP	Japanese (English abstract)

Other Art (Including Author, Title, Date Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C1	English translation of Office Communication issued in Japanese Patent Application No. 2022-090719, dated August 10, 2023. (Attorney Docket No. BECC.P0002JP.D4)

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Notice of References Cited	Application/Control No. 17/645,727	Applicant(s)/Patent Under Reexamination Chen, Yong Qin	
	Examiner ISIAKA O AKANBI	Art Unit 2877	Page 1 of 1

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*	B	US-4727020-A	1988-02-23	Recktenwald; Diether J.	G01N15/1459	436/63
*	C	US-5317162-A	1994-05-31	Pinsky; Bertram G.	G01N15/1459	250/459.1
*	D	US-5540494-A	1996-07-30	Purvis, Jr.; Norman B.	G01N15/0211	356/336
*	E	US-6683314-B2	2004-01-27	Oostman, Jr.; Clifford A.	G01J3/36	250/459.1
*	F	US-20080010019-A1	2008-01-10	Thomas; Richard A.	G01J3/021	702/57
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	T					

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*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in YYYY-MM-DD format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/645,727	Chen, Yong Qin
	Examiner	Art Unit
	ISIAKA O AKANBI	2877

CPC - Searched*		
Symbol	Date	Examiner
(G01N15/1436 or F04B11/0025 or G01N15/1434 or G01N15/1459 or G01N35/1095 or G02B6/26 or G02B6/29365 or G02B21/04 or G02B21/361 or G02B27/0025 or G01N2015/1006 or G01N2015/144 or G01N2015/1452).cpc.		

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
356	338, 335, 339, 336, 340, 625		

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
PE2E Search (US-PGPUB; USPAT; USOCR; EPO CPC)- See Search History Printout		
Inventor Search		

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/ISIAKA O AKANBI/ Primary Examiner, Art Unit 2877	

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/645,727	Chen, Yong Qin
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✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	02/10/2024								
	1	✓								
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	A183	20130020498	1/24/13	Ebi et al.
	A184	20130050782	2/28/13	Heng et al.
	A185	20130070243	3/21/13	Goehde
	A186	20130094102	4/18/13	Baba
	A187	20130204538	8/8/13	Rich
	A188	20130214176	08/22/13	Graves et al.

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language
	B1	CN 102087198	6/8/11	China	Chinese (English abstract)
	B2	CN 102087198	06/08/11	China	Chinese (English Abstract)
	B3	CN 102282453	12/14/11	China	Chinese (English Abstract)
	B4	CN 102449525	05/09/12	China	Chinese (English Abstract)
	B5	CN 102818794	12/12/12	China	Chinese (English abstract)
	B6	CN 102818794	12/12/12	China	Chinese (English Abstract)

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EXAMINER:	/ISIAKA O AKANBI/	DATE CONSIDERED:	02/10/2024

EXAMINER: INITIAL IF REFERENCE CONSIDERED, WHETHER OR NOT CITATION IS IN CONFORMANCE WITH MPEP609; DRAW LINE THROUGH CITATION IF NOT IN CONFORMANCE AND NOT CONSIDERED. INCLUDE COPY OF THIS FORM WITH NEXT COMMUNICATION TO APPLICANT.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /I.O.A/

Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT	Applicant: IRIS INTERNATIONAL, INC.	
(Use several sheets if necessary)	Filing Date: December 22, 2021	Group: 3746

U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1-9	*See Page 9-12*	*See Page 12-13*

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language
	B7	CN 102818795	12/12/12	China	Chinese (English abstract)
	B8	CN 102818795	12/12/12	China	Chinese (English Abstract)
	B9	CN 102818796	12/12/12	China	Chinese (English abstract)
	B10	CN 102818796	12/12/12	China	Chinese (English Abstract)
	B11	CN 1199177	11/18/98	China	Chinese (English Abstract)
	B12	CN 201917509U	8/3/11	China	Chinese (English abstract)
	B13	CN 201936066U	8/17/11	China	Chinese (English abstract)
	B14	CN 201984209U	9/21/11	China	Chinese (English abstract)
	B15	EP 0889319	1/7/99	EPO	German (English abstract)
	B16	EP 1004907	4/22/09	EPO	English
	B17	EP 1953526	8/6/08	EPO	English
	B18	EP 2381475	3/4/15	EPO	English
	B19	EP 459764A2	12/4/91	EPO	English
	B20	EP 459764B1	12/11/96	EPO	English
	B21	EP 757346A1	2/5/97	EPO	English
	B22	EP 757346B1	11/14/01	EPO	English
	B23	EP 758755A2	2/19/97	EPO	English
	B24	JP 05333245	12/17/93	Japan	Japanese (English abstract)
	B25	JP 2003-505707	02/12/03	Japan	Japanese (English Abstract)
	B26	JP 2004-341204	12/02/04	Japan	Japanese (English Abstract)
	B27	JP 2004-500572	01/08/04	Japan	Japanese (English Abstract)
	B28	JP 2008-534960	08/28/08	Japan	Japanese (English Abstract)

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U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1-9	*See Page 9-12*	*See Page 12-13*

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language
	B29	JP 2010-085194	04/15/10	Japan	Japanese (English Abstract)
	B30	JP 2012-026837	02/09/12	Japan	Japanese (English Abstract)
	B31	JP 829726	2/2/96	Japan	Japanese (English translation)
	B32	JP H03-197641	08/29/91	Japan	Japanese (English Abstract)
	B33	JP H04-184241	07/01/92	Japan	Japanese (English Abstract)
	B34	JP H05-119035	05/14/93	Japan	Japanese (English Abstract)
	B35	JP H09-502794	03/18/97	Japan	Japanese (English Abstract)
	B36	JP HI0-73528	03/17/98	Japan	Japanese (English Abstract)
	B37	JP S55-144226	11/11/80	Japan	Japanese (English Abstract)
	B38	JP S61-184427	08/18/86	Japan	Japanese (English Abstract)
	B39	WO 0057173	9/28/00	WIPO	English
	B40	WO 0127590	4/19/01	WIPO	English
	B41	WO 0140764	6/7/01	WIPO	English
	B42	WO 03012403	2/13/03	WIPO	French (English abstract)
	B43	WO 2005033654	4/14/05	WIPO	English
	B44	WO 2006013316	2/9/06	WIPO	English
	B45	WO 2009095358	8/6/09	WIPO	German (English abstract)
	B46	WO 2009098867	8/13/09	WIPO	Japanese (English abstract)
	B47	WO 2011026942	3/10/11	WIPO	English
	B48	WO 2012056217	5/3/12	WIPO	English
	B49	WO 2012177367	12/27/12	WIPO	English

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See Page 1-9	*See Page 9-12*	*See Page 12-13*

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language
	B50	WO 2013/181453	12/05/13	WIPO	English
	B51	WO 2013013229	1/24/13	WIPO	English
	B52	WO 2013093035	6/27/13	WIPO	English
	B53	WO 9307471	4/15/93	WIPO	English
	B54	WO 9316368	8/16/93	WIPO	English
	B55	WO 9429695	12/22/94	WIPO	English
	B56	WO 9714066A2	4/17/97	WIPO	English

Other Art (Including Author, Title, Date Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C1	Brogioli et al., "Heterodyne near-field scattering," *Applied Physics Letters* 81(22):4109-4111, 2002.
	C2	Extended European Search Report for EP 13796734.5, mailed March 18, 2016
	C3	Goda et al., "Serial time-encoded amplified imaging for observation of fast dynamic phenomena," *Nature* 458:1145-1149. 2009
	C4	International Search Report and Written Opinion for PCT/US2013/043453 mailed December 20, 2013.
	C5	International Search Report and Written Opinion for PCT/US2014/067682 mailed April 9, 2015.
	C6	Office Action issued in Chinese Patent Application No. 201380039184.6, dated February 12, 2018 (Attorney Docket No. BECC.P0002CN)

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U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1-9	*See Page 9-12*	*See Page 12-13*

Other Art (Including Author, Title, Date Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C7	Office Action issued in Corresponding Chinese Application No. 201611102428.2, dated May 18, 2020 (English Translation provided) (Attorney Docket No. BECC.P0002CN.D1).
	C8	Office Action issued in Corresponding Chinese Patent Application No. 201480074396, dated June 10, 2019 (English Translation) (Attorney Docket No. BECC.P0003CN)
	C9	Office Action issued in corresponding Chinses application no. 201611102428.2, dated September 30, 2019 (Attorney Docket no. BECC.P0002CN.D1).
	C10	Office Action issued in Japanese Patent Application No. 2015-515208, issued May 29, 2017 (English Translation Provided) (Attorney Docket No. BECC.P0002JP)
	C11	Office Action issued in Japanese Patent Application No. 2015-515208, dated May 02, 2018 (Attorney Docket No. BECC.P0002JP)
	C12	Office Action issued in Japanese Patent Application No. 2016-216891, dated December 04, 2017 (English Translation) (Attorney Docket No. BECC.P0002JP.D1)
	C13	Schmidt, B., "Ein lichtstarkes komafreies Spiegelsystem," *Mitteilungen der Haburger Sternwarte in Bergedorf* 7(36):15-17, 1932.
	C14	Smiley, C. H., "The Schmidt Camera," *Popular Astronomy* 44:415-421, 1936.

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PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	1617	((("CHEN") near3 ("Yong"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/02/08 09:01 AM
L2	14	L1 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 09:12 AM
L3	14	L2 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 09:20 AM
L4	14	L3 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 09:21 AM
L5	38	((("IRIS") near3 ("INTERNATIONAL") near3 ("INC"))).AS,AANM.	(USPAT)	OR	ON	ON	2024/02/08 12:34 PM
L6	14	L5 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:35 PM

		(WDM)))					
L7	14	L6 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:35 PM
L8	14	I7 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:36 PM
L9	7	(isiaka NEAR akanbi) AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:36 PM
L10	0	L9 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:38 PM
L11	7	L9 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:38 PM
L12	31	(Hoa NEAR Pham) AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:35 PM

		charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))					
L13	0	L12 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:36 PM
L14	29	L12 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:36 PM
L15	0	L14 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter$3) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:38 PM
L16	10	L14 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter$3) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:38 PM
L17	10	L14 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter$3 concave convex) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:40 PM
L18	103967	(G01N15/1436 or F04B11/0025 or G01N15/1434 or G01N15/1459 or G01N35/1095 or G02B6/26 or G02B6/29365 or G02B21/04 or G02B21/361 or	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,	OR	ON	ON	2024/02/08 05:11 PM

		G02B27/0025 or G01N2015/1006 or G01N2015/144 or G01N2015/1452).cpc.	MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L19	902	I18 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:12 PM
L20	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:13 PM
L21	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:13 PM
L22	21	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:14 PM
L23	46	L19 AND ((color$1 colour$1 spectrum$1	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:14 PM

		spect$3) SAME fluo$8 SAME (concave curv$7 convex diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))					
L24	45	l23 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:15 PM
L25	15	("5411029" | "5540494" | "6573991" | "7471393" | "20050151968" | "20080010019" | "20080215297" | "20080221711" | "20080319680").pn. OR ("9025145").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/02/09 08:01 AM
L26	3	L25 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:08 AM
L27	0	L26 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (concave curv$7 convex diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:09 AM
L28	3	L26 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:10 AM

		(detector$1 sensor$1 receiver$1 imag$3))					
L29	7	L25 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:12 AM
L30	3	L29 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (receiv$3 collect$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:13 AM
L31	5	L29 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:14 AM
L32	79	("2816479" | "3695765" | "3710933" | "3873209" | "4263508" | "4360270" | "4765737" | "4794806" | "4857451" | "5007737" | "5041733" | "5056918" | "5090808" | "5104221" | "5105093" | "5138170" | "5325168").pn. OR ("5540494").urpn. AND (PGPB | USPT |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/02/09 08:15 AM

		USOC).dbnm.					
L33	46	l32 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:16 AM
L34	33	L33 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:16 AM
L35	11208	356/337, 356/338, 356/335, 356/339, 356/336, 356/340, 356/625	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:13 AM
L36	2413	L35 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:13 AM
L37	593	L36 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:14 AM

		multiplexer (WDM)))					
L38	581	L37 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:14 AM
L39	14	L38 AND ((fiber$1 fibre$1) SAME ((plural$3 second first multiple$1) near5 (dichroic filter$1 detector$1)) SAME collimat$3)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:17 AM
L40	3	"20120019825,"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 10:06 AM
L41	3	L40 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 10:06 AM
L42	3	L41 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 10:07 AM
L43	3	l42 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 10:07 AM
L44	249	"6683314," "4727020"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:17 PM
L45	108	L44 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:17 PM
L46	107	L45 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:18 PM

L47	72	L46 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:18 PM
L48	68	"6683314"	(USPAT)	OR	ON	ON	2024/02/09 07:43 PM
L49	54	L48 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:48 PM
L51	46	l49 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 beam$1 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:49 PM
L52	46	L51 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:50 PM
L53	2	"20030048539"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:52 PM
L54	1	L53 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:53 PM

		(detector$1 sensor$1 receiver$1 imag$3))					
L55	1	L54 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 beam$1 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:53 PM
L56	1	L55 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:53 PM
L58	207	"5317162"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/02/10 08:07 AM
L59	116	L58 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:08 AM
L60	59	L59 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 beam$1 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:09 AM
L61	34	L60 AND ((fiber$1 fibre$1) SAME wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:09 AM
L62	59	L60 AND ((fiber$1 fibre$1) wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:11 AM
L63	6	L60 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:12 AM

		SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))					
L64	6	L60 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex curv$2) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:12 AM
L65	11	L60 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5 concave convex curv$2) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:13 AM
L66	11	L60 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5 concave convex curv$2) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:13 AM

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

Bibliographic Data

Application No: 17/645,727

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /ISIAKA O AKANBI/ Examiner's Signature | Initials

Title: FLOW CYTOMETER

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/22/2021	356	2877	BECC.P0002US.CIP.D2C1
RULE			

APPLICANTS

IRIS INTERNATIONAL, INC., Chatsworth, CA, UNITED STATES

INVENTORS

Yong Qin Chen, San Jose, CA, UNITED STATES

CONTINUING DATA

This application is a CON of 15638477 06/30/2017 PAT 11255772

15638477 is a DIV of 14555102 11/26/2014 PAT 9746412

14555102 has PRO of 61911859 12/04/2013

14555102 is a CIP of PCT/US2013/043453 05/30/2013

PCT/US2013/043453 has PRO of 61816819 04/29/2013

PCT/US2013/043453 has PRO of 61715836 10/19/2012

PCT/US2013/043453 has PRO of 61715819 10/18/2012

PCT/US2013/043453 has PRO of 61653245 05/30/2012

PCT/US2013/043453 has PRO of 61653328 05/30/2012

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

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Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT	Applicant: IRIS INTERNATIONAL, INC.	
(Use several sheets if necessary)	Filing Date: December 22, 2021	Group: 3746

U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1	*See Page 1*	*See Page 1*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A1	2004/0033010	12/19/2004	McGuire, Jr.
	A2	2005/0002425	01/06/2005	Govorkov et al.
	A3	2005/0274890	12/15/2005	Anderton et al.
	A4	2007/0195310	08/03/2007	Kanda
	A5	2010/0067079	03/18/2010	Rathjen
	A6	2011/0216401	09/08/2011	Curry
	A7	8,928,881	01/06/2015	Swalwell

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language

Other Art (Including Author, Title, Date Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation

135055193.1

EXAMINER: /ISIAKA O AKANBI/	DATE CONSIDERED: 02/10/2024

EXAMINER: INITIAL IF REFERENCE CONSIDERED, WHETHER OR NOT CITATION IS IN CONFORMANCE WITH MPEP609; DRAW LINE THROUGH CITATION IF NOT IN CONFORMANCE AND NOT CONSIDERED. INCLUDE COPY OF THIS FORM WITH NEXT COMMUNICATION TO APPLICANT.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /I.O.A/

Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT	Applicant: IRIS INTERNATIONAL, INC.	
(Use several sheets if necessary)	Filing Date: December 22, 2021	Group: 3746

U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1	*See Page 1*	*See Page 1*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A1	9,746,412	08/29/2017	Chen
	A2	11,255,772	02/02/2022	Chen
	A3	11,333,597	05/17/2022	Yan et al.

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language

Other Art (Including Author, Title, Date Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C1	Office Communication issued in U.S. Patent Application No. 17/980,669, dated March 27, 2023. (Attorney Docket No. BECC.P0002US.CIP.D2C)

135269291.1

EXAMINER: /ISIAKA O AKANBI/	DATE CONSIDERED: 02/10/2024

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Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT (Use several sheets if necessary)	Applicant: IRIS INTERNATIONAL, INC.	
	Filing Date: December 22, 2021	Group: 3746

U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1	*See Page 1*	*See Page 1*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A189	2003/0044967	03/06/2003	Heffelfinger et al.
	A190	2011/0089328	04/21/2011	Li

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language
	B57	JP 2005-315799	11/10/2005	Japan	Japanese (with Corresponding US 2007/0195310)
	B58	JP S57-116215	07/19/1982	Japan	Japanese (with Machine Translation)

Other Art (Including Author, Title, Date Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C15	English translation of Office Action issued in corresponding Japanese Patent Application No. 2020-206548 on dated November 29, 2021. (Attorney Docket No. BECC.P0002JP.D3)

105301082.1

EXAMINER:	/ISIAKA O AKANBI/	DATE CONSIDERED:	02/10/2024

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Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT	Applicant: IRIS INTERNATIONAL, INC.	
(Use several sheets if necessary)	Filing Date: December 22, 2021	Group: 3746

U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1	*See Page 1*	*See Page 1*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A1	2003/0048539	03/13/2003	Oostman Jr., et al.

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language
	B1	JP 2005-017683	01/20/2005	JP	Japanese (English abstract)
	B2	JP 2010-286381	12/24/2010	JP	Japanese (English abstract)

Other Art (Including Author, Title, Date Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C1	English translation of Office Communication issued in Japanese Patent Application No. 2022-090719, dated August 10, 2023. (Attorney Docket No. BECC.P0002JP.D4)

137058312.1

EXAMINER:	/ISIAKA O AKANBI/	DATE CONSIDERED:	02/10/2024

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1	1145

129381 7590 02/15/2024

NORTON ROSE FULBRIGHT US LLP - BCI
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

EXAMINER	
AKANBI, ISIAKA O	

ART UNIT	PAPER NUMBER
2877	

NOTIFICATION DATE	DELIVERY MODE
02/15/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

PatentDocket@Beckman.com
aoipdocket@nortonrosefulbright.com

Office Action Summary	Application No. 17/645,727	Applicant(s) Chen, Yong Qin	
	Examiner ISIAKA O AKANBI	Art Unit 2877	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 12/22/2021.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-20 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-20 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 12/22/2021 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date See Continuation Sheet.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Continuation of Attachment(s) 2) Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date: 03/09/2022; 03/25/2022; 03/13/2023; 03/28/2023 and 08/23/2023

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

DETAILED ACTION

Information Disclosure Statement

The information disclosure statement filed on 03/09/2022; 03/25/2022; 03/13/2023; 03/28/2023 and 08/23/2023 has been entered and considered by the examiner.

Drawings

The drawings filed on 12/22/2021, has been accepted for examination.

Claim Rejections - 35 USC § 102

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a)(1) the claimed invention was patented, described in a printed publication, or in public use, on sale or otherwise available to the public before the effective filing date of the claimed invention.

Claim(s) 1-20 is/are rejected under 35 U.S.C. 102(a)(1) as being anticipated by Oostman, JR. et al. (2003/0048539 A1).

Regarding claims 1, 13 and 18, **Oostman** discloses a flow cytometer **included in analytical instruments for flourescent light analysis (figs. 1-15)** comprising:

a light source **laser 11/ lasers 52 and 54** arranged to illuminate a stream of particles **43/flow cell 78** in a viewing zone of a flow cell in the flow cytometer **as can be seen in (i.e. figs. 1 and 3)**;

a collecting optical element **combination of focusing elements 13, 14 and 15 are** configured to collect and focus fluorescent light emitted by a particle illuminated by the light source **[pars. 0002-7]**; and

combination optical element (lens 19 and 25) is a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including **[pars. 0003-7]**,

Objective lens 19 is placed across axis 24 to collect and collimate the fluorescent is a collimating optical element arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to project a collimated beam,

a first semiconductor detector **is included in plurality of detector/detectors (32, 33, 40, 47 and 50)/(Oostman, claims 14 and 16)** configured to detect and quantitate a first color band in the collimated beam,

a first curved mirror **dichroic mirror 25/64/58** arranged to receive at least a portion of the collimated beam **(i.e. 28/56)**, the first curved mirror configured to reflect the portion of the collimated beam received from the collimating optical element **(i.e. 19/56/57)** towards the first semiconductor detector, and

the (i.e. first dichroic mirror 25) includes a first dichroic filter optically disposed between the curved mirror **shape of the (i.e. first dichroic mirror 25)** and the first semiconductor detector **included in (i.e. detector 32)**, **implicitly and/or functionally allows** the dichroic filter configured to allow the first color band in the collimated beam **(i.e. 28/56)** to pass through the first dichroic filter **included in the (i.e. first dichroic mirror 25)** onto the first semiconductor detector **(i.e. detector 32)**, and to reflect the second color band **(i.e. 30)** in the collimated beam **(i.e. 28/56)** away from the first semiconductor detector **(i.e. detector 32)**.

For the purposes of clarity, the structure recited in claim 13 and 18 are symmetrical to the structure recited in claim 1, as such, claims 13 and 18 are rejected above as being anticipated by **Oostman**.

Additionally, Applicant's attention is further request to apparatus described in U.S. Pat. No. 5,317,162, and U.S. Pat. No. 4,727,020 that is incorporated by reference in [pars. 0003-7] of Oostman for additional disclosure and clarification.

As to claims 2-12, **Oostman** also discloses a structure that is use in a flow cytometer/system that is implementing limitations such as, further comprising an optical fiber **(i.e. 123, 125, 127 and 129)** optically disposed between the collecting optical element and the WDM, the optical fiber arranged and configured to deliver the fluorescent light collected by the collecting optical element to the WDM **(see abstract) [pars. 0009-11, 0029-31] (figs. 4-5)** (claim 2); further comprising a first focusing optical element optically disposed between the first dichroic filter and the first semiconductor detector **is a focusing lens and the detector photomultiplier tubes are positionally relatively adjustable so that an optimum detector position can be found by motion of a detector element relative to a lens focusing incoming light [par. 0010]**, the first focusing optical element configured to focus the first color band **(i.e. green)** in the collimated beam passing through the first dichroic filter **included in the (i.e. first dichroic mirror 25)** onto the first semiconductor detector **(i.e. detector 32)**(claim 3); further comprising a second semiconductor detector **is included in plurality of detector/detectors (32, 33, 40, 47 and 50)/(Oostman, claims 14 and 16)** and configured to detect and quantitate the second color band in the collimated beam **(i.e. 28/56)** reflected by the first dichroic filter **included in the (i.e. first dichroic mirror 25)**(claim 4);

further comprising a second curved mirror **shape of the (i.e. second dichroic mirror 34)** and **includes** a second dichroic filter, the second curved mirror arranged and configured to reflect at least a portion of the collimated beam **(i.e. 28)** reflected by the first dichroic filter **included in the (i.e. first dichroic mirror 25)** towards the second semiconductor detector **(i.e. 33)**, the second dichroic filter **included in the (i.e. first**

dichroic mirror 25) arranged and configured to allow the second color band in the collimated beam **(i.e. 28)** to pass through the second dichroic filter **included in the (i.e. first dichroic mirror 34)** onto the second semiconductor detector, and to reflect a third color band in the collimated beam away from the second semiconductor detector **(i.e. 33)**(claim 5); further comprising a third semiconductor detector **included in plurality of detector/detectors (32, 33, 40, 47 and 50)/(Oostman, claims 14 and 16)** arranged and configured to detect and quantitate the third color band in the collimated beam **(i.e. 28)** reflected by the second dichroic filter **included in the (i.e. first dichroic mirror 34)**(claim 6); wherein the first curved **shape (i.e. second dichroic mirror 25)** mirror reflects the portion of the collimated beam **(i.e. 28)** received from the collimating optical element **(19)** to form an image (claim 7); **the structure of the configuration anticipates** wherein the formed image is an image of the collimating optical element **(19)**(claim 8); wherein the light source **laser 11** is arranged and configured to illuminate the stream of particles **(43)** from one side of the flow cell **(i.e. fluidic system 18)**, and wherein the collecting optical element **(i.e. 19)** is arranged and configured to collect fluorescent light from another side of the flow cell **(i.e. fluidic system 18)** (claim 9); wherein the collecting optical element **(i.e. 19)** is further configured to collect and focus side-scatter light scattered by the illuminated particle in the stream **(43)** (claim 10); wherein the light source comprises a plurality of lasers **(i.e. 52 and 54)** (claim 11) **and** wherein the plurality of lasers **(i.e. 52 and 54)** comprises a first laser configured to illuminate a particle in the stream at a first location in the viewing zone, and a second laser configured to illuminate the particle at a second location in the viewing zone **as can be seen in in depicted drawing (fig. 3)** (claim 12).

As to claims 14-17, 19 and 20, **Oostman** also discloses a structure that is use in a flow cytometer/system that is implementing limitations such as, further comprising a row of focusing optical elements **plurality of focusing elements (i.e. 168, 158) in each of detector(s) leg(s)(160, 170, 180, 189, 179,169,159) [pars. 0031-32]**, each focusing optical element in the row arranged and configured to focus the band of fluorescent light passing through a dichroic filter in the row of dichroic filters onto the corresponding semiconductor detector, **as can be seen in in depicted (fig. 5)** (claim 14); wherein the row of mirrors **(i.e. beam splitting element 151 which is a dichroic mirror)** includes at least one curved **shape** mirror configured to form an image in the fluorescent light reflected by said curved mirror (claim 15); **the structure of the configuration anticipates** wherein the image formed by said curved mirror is an image of the collimating optical element (claim 16); **and** wherein fluorescent light received by the collimating optical element is reflected back and forth between the row of mirrors and the row of dichroic filters in a zig-zag pattern, **as can be seen in depicted drawing (figs. 5-6) [pars. 0031-33]** (claim 17); wherein the first side of the flow stream **(43)** is orthogonal to the second side of the flow stream, **as can be seen depicted in drawing (i.e. figs. 1, 3,4)**(claim 19); **and** wherein the collecting optical element **light collector 19/56** is further configured to collect and focus side-scatter light scattered by the illuminated particle **[pars. 0003-0011)** (claim 20).

Additional Prior Art

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The references listed in the attached form PTO-892 teach of other prior art flow cytometer.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Isiaka Akanbi whose telephone number is (571) 272-8658. The examiner can normally be reached on 8:00 a.m. - 4:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tarifur R. Chowdhury can be reached on (571) 272-2287. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/ISIAKA O AKANBI/
Primary Examiner, Art Unit 2877

Doc Code: ECOMM.AUTH/ECOMM.WTDW
Doc Description: Internet Communications Authorization/Internet Communications Authorization Withdrawal

PTO/SB/439 (11-15)

AUTHORIZATION FOR INTERNET COMMUNICATIONS IN A PATENT APPLICATION OR REQUEST TO WITHDRAW AUTHORIZATION FOR INTERNET COMMUNICATIONS		
	Application No.	17/645,727
	Filing Date	December 22, 2021
	First Named Inventor	Yong Qin Chen
	Art Unit	2877
	Examiner Name	ISIAKA O AKANBI
	Practitioner Docket No.	BECC.P0002US.CIP.D2C1/1001193453

To: Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

I. To authorize permission for Internet Communications.

☒ Recognizing that Internet communications are not secure, I hereby authorize the USPTO to communicate with the undersigned and practitioners in accordance with 37 CFR 1.33 and 37 CFR 1.34 concerning any subject matter of this application via video conferencing, instant messaging, or electronic mail. I understand that a copy of these communications will be made of record in the application file. (MPEP 502.03)

II. To withdraw authorization for Internet Communications.

☐ The authorization given on _____, to the USPTO to communicate with the undersigned and any practitioner in accordance with 37 CFR 1.33 and 37 CFR 1.34 concerning any subject matter of this application via Internet communications such as video conferencing, instant messaging, or electronic mail is hereby withdrawn. I understand that the withdrawal is effective when approved rather than when received.

I am the

☐ applicant.

☒ attorney or agent of record. Registration number 65,985.

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.

/Mark G. Tison/ — Signature

February 22, 2024 — Date

Mark G. Tison — Typed or printed name

512 536-3033 — Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Juristic entities must be represented by a patent practitioner (see 37 CFR 1.31, which is applicable to any paper filed on or after September 16, 2012, that is presented on behalf of a juristic entity, regardless of application filing date). Submit multiple forms if more than one signature is required, see below*.

☐ * Total of _____ forms are submitted.

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The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**02/22/2024 04:46:33 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Grace Adame-Delgado
PATENT CENTER #	64417017	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Mark Tison

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
BECCP0002USCIPD2C1_Authorization_for_Internet_Communications.pdf	2	Internet Communications Authorization	130 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
BECCP0002USCIPD2C1_Authorization_for_Internet_Communications.pdf	3B7AF1FD407C87B9779B6A16285379F7AC828E6DF3C2B0E5C3253525B361E5A94FB499DE4D202DEA88FD69AAB6D0708D8E1BCF548F1407719EADD68644C60E85

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/645,727	Filing Date 12/22/2021	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $480 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	04/09/2024	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/MARCUS M WASHINGTON/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**04/09/2024 12:15:52 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Susan Lien
PATENT CENTER #	65019226	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Michael Pohl

Documents

TOTAL DOCUMENTS: 3

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
BECCP0002USCIPD2C1_Response.pdf		11	-	339 KB
BECCP0002USCIPD2C1_Response-A....pdf	(1-1)	1	Amendment/Request for Reconsideration-After Non-Final Rejection	129 KB
BECCP0002USCIPD2C1_Response-IACS.pdf	(2-7)	6	Amendment Copy Claims/Response to Suggested Claims	104 KB
BECCP0002USCIPD2C1_Response-REM.pdf	(8-11)	4	Applicant Arguments/Remarks Made in an Amendment	295 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
BECCP0002USCIPD2C1_Response.pdf	3AB437EF2DFF1184E59851CD458B79613CC673AFB5E918D5E26C22D258D307E525E9A20CDE87E086FE410FBAB281E6F0E010482B860C87158450D433316C9850
BECCP0002USCIPD2C1_Response-A....pdf	D9F5ECF94890D0439ABD44BC487E9E1631DF739C41CD785D6D550276389938C27242008E1B248BF0852CEB2086792037DE744A2E3FE6B6A329FE6770A165E1C7
BECCP0002USCIPD2C1_Response-IACS.pdf	D7C0C34D951E5B253F0106CC9DD2F88A27955F9021E10BFB1BCE5BCD7481C4B497759853ED7A25B4344FCF866C65388B54F6AE551347CF5A9017ED1E69768C75
BECCP0002USCIPD2C1_Response-REM.pdf	9BE2FBBBE628457055A0A35A7CA793BA58C88CD04FBB8D2151386B991DE40A1E2F96A69EAAC35EB72E3DEE3669211EAE760EBD8CE3C196E8628F47508BC05D9B

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Iris International, Inc.	Group Art Unit: 2877
Serial No.: 17/645,727	Examiner: Isiaka O. Akanbi
Filed: December 22, 2021	Atty. Dkt. No.: BECC.P0002US.CIP.D2C1
For: Flow Cytometer	Confirmation No.: 1145

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

CERTIFICATE OF ELECTRONIC TRANSMISSION
37 C.F.R. § 1.8

I hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office via Patent Center on the date below:

April 9, 2024	/Michael Pohl/
Date	Michael Pohl

RESPONSE TO OFFICE ACTION SENT FEBRUARY 15, 2024

Applicant submits this paper in response to the Office Action sent February 15, 2024. Should any fees be required for any reason relating to the filing of this paper and not otherwise be paid, Applicant authorizes the Commissioner to deduct them from Norton Rose Fulbright US LLP's Deposit Account No. 50-1212/BECC.P0002US.CIP.D2C1.

Claim Amendments begin on page **2**.

Remarks begin on page **8**.

Claim Amendments

1. (Currently Amended) A flow cytometer, comprising:

a light source arranged to illuminate a stream of particles in a viewing zone of a flow cell in the flow cytometer;

a collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a collimating optical element arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to ~~project a collimated beam~~ collimate the fluorescent light,

a first semiconductor detector configured to detect and quantitate a first color band in the ~~collimated beam~~ fluorescent light,

a first curved mirror arranged to receive at least a portion of the ~~collimated beam~~ fluorescent light after the fluorescent light has passed through the collimating optical element, the first curved mirror configured to reflect the portion of the ~~collimated beam received from the collimating optical element~~ fluorescent light towards the first semiconductor detector, and

a first dichroic filter optically disposed between the first curved mirror and the first semiconductor detector, the dichroic filter configured to allow the first color band in the ~~collimated beam~~ fluorescent light to pass through the first dichroic filter onto the first semiconductor detector, and to reflect **[[**the**]]** a second color band in the ~~collimated beam~~ fluorescent light away from the first semiconductor detector.

2. (Original) The flow cytometer of claim 1, further comprising an optical fiber optically disposed between the collecting optical element and the WDM, the optical fiber arranged and configured to deliver the fluorescent light collected by the collecting optical element to the WDM.

3. (Currently Amended) The flow cytometer of claim 1, further comprising a first focusing optical element optically disposed between the first dichroic filter and the first semiconductor detector, the first focusing optical element configured to focus the first color band in the ~~collimated beam~~ fluorescent light passing through the first dichroic filter onto the first semiconductor detector.

4. (Currently Amended) The flow cytometer of claim 3, further comprising a second semiconductor detector arranged and configured to detect and quantitate the second color band in the ~~collimated beam~~ fluorescent light reflected by the first dichroic filter.

5. (Currently Amended) The flow cytometer of claim 4, further comprising:

a second curved mirror and a second dichroic filter, the second curved mirror arranged and configured to reflect at least a portion of the ~~collimated beam~~ fluorescent light reflected by the first dichroic filter towards the second semiconductor detector, the second dichroic filter arranged and configured to allow the second color band in the ~~collimated beam~~ fluorescent light to pass through the second dichroic filter onto the second semiconductor, and to reflect a third color band in the ~~collimated beam~~ fluorescent light away from the second semiconductor detector; and

a third semiconductor detector arranged and configured to detect and quantitate the third color band in the fluorescent light reflected by the second dichroic filter.

6. (Cancelled).

7. (Currently Amended) The flow cytometer of claim 1, wherein the first curved mirror reflects the portion of the ~~collimated beam received from the collimating optical element~~ fluorescent light to form an image.

8. (Original) The flow cytometer of claim 7, wherein the formed image is an image of the collimating optical element.

9. (Original) The flow cytometer of claim 1, wherein the light source is arranged and configured to illuminate the stream of particles from one side of the flow cell, and wherein the collecting optical element is arranged and configured to collect fluorescent light from another side of the flow cell.

10. (Original) The flow cytometer of claim 9, wherein the collecting optical element is further configured to collect and focus side-scatter light scattered by the illuminated particle in the stream.

11. (Original) The flow cytometer of claim 1, wherein the light source comprises a plurality of lasers.

12. (Original) The flow cytometer of claim 11, wherein the plurality of lasers comprises a first laser configured to illuminate a particle in the stream at a first location in the viewing zone, and a second laser configured to illuminate the particle at a second location in the viewing zone.

13. (Original) A flow cytometer comprising:

a light source arranged to illuminate a stream of particles in a viewing zone;

a collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a row of mirrors arranged and configured to sequentially reflect different color bands of the fluorescent light collected by the collecting optical element, the row of mirrors including at least one curved mirror;

a row of dichroic filters opposed to the row of mirrors, each dichroic filter configured to pass one color band of the fluorescent light reflected by a mirror in the row of mirrors, and to reflect another color band of the fluorescent light reflected by the mirror;

a row of semiconductor detectors, each semiconductor detector arranged and configured to detect and quantitate the band of fluorescent light passing through a dichroic filter in the row of dichroic filters.

14. (Original) The flow cytometer of claim 13, further comprising a row of focusing optical elements, each focusing optical element in the row arranged and configured to focus the band of fluorescent light passing through a dichroic filter in the row of dichroic filters onto the corresponding semiconductor detector.

15. (Original) The flow cytometer of claim 14, wherein the row of mirrors includes at least one curved mirror configured to form an image in the fluorescent light reflected by said curved mirror.

16. (Currently Amended) The flow cytometer of claim 15, wherein the image formed by said curved mirror is an image of **[[**the**]]** a collimating optical element that is arranged to receive the fluorescent light collected by the collecting optical element and configured to collimate the fluorescent light.

17. (Currently Amended) The flow cytometer of claim 13, wherein the row of mirrors and row of dichroic filters are arranged such that fluorescent light received by the ~~collimating optical element~~ WDM is reflected back and forth between the row of mirrors and the row of dichroic filters in a zig-zag pattern.

18. (Currently Amended) A flow cytometer, comprising:

a light source arranged to illuminate a flow-stream of particles in a viewing zone from a first side of the flow stream;

a collecting optical element arranged on a second side of the flow stream, the collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a collimating optical element arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to ~~project a collimated beam~~ collimate the fluorescent light,

a first semiconductor detector configured to detect and quantitate a first color band in the ~~collimated beam~~ fluorescent light,

a first curved mirror arranged to receive at least a portion of the ~~collimated beam~~ fluorescent light after the fluorescent light has passed through the collimating optical element, the first curved mirror configured to reflect the portion of the ~~collimated beam received from the collimating optical element~~ fluorescent light towards the first semiconductor detector, and

a first dichroic filter disposed between the first curved mirror and the first semiconductor detector, the dichroic filter configured to allow the first color band in the ~~collimated beam~~ fluorescent light to pass through the first dichroic filter onto the first semiconductor detector, and to reflect a second color band in the ~~collimated beam~~ fluorescent light away from the first semiconductor detector.

19. (Currently Amended) The flow cytometer of claim **[[**19**]]** 18, wherein the first side of the flow stream is orthogonal to the second side of the flow stream.

20. (Original) The flow cytometer of claim 19, wherein the collecting optical element is further configured to collect and focus side-scatter light scattered by the illuminated particle.

21. (New) The flow cytometer of claim 1, wherein the first curved mirror is arranged to receive the portion of the fluorescent light when the portion of the fluorescent light is collimated.

Remarks

I. Status of the Claims

Claims 1, 3-5, 7, and 16-19 are amended, claim 6 is cancelled, and claim 21 is new. Support for the claim amendments can be found in, for example, 66:6-70:3 and FIG. 25 of the originally-filed application. Claims 1-5 and 7-21 are pending. No new matter is added.

II. The Claims Are Patentable Over Oostman

The Office rejects all claims under 35 U.S.C. § 102 as allegedly anticipated by Pub No. US 2003/0048539 ("Oostman"). Action at 3-7. Applicant respectfully disagrees.

A. Collecting Optical Element

Independent claims 1, 13, and 18 each recite "a light source arranged to illuminate … particles" and "a collecting optical element" that is "configured to collect and focus fluorescent light emitted by a particle illuminated by the light source." The Office contends that the apparatus disclosed in Oostman's FIG. 1 has a light source—"air cooled argon ion laser 11" whose "beam 12 … impinge[s] upon a fluorescent substance in a flow cell 41" to "caus[e] fluorescent excitation"—that is arranged to illuminate particles. Action at 3; Oostman at ¶ [0003]. And, per the Office, "focusing elements 13, 14 and 15" of Oostman's FIG. 1 are together "a collecting optical element … configured to collect and focus fluorescent light emitted by a particle illuminated by the light source" as claimed. Action at 3. But that is not so.

As annotated below in Oostman's FIG. 1, focusing elements 13, 14, and 15 do not collect and focus "the fluorescent signal from the target substance" illuminated by laser beam 12. Oostman at ¶ [0003], FIG. 1. Instead, "laser beam 12 from [] air cooled argon ion 11 passes through focusing elements 13, 14, and 15 to impinge upon a fluorescent substance in [] flow cell 41." *Id.* (emphasis added). Because focusing elements 13, 14, and 15 receive laser beam 12—not the fluorescent light from the illuminated fluorescent substance—they are not "configured to

collect and focus fluorescent light emitted by a particle illuminated by the light source" as the claims require. Nor has the Office shown that any other embodiment in Oostman has a collecting optical element that is so-configured, in addition to the other recited components. *See* Action at 3 (only relying on "focusing elements 13, 14, and 15").[1]

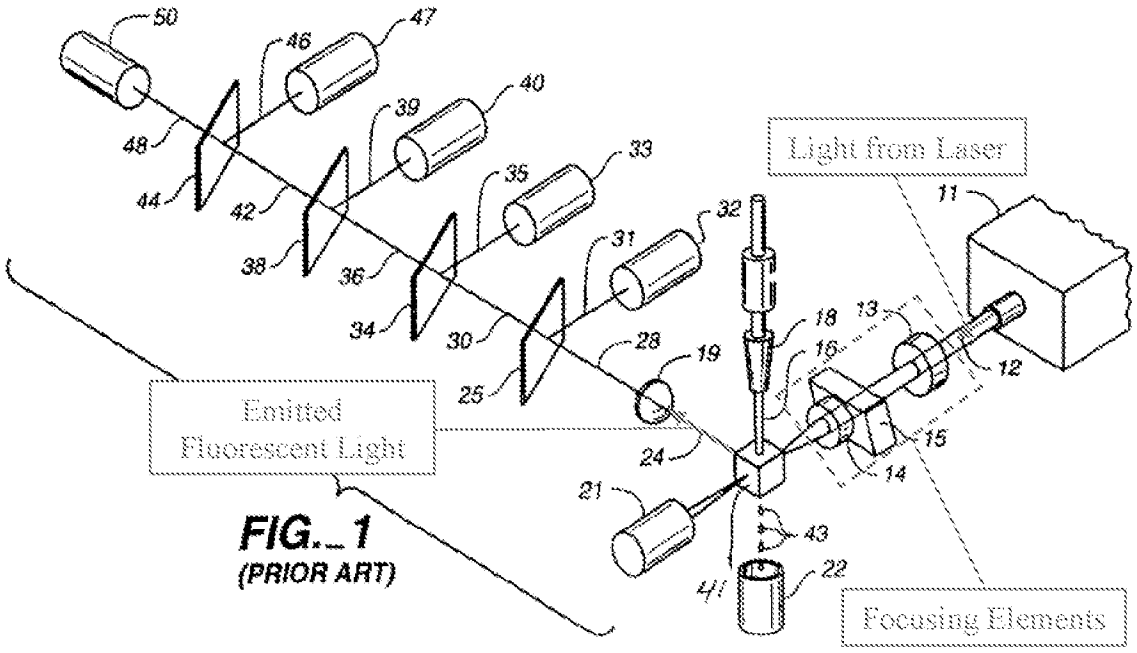


FIG._1
(PRIOR ART)

For at least these reasons, independent claims 1, 13, and 18 and their respective dependent claims are novel over Oostman.

B. Curved Mirror

Independent claims 1 and 18 each recite "a first curved mirror" that is "configured to reflect [a] portion of the fluorescent light towards the first semiconductor detector," and independent

[1] When addressing other claim limitations, the Office relies on components from distinct embodiments in Oostman, but "anticipation is not proven by 'multiple, distinct teachings that the artisan might somehow combine to achieve the claimed invention.'" Action at 3-4; *Microsoft Corp. v. Biscotti, Inc.*, 878 F.3d 1052, 1069 (Fed. Cir. 2017).

claim 13 recites a "row of mirrors [that] includ[e] at least one curved mirror" and are "configured to sequentially reflect different color bands of the fluorescent light." The Office contends that, in Oostman, dichroic mirror 25 of the FIG. 1 apparatus and dichroic mirrors 58 and 64 of the FIG. 3 apparatus[2] are curved mirrors as claimed. Action at 4. But Oostman does not state that dichroic mirrors 25, 58, and 64 are curved. *See* Oostman at ¶¶ [0003], [0007] (not describing shape). At most, Oostman depicts each of dichroic mirrors 25, 58, and 64 as having a planar rather than a curved reflective surface. *Id.* at FIGs. 1, 3. For at least these additional, independent reasons, independent claims 1, 13, and 18 and their respective dependent claims are novel over Oostman.

C. Dichroic Filter

Independent claims 1 and 18 each recite "a first dichroic filter" in addition to the "first curved mirror." Furthermore, independent claim 13 recites a "row of dichroic filters" in addition to the "row of mirrors." The separate listing of the mirror(s) and dichroic filter(s) in these claims means that those are distinct components because "[w]here a claim lists elements separately, 'the clear implication of the claim language' is that those elements are 'distinct component[s]' of the patented invention." *Becton, Dickinson & Co. v. Tyco Healthcare Grp., LP*, 616 F.3d 1249, 1254 (Fed. Cir. 2010) (quoting *Gaus v. Conair Corp.*, 363 F.3d 1284, 1288 (Fed. Cir. 2004)). Indeed, interpreting the claims otherwise would be nonsensical: claims 1 and 18 require the dichroic filter to be "between the first curved mirror and the first semiconductor detector" and claim 13 requires the row of dichroic filters to be "opposed to the row of mirrors," which are spatial relationships that would not exist without a distinct mirror and dichroic filter.

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[2] Because the Office only contends that the FIG. 1 apparatus—not the distinct FIG. 3 apparatus—has, *inter alia*, "a collecting optical element," the FIG. 3 apparatus and any components thereof—including dichroic mirrors 58 and 64—cannot support the Office's anticipation position. *See* Action at 3-4; Oostman at ¶¶ [0003], [0007] (the FIG. 1 apparatus is from "U.S. Pat. No. 5,317,162" while the FIG. 3 apparatus is from "U.S. Pat. No. 4,727,020"); *Microsoft*, 878 F.3d at 1069 (no combining "multiple, distinct teachings" for anticipation).

The Office fails to treat the claimed mirror(s) and dichroic filter(s) as distinct components in its rejections. In particular, the Office identifies a single structure—dichroic mirror 25 of the apparatus in Oostman's FIG. 1—as allegedly corresponding to both the claimed mirror and dichroic filter. *See* Action at 4. But because those are distinct structures in the claim, "the claimed [mirror] and [dichroic filter] cannot be read on the **same** device found in [the prior art]." *Ex parte Masiero*, Appeal No. 2020-003171, slip op. at 4-6, 8-9 (PTAB Oct. 19, 2021). The Office's reliance on a single prior art structure to meet two distinct claimed components thus renders the rejection defective. For at least this additional, independent reason, independents claims 1, 13, and 18 and their respective dependent claims are novel over Oostman.

Applicant respectfully requests reconsideration and withdrawal of the rejections.

III. Conclusion

The pending claims are in condition for allowance for at least the reasons set forth above. Applicant does not acquiesce to the Office's characterizations of the claim language or the cited references, and reserves the right to challenge any such characterizations in the future. The Examiner is invited to contact the undersigned attorney with any questions or comments relating to this application.

Respectfully submitted,

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Date: April 9, 2024

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/645,727	Chen, Yong Qin
	Examiner	**Art Unit**
	ISIAKA O AKANBI	2877

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	02/10/2024	04/29/2024							
	1	✓	✓							
	2	✓	✓							
	3	✓	✓							
	4	✓	✓							
	5	✓	✓							
	6	✓	-							
	7	✓	✓							
	8	✓	✓							
	9	✓	✓							
	10	✓	✓							
	11	✓	✓							
	12	✓	✓							
	13	✓	✓							
	14	✓	✓							
	15	✓	✓							
	16	✓	✓							
	17	✓	✓							
	18	✓	✓							
	19	✓	✓							
	20	✓	✓							
	21		✓							

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/645,727	Chen, Yong Qin
	Examiner	Art Unit
	ISIAKA O AKANBI	2877

CPC - Searched*		
Symbol	Date	Examiner
(G01N15/1436 or F04B11/0025 or G01N15/1434 or G01N15/1459 or G01N35/1095 or G02B6/26 or G02B6/29365 or G02B21/04 or G02B21/361 or G02B27/0025 or G01N2015/1006 or G01N2015/144 or G01N2015/1452).cpc.	04/29/2024	IOA

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
356	338, 335, 339, 336, 340, 625	04/29/2024	IOA

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
PE2E Search (US-PGPUB; USPAT; USOCR; EPO CPC)- See Search History Printout	04/29/2024	IOA
Inventor Search	04/29/2024	IOA

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/ISIAKA O AKANBI/ Primary Examiner, Art Unit 2877	

Bibliographic Data

Application No: 17/645,727

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /ISIAKA O AKANBI/ Examiner's Signature | Initials

Title: FLOW CYTOMETER

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/22/2021	356	2877	BECC.P0002US.CIP.D2C1
RULE			

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CONTINUING DATA

This application is a CON of 15638477 06/30/2017 PAT 11255772

15638477 is a DIV of 14555102 11/26/2014 PAT 9746412

14555102 has PRO of 61911859 12/04/2013

14555102 is a CIP of PCT/US2013/043453 05/30/2013

PCT/US2013/043453 has PRO of 61816819 04/29/2013

PCT/US2013/043453 has PRO of 61715836 10/19/2012

PCT/US2013/043453 has PRO of 61715819 10/18/2012

PCT/US2013/043453 has PRO of 61653245 05/30/2012

PCT/US2013/043453 has PRO of 61653328 05/30/2012

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

01/05/2022

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PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	1617	((("CHEN") near3 ("Yong"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/02/08 09:01 AM
L2	14	L1 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 09:12 AM
L3	14	L2 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 09:20 AM
L4	14	L3 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 09:21 AM
L5	38	((("IRIS") near3 ("INTERNATIONAL") near3 ("INC"))).AS,AANM.	(USPAT)	OR	ON	ON	2024/02/08 12:34 PM
L6	14	L5 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:35 PM

		(WDM)))					
L7	14	L6 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:35 PM
L8	14	I7 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:36 PM
L9	7	(isiaka NEAR akanbi) AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:36 PM
L10	0	L9 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:38 PM
L11	7	L9 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:38 PM
L12	31	(Hoa NEAR Pham) AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:35 PM

		charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))					
L13	0	L12 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:36 PM
L14	29	L12 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:36 PM
L15	0	L14 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter$3) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:38 PM
L16	10	L14 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter$3) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:38 PM
L17	10	L14 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter$3 concave convex) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:40 PM
L18	103967	(G01N15/1436 or F04B11/0025 or G01N15/1434 or G01N15/1459 or G01N35/1095 or G02B6/26 or G02B6/29365 or G02B21/04 or G02B21/361 or	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,	OR	ON	ON	2024/02/08 05:11 PM

		G02B27/0025 or G01N2015/1006 or G01N2015/144 or G01N2015/1452).cpc.	MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L19	902	I18 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:12 PM
L20	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:13 PM
L21	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:13 PM
L22	21	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:14 PM
L23	46	L19 AND ((color$1 colour$1 spectrum$1	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:14 PM

		spect$3) SAME fluo$8 SAME (concave curv$7 convex diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))					
L24	45	l23 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:15 PM
L25	15	("5411029" | "5540494" | "6573991" | "7471393" | "20050151968" | "20080010019" | "20080215297" | "20080221711" | "20080319680").pn. OR ("9025145").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/02/09 08:01 AM
L26	3	L25 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:08 AM
L27	0	L26 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (concave curv$7 convex diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:09 AM
L28	3	L26 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:10 AM

		(detector$1 sensor$1 receiver$1 imag$3))					
L29	7	L25 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:12 AM
L30	3	L29 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (receiv$3 collect$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:13 AM
L31	5	L29 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:14 AM
L32	79	("2816479" | "3695765" | "3710933" | "3873209" | "4263508" | "4360270" | "4765737" | "4794806" | "4857451" | "5007737" | "5041733" | "5056918" | "5090808" | "5104221" | "5105093" | "5138170" | "5325168").pn. OR ("5540494").urpn. AND (PGPB | USPT |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/02/09 08:15 AM

		USOC).dbnm.					
L33	46	l32 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:16 AM
L34	33	L33 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:16 AM
L35	11208	356/337, 356/338, 356/335, 356/339, 356/336, 356/340, 356/625	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:13 AM
L36	2413	L35 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:13 AM
L37	593	L36 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:14 AM

		multiplexer (WDM)))					
L38	581	L37 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:14 AM
L39	14	L38 AND ((fiber$1 fibre$1) SAME ((plural$3 second first multiple$1) near5 (dichroic filter$1 detector$1)) SAME collimat$3)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:17 AM
L40	3	"20120019825,"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 10:06 AM
L41	3	L40 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 10:06 AM
L42	3	L41 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 10:07 AM
L43	3	l42 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 10:07 AM
L44	249	"6683314," "4727020"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:17 PM
L45	108	L44 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:17 PM
L46	107	L45 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:18 PM

L47	72	L46 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:18 PM
L48	68	"6683314"	(USPAT)	OR	ON	ON	2024/02/09 07:43 PM
L49	54	L48 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:48 PM
L51	46	l49 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 beam$1 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:49 PM
L52	46	L51 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:50 PM
L53	2	"20030048539"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:52 PM
L54	1	L53 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:53 PM

		(detector$1 sensor$1 receiver$1 imag$3))					
L55	1	L54 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 beam$1 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:53 PM
L56	1	L55 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:53 PM
L58	207	"5317162"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/02/10 08:07 AM
L59	116	L58 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:08 AM
L60	59	L59 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 beam$1 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:09 AM
L61	34	L60 AND ((fiber$1 fibre$1) SAME wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:09 AM
L62	59	L60 AND ((fiber$1 fibre$1) wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:11 AM
L63	6	L60 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:12 AM

		SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))					
L64	6	L60 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex curv$2) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:12 AM
L65	11	L60 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5 concave convex curv$2) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:13 AM
L66	11	L60 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5 concave convex curv$2) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:13 AM
L67	14	L3 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/28 07:55 AM
L68	1635	((("CHEN") near3 ("Yong"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/04/29 10:33 AM
L69	14	L1 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:33 AM

		measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))					
L70	14	L2 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:33 AM
L71	105898	(G01N15/1436 or F04B11/0025 or G01N15/1434 or G01N15/1459 or G01N35/1095 or G02B6/26 or G02B6/29365 or G02B21/04 or G02B21/361 or G02B27/0025 or G01N2015/1006 or G01N2015/144 or G01N2015/1452).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/04/29 10:33 AM
L72	925	I18 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:33 AM
L73	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM

		dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))					
L74	11261	356/337, 356/338, 356/335, 356/339, 356/336, 356/340, 356/625	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM
L75	2424	L35 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM
L76	599	L36 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM
L77	587	L37 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM
L78	14	L38 AND ((fiber$1 fibre$1) SAME ((plural$3 second first multiple$1) near5 (dichroic filter$1 detector$1)) SAME collimat$3)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1	1145

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EXAMINER	
AKANBI, ISIAKA O	

ART UNIT	PAPER NUMBER
2877	

NOTIFICATION DATE	DELIVERY MODE
05/02/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No. 17/645,727	Applicant(s) Chen, Yong Qin	
	Examiner ISIAKA O AKANBI	Art Unit 2877	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 04/09/2024.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☑ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-5 and 7-21 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-5 and 7-21 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 12/22/2021 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

DETAILED ACTION

Amendment

The amendment filed on 04/09/2024 has been entered into this application. Claim 6 is/are cancelled. Claim 21 is/are has/have been added.

Claim Rejections - 35 USC § 103

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis (i.e., changing from AIA to pre-AIA) for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-5 and 7-21 is/are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Oostman, JR. et al. (2003/0048539 A1, Previously cited reference).

Regarding claims 1, 13, 18 and 21, **Oostman** discloses a flow cytometer **included in analytical instruments for flourescent light analysis (figs. 1-15)** comprising:

a light source **laser 11/ lasers 52 and 54** arranged to illuminate a stream of particles **43/flow cell 78** in a viewing zone of a flow cell in the flow cytometer **as can be seen in (i.e. figs. 1 and 3)**;

objective lens 19 collect and collimate the fluorescent signal from the target substance is a collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source **[pars. 0002-7]**; and

dichroic mirror 25 is a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light **(28)** collected by the collecting optical element **the objective lens 19**, the WDM including **[pars. 0003-7]**,

combination of objective lens 19 and 25 is placed across axis 24, the objective collects and collimate the fluorescent [par. 0003] is a collimating optical element arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light **is a functional limitation of the property of objective lens 19 [par. 0003]**,

a first semiconductor detector **is included in plurality of detector/detectors (32, 33, 40, 47 and 50)/(Oostman, claims 14 and 16)** configured to detect and quantitate a first color band in the fluorescent light **(i.e. reflected leg 31)**,

a first curved mirror **a dichroic mirror is included in dichroic mirror(s) 25/64/58** arranged to receive at least a portion of the fluorescent light **(28)** after the fluorescent light has passed through the collimating optical element **(19 collimate the fluorescent signal from the target substance)**, the first curved mirror configured to reflect the portion **reflected leg 31** of the fluorescent light towards the first semiconductor detector **(i.e. detector 32);** wherein **obviously** the first curved mirror **the dichroic mirror included a shaped dichroic mirror(s) 25** is arranged to receive the portion of the fluorescent light when the portion of the fluorescent light **(28)** is collimated (claim 21) **by objective lens 19 that collect and collimate the fluorescent signal from the target substance** and

the (i.e. first dichroic mirror 25) implicitly includes a first dichroic filter optically disposed between the curved mirror **shape of the (i.e. first dichroic mirror 25)** and the first semiconductor detector **included in (i.e. detector 32)**, **implicitly and/or functionally allows** the dichroic filter configured to allow the first color band in the fluorescent light **(i.e. 28/56)** to pass through the first dichroic filter **implicitly included in the (i.e. first dichroic mirror 25)** onto the first semiconductor detector **(i.e. detector 32)**, and to reflect the second color band **(i.e. the transmitted leg 30)** in the fluorescent light **(i.e. 28/56)** away from the first semiconductor detector **(i.e. detector 32)**.

Oostman fail to explicitly specify the constructional make-up of the dichroic mirror and/or the elements of the dichroic mirror make-up as being separated instead of integrated as a single unit, and the shape of the filter which made-up the dichroic mirror as being curve.

However, even though, Oostman fail to teach the constructional changes in the system the dichroic mirror of the claim(s), the constructional/structural change difference(s) is/are considered obvious design variation of separating plurality as one and/or separating integrated single system such as dichroic mirror into multiple elements that make-up the structure of the dichroic mirror, which is a beam-splitter with some sort of shape integrated filter(s) in order to split a beam into two parts of different wavelength without any appreciable loss of intensity. This makes it very useful for many different purposes, and in fluorescence microscopy (reliance on the knowledge of one of ordinary skill at the time the invention was made in order to provide an enabling disclosure, In re BODE et al, 193 USPQ 12 at 16 (CCPA, 1977).).

It would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to modify Oostman dichroic mirror by separation of the components and changing the shape as desired appropriate in the manner set forth in applicant's claims, since it is well established, whether the element is separated into multiple elements, see *In re Dulberg*, 129 USPQ 348 (CCPA, 1961) or the element is integrated into a single element, see *In re Larson*, 144 USPQ 347 (CCPA, 1965) so long as the same function performed by the prior art and the claimed invention, then the prior art still anticipates or renders obvious the claimed invention.

Therefore, it would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to modify Oostman dichroic mirror by separation of the components and changing the shape as desired appropriate in the manner set forth in applicant's claims, since the propose modification of the prior art would not change the principle of operation of the prior art invention being modified, the dichroic mirror would/will still split a beam into two parts of different wavelength without any appreciable loss of intensity that makes it very useful for many different purposes, for instance, in fluorescence microscopy, a dichroic mirror is used to separate the fluorescence light, with critical image information (... some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See In re Fine, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and In re Jones, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992)) and with some reliance on the knowledge of one of ordinary skill at the time the invention was made in order to provide an enabling disclosure, In re BODE et al, 193 USPQ 12 at 16 (CCPA, 1977).

In addition, since it has been held that the provision of adjustability, where needed, involves only routine skill in the art, In re Stevens, 101 USPQ 284 (CC1954).

For the purposes of clarity, the structure recited in claim 13 and 18 are symmetrical to the structure recited in claim 1, as such, claims 13 and 18 are rejected above as being unpatentable over Oostman.

Additionally, Applicant's attention is further request to apparatus described in U.S. Pat. No. 5,317,162, and U.S. Pat. No. 4,727,020 that is incorporated by reference in [pars. 0003-7] of Oostman for additional disclosure and clarification.

As to claims 2-5 and 7-12, **Oostman** also discloses a structure that is use in a flow cytometer/system that is implementing limitations such as, further comprising an optical fiber **(i.e. 123, 125, 127 and 129)** optically disposed between the collecting optical element and the WDM, the optical fiber arranged and configured to deliver the fluorescent light collected by the collecting optical element to the WDM **(see abstract) [pars. 0009-11, 0029-31] (figs. 4-5)** (claim 2); further comprising a first focusing optical element optically disposed between the first dichroic filter and the first semiconductor detector **is a focusing lens and the detector photomultiplier tubes are positionally relatively adjustable so that an optimum detector position can be found by motion of a detector element relative to a lens focusing incoming light [par. 0010]**, the first focusing optical element configured to focus the first color band **(i.e. green)** in the collimated beam passing through the first dichroic filter **included in the (i.e. first dichroic mirror 25)** onto the first semiconductor detector **(i.e. detector 32)**(claim 3); further comprising a second semiconductor detector **is included in plurality of detector/detectors (32, 33, 40, 47 and 50)/(Oostman, claims 14 and 16)** and configured to detect and quantitate the second color band in the collimated beam **(i.e. 28/56)** reflected by the first dichroic filter **included in the (i.e. first dichroic mirror 25)**(claim 4);

further comprising a second curved mirror **shape of the (i.e. second dichroic mirror 34)** and **includes** a second dichroic filter, the second curved mirror arranged and configured to reflect at least a portion of the collimated beam **(i.e. 28)** reflected by the first dichroic filter **included in the (i.e. first dichroic mirror 25)** towards the second semiconductor detector **(i.e. 33)**, the second dichroic filter **included in the (i.e. first**

dichroic mirror 25) arranged and configured to allow the second color band in the collimated beam **(i.e. 28)** to pass through the second dichroic filter **included in the (i.e. first dichroic mirror 34)** onto the second semiconductor detector, and to reflect a third color band in the collimated beam away from the second semiconductor detector **(i.e. 33)**(claim 5); wherein the first curved **shape (i.e. second dichroic mirror 25)** mirror reflects the portion of the collimated beam **(i.e. 28)** received from the collimating optical element **(19)** to form an image (claim 7); **the structure of the configuration anticipates** wherein the formed image is an image of the collimating optical element **(19)**(claim 8); wherein the light source **laser 11** is arranged and configured to illuminate the stream of particles **(43)** from one side of the flow cell **(i.e. fluidic system 18)**, and wherein the collecting optical element **(i.e. 19)** is arranged and configured to collect fluorescent light from another side of the flow cell **(i.e. fluidic system 18)** (claim 9); wherein the collecting optical element **(i.e. 19)** is further configured to collect and focus side-scatter light scattered by the illuminated particle in the stream **(43)** (claim 10); wherein the light source comprises a plurality of lasers **(i.e. 52 and 54)** (claim 11) **and** wherein the plurality of lasers **(i.e. 52 and 54)** comprises a first laser configured to illuminate a particle in the stream at a first location in the viewing zone, and a second laser configured to illuminate the particle at a second location in the viewing zone **as can be seen in in depicted drawing (fig. 3)** (claim 12).

As to claims 14-17, 19 and 20, **Oostman** also discloses a structure that is use in a flow cytometer/system that is implementing limitations such as, further comprising a row of focusing optical elements **plurality of focusing elements (i.e. 168, 158) in each of detector(s) leg(s)(160, 170, 180, 189, 179,169,159) [pars. 0031-32]**, each focusing

optical element in the row arranged and configured to focus the band of fluorescent light passing through a dichroic filter in the row of dichroic filters onto the corresponding semiconductor detector, **as can be seen in in depicted (fig. 5)** (claim 14); wherein the row of mirrors **(i.e. beam splitting element 151 which is a dichroic mirror)** includes at least one curved **shape** mirror configured to form an image in the fluorescent light reflected by said curved mirror (claim 15); **the structure of the configuration anticipates** wherein the image formed by said curved mirror is an image of the collimating optical element (claim 16); **and** wherein fluorescent light received by the collimating optical element is reflected back and forth between the row of mirrors and the row of dichroic filters in a zig-zag pattern, **as can be seen in depicted drawing (figs. 5-6) [pars. 0031-33]** (claim 17); wherein the first side of the flow stream **(43)** is orthogonal to the second side of the flow stream, **as can be seen depicted in drawing (i.e. figs. 1, 3,4)**(claim 19); **and** wherein the collecting optical element **light collector 19/56** is further configured to collect and focus side-scatter light scattered by the illuminated particle **[pars. 0003-0011)** (claim 20).

Response to Arguments

Applicant's arguments/remarks, filed on 04/09/2024, with respect to the rejection(s) of claim(s) have been considered but are moot because the arguments do not apply to the new ground(s) of rejection(s) being used in the current rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Isiaka Akanbi whose telephone number is (571) 272-8658. The examiner can normally be reached on 8:00 a.m. - 4:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tarifur R. Chowdhury can be reached on (571) 272-2287. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/ISIAKA O AKANBI/
Primary Examiner, Art Unit 2877

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1	1145

129381 7590 05/24/2024

NORTON ROSE FULBRIGHT US LLP - BCI
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

EXAMINER
AKANBI, ISIAKA O

ART UNIT	PAPER NUMBER
2877	

NOTIFICATION DATE	DELIVERY MODE
05/24/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

PatentDocket@Beckman.com
aoipdocket@nortonrosefulbright.com

Applicant-Initiated Interview Summary	Application No. 17/645,727	Applicant(s) Chen, Yong Qin		
	Examiner ISIAKA O AKANBI	Art Unit 2877	AIA (First Inventor to File) Status No	Page 1 of 1

All Participants (applicant, applicants representative, PTO personnel)	Title	Type
ISIAKA O AKANBI	Primary Examiner	Telephonic
Michael Pohl	Attorney	

Date of Interview: 21 May 2024

Issues Discussed:

Other

Applicant's representative provided arguments as to how Oostman's (US 2003/0048539) differs from the claimed invention specifically the limitation of a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including, **a collimating optical element** arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light, as depicted in drawing fig. 25 is separate from a collecting optical element configured to collect and focus fluorescent light emitted by a particle.... In response, Examiner agree with the Applicant's representative that it appears that Oostman does not teach this particular limitation separate element. However, the examiner indicated to Applicant's representative that a further search will be required to determine the patentability of the claim limitation. No agreement is reach.

/ISIAKA O AKANBI/ Primary Examiner, Art Unit 2877	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/645,727	Filing Date 12/22/2021	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

	(Column 1)	(Column 2)			
FOR	NUMBER FILED	NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $480 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	06/04/2024	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/ANGELA S WHITE/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**06/04/2024 04:22:35 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Deborah Roszkowski
PATENT CENTER #	65823292	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Michael Pohl

Documents

TOTAL DOCUMENTS: 4

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
BECCP0002USCIPD2C1_ResponseFOA.pdf		27	-	7782 KB
BECCP0002USCIPD2C1_ResponseFOA-A.NE.pdf	(1-1)	1	Response After Final Action	134 KB
BECCP0002USCIPD2C1_ResponseFOA-CLM.pdf	(2-7)	6	Claims	142 KB
BECCP0002USCIPD2C1_ResponseFOA-REM.pdf	(8-27)	20	Applicant Arguments/Remarks Made in an Amendment	7771 KB
BECCP0002USCIPD2C1_AFCP.pdf		2	After Final Consideration Program Request	185 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
BECCP0002USCIPD2C1_ResponseFOA.pdf	1F6EA658C8B6168048EB84CBB10E38202124AA88BBAA3F2F540B8FE5653F3BD36BFB9CD90984232E8019CBC176CCD37457C483CFABFBD2CD7648235F93C7F4F7
BECCP0002USCIPD2C1_ResponseFOA-A.NE.pdf	E054DFD98D99873D13CAA774C4722DC83FA449759B3C93C8EF6BCF669B0ADEAEC4148A20900556A93BF58B6EA288CEF51F6462BFB131E8C538D87E30705A7990
BECCP0002USCIPD2C1_ResponseFOA-CLM.pdf	24E497F3721FB4A615A50337512B1689A8BF4CFCF1EC0770AD920B790DB76A38891DB6D8E87CC2BC7A4AB0342B943E160BF9E9CEB0A8AAC602E04293ABDE6C78
BECCP0002USCIPD2C1_ResponseFOA-REM.pdf	42E5DD61B205B971CF232A78E2400FC4DA30893E32B75C6F2F8D0A25E914DA4D3310E4ADEFBDC079F9B3ED05555973CD18990DCD4096F2520A7217B8793CE0EF
BECCP0002USCIPD2C1_AFCP.pdf	17B90EE00DE9A232E7B715A8D6EF09394E4095F68C4F4C922C6EF51A2B8FA045F92E92529E2BEE6865B09BFBAB9B3EF94136EAF0B8C6DCE60E4B0CAE06C5995A

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Iris International, Inc.	Group Art Unit: 2877
Serial No.: 17/645,727	Examiner: Isiaka O. Akanbi
Filed: December 22, 2021	Atty. Dkt. No.: BECC.P0002US.CIP.D2C1
For: Flow Cytometer	Confirmation No.: 1145

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

CERTIFICATE OF ELECTRONIC TRANSMISSION
37 C.F.R. § 1.8

I hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office via Patent Center on the date below:

June 4, 2024	/Michael Pohl/
Date	Michael Pohl

RESPONSE TO FINAL OFFICE ACTION SENT MAY 2, 2024

Applicant submits this paper in response to the Final Office Action sent May 2, 2024 along with a request for reconsideration under the After Final Consideration Pilot 2.0 (AFCP 2.0). Should any fees be required for any reason relating to the filing of this paper and not otherwise be paid, Applicant authorizes the Commissioner to deduct them from Norton Rose Fulbright US LLP's Deposit Account No. 50-1212/BECC.P0002US.CIP.D2C1.

Claim Amendments begin on page **2**;

Remarks begin on page **8**;

Appendices begin following page **12**.

Claim Amendments

1. (Currently Amended) A flow cytometer, comprising:

a light source arranged to illuminate a stream of particles in a viewing zone of a flow cell in the flow cytometer;

a collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source such that the fluorescent light leaving the collecting optical element converges; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light,

a first semiconductor detector configured to detect and quantitate a first color band in the fluorescent light,

a first curved mirror arranged to receive at least a portion of the fluorescent light after the fluorescent light has passed through the collimating optical element, the first curved mirror configured to reflect the portion of the fluorescent light towards the first semiconductor detector, and

a first dichroic filter optically disposed between the first curved mirror and the first semiconductor detector, the dichroic filter configured to allow the first color band in the fluorescent light to pass through the first dichroic filter onto the first semiconductor detector, and to reflect a second color band in the fluorescent light away from the first semiconductor detector.

2. (Original) The flow cytometer of claim 1, further comprising an optical fiber optically disposed between the collecting optical element and the WDM, the optical fiber arranged and configured to deliver the fluorescent light collected by the collecting optical element to the WDM.

3. (Previously Presented) The flow cytometer of claim 1, further comprising a first focusing optical element optically disposed between the first dichroic filter and the first semiconductor detector, the first focusing optical element configured to focus the first color band in the fluorescent light passing through the first dichroic filter onto the first semiconductor detector.

4. (Previously Presented) The flow cytometer of claim 3, further comprising a second semiconductor detector arranged and configured to detect and quantitate the second color band in the fluorescent light reflected by the first dichroic filter.

5. (Previously Presented) The flow cytometer of claim 4, further comprising:

a second curved mirror and a second dichroic filter, the second curved mirror arranged and configured to reflect at least a portion of the fluorescent light reflected by the first dichroic filter towards the second semiconductor detector, the second dichroic filter arranged and configured to allow the second color band in the fluorescent light to pass through the second dichroic filter onto the second semiconductor, and to reflect a third color band in the fluorescent light away from the second semiconductor detector; and

a third semiconductor detector arranged and configured to detect and quantitate the third color band in the fluorescent light reflected by the second dichroic filter.

6. (Cancelled).

7. (Previously Presented) The flow cytometer of claim 1, wherein the first curved mirror reflects the portion of the fluorescent light to form an image.

8. (Original) The flow cytometer of claim 7, wherein the formed image is an image of the collimating optical element.

9. (Original) The flow cytometer of claim 1, wherein the light source is arranged and configured to illuminate the stream of particles from one side of the flow cell, and wherein the collecting optical element is arranged and configured to collect fluorescent light from another side of the flow cell.

10. (Original) The flow cytometer of claim 9, wherein the collecting optical element is further configured to collect and focus side-scatter light scattered by the illuminated particle in the stream.

11. (Original) The flow cytometer of claim 1, wherein the light source comprises a plurality of lasers.

12. (Original) The flow cytometer of claim 11, wherein the plurality of lasers comprises a first laser configured to illuminate a particle in the stream at a first location in the viewing zone, and a second laser configured to illuminate the particle at a second location in the viewing zone.

13. (Currently Amended) A flow cytometer comprising:

a light source arranged to illuminate a stream of particles in a viewing zone;

a collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source such that the fluorescent light leaving the collecting optical element converges; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a row of mirrors arranged and configured to sequentially reflect different color bands of the fluorescent light collected by the collecting optical element, the row of mirrors including at least one curved mirror;

a row of dichroic filters opposed to the row of mirrors, each dichroic filter configured to pass one color band of the fluorescent light reflected by a mirror in the row of mirrors, and to reflect another color band of the fluorescent light reflected by the mirror;

a row of semiconductor detectors, each semiconductor detector arranged and configured to detect and quantitate the band of fluorescent light passing through a dichroic filter in the row of dichroic filters.

14. (Original) The flow cytometer of claim 13, further comprising a row of focusing optical elements, each focusing optical element in the row arranged and configured to focus the band of fluorescent light passing through a dichroic filter in the row of dichroic filters onto the corresponding semiconductor detector.

15. (Original) The flow cytometer of claim 14, wherein the row of mirrors includes at least one curved mirror configured to form an image in the fluorescent light reflected by said curved mirror.

16. (Previously Presented) The flow cytometer of claim 15, wherein the image formed by said curved mirror is an image of a collimating optical element that is arranged to receive the fluorescent light collected by the collecting optical element and configured to collimate the fluorescent light.

17. (Previously Presented) The flow cytometer of claim 13, wherein the row of mirrors and row of dichroic filters are arranged such that fluorescent light received by the WDM is reflected back and forth between the row of mirrors and the row of dichroic filters in a zig-zag pattern.

18. (Currently Amended) A flow cytometer, comprising:

a light source arranged to illuminate a flow-stream of particles in a viewing zone from a first side of the flow stream;

a collecting optical element arranged on a second side of the flow stream, the collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source such that the fluorescent light leaving collecting optical element converges; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light,

a first semiconductor detector configured to detect and quantitate a first color band in the fluorescent light,

a first curved mirror arranged to receive at least a portion of the fluorescent light after the fluorescent light has passed through the collimating optical element, the first curved mirror configured to reflect the portion of the fluorescent light towards the first semiconductor detector, and

a first dichroic filter disposed between the first curved mirror and the first semiconductor detector, the dichroic filter configured to allow the first color band in the fluorescent light to pass through the first dichroic filter onto the first semiconductor detector, and to reflect a second color band in the fluorescent light away from the first semiconductor detector.

19. (Previously Presented) The flow cytometer of claim 18, wherein the first side of the flow stream is orthogonal to the second side of the flow stream.

20. (Original) The flow cytometer of claim 19, wherein the collecting optical element is further configured to collect and focus side-scatter light scattered by the illuminated particle.

21. (Previously Presented) The flow cytometer of claim 1, wherein the first curved mirror is arranged to receive the portion of the fluorescent light when the portion of the fluorescent light is collimated.

Remarks

I. Status of the Claims

Claims 1, 13, and 18 are amended. Support for the claim amendments can be found in, for example, 43:23-44:7, 53:21-54:5, 54:18-54:31, 68:6-69:2, and FIGs. 1, 9A, 10, and 25 of the originally-filed application. Claims 1-5 and 7-21 are pending. No new matter is added.

II. Summary of Examiner Interview

Applicant thanks Examiner Akanbi for participating in an interview with Applicant's representative, Michael Pohl, on May 21, 2024. Differences between Pub. No. US 2003/0048539 ("Oostman") and the claims were discussed. In particular, Examiner Akanbi and Mr. Pohl first discussed whether Oostman's objective lens 19 that collimates fluorescent light was a "collecting optical element configured to collect and focus fluorescent light." Examiner Akanbi indicated that objective lens 19's ability to collimate fluorescent light meant, under a broadest reasonable interpretation of the claims, that the objective lens "focus[es]" the fluorescent light in Oostman. Mr. Pohl disagreed, but indicated that Applicant would consider claim amendments to obviate the disagreement over the interpretation of the claims and to expedite prosecution.

Examiner Akanbi and Mr. Pohl then discussed whether Oostman had a separate "collecting optical element" and "collimating optical element" as recited in independent claims 1 and 18. Agreement was reached that Oostman did not disclose such separate elements, and Examiner Akanbi suggested amending the claims to explicitly specify that the claimed collimating optical element "is separate from" the claimed collecting optical element. Examiner Akanbi indicated that further search would be required to assess the patentability of the separateness requirement.

No agreement was reached.

III. The Claims Are Patentable Over Oostman

The Office rejects all claims under 35 U.S.C. § 103 as allegedly obvious over Oostman. Action at 3-9. Applicant respectfully disagrees.

A. A Collecting Optical Element Configured to "Focus" Fluorescent Light

Independent claims 1, 13, and 18 each recite "a light source arranged to illuminate … particles" and "a collecting optical element" that is "configured to collect and focus fluorescent light emitted by a particle illuminated by the light source." The Office contends that the apparatus disclosed in Oostman's FIG. 1 has a light source—"air cooled argon ion laser 11" whose "beam 12 … impinge[s] upon a fluorescent substance in a flow cell 41" to "caus[e] fluorescent excitation"—that is arranged to illuminate particles. Action at 3; Oostman at ¶ [0003]. And, per the Office, "[o]bjective lens 19" of Oostman's FIG. 1 is a "collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source" as claimed. Action at 3; Oostman at ¶ [0003].

Applicant respectfully disagrees that Oostman's objective lens 19 is configured to "focus fluorescent light" because the objective lens "collimate[s]" rather than focuses "the fluorescent signal from the target substance." Oostman at ¶ [0003] (emphasis added). Because Oostman's objective lens 19 collimates fluorescent light, a POSITA would have understood that the objective lens "brings all of the rays [] parallel to each other," albeit with some "beam divergence" in view of practical limitations. *See, e.g.*, Excerpts from Newport Catalog at 480, 500, *available at* http://rpdata.caltech.edu/courses/aph162/2007 (defining "Collimated Beam" and explaining how collimated beams have some "beam divergence" because "nothing is ever a true point source") (attached as APPENDIX A). This is not "focus[ing]" the fluorescent light, which instead involves converging the light. *See, e.g.*, *id.* at 480 ("the focusing of a laser beam to a small spot" involves converging the light to "the focused spot"); Excerpt from Merriam Webster's Collegiate

Dictionary Tenth Edition at 451 (1993) ("focus" means "to bring (as light rays) to a focus: CONCENTRATE" or "to come to a focus : CONVERGE") (attached as APPENDIX B); *compare, e.g.*, Specification at 54:27-31 and FIG. 10 (light that doublet lens 609 "focus[es]" converges "onto the image plane 605'") *with* Specification at 68:21-26 and FIG. 25 (light "effectively collimated" by collimating optical element 902 is not converging).

Nevertheless, in an effort to expedite prosecution, independent claims 1, 13, and 18 are each amended to recite "that the fluorescent light leaving the collecting optical element converges," which makes clear that the fluorescent light "focus[ed]" by the "collecting optical element" converges instead of being collimated. Because Oostman's objective lens 19 collimates the fluorescent light (e.g., makes its rays parallel, albeit with some divergence), it is not configured to "focus [the] fluorescent light … such that the fluorescent light leaving [the objective lens] converges" as the claims require. *See* Oostman at ¶ [0003]; *supra*.

B. Separate Collecting Optical Element and Collimating Optical Element

Independent claims 1 and 18 each recite, in addition to the "collecting optical element," a "wavelength division multiplexer (WDM)" that includes "a collimating optical element … arranged to receive the fluorescent light collected by the collecting optical element." The separate listing of the collecting optical element and collimating optical element in these claims means that those are distinct components because "[w]here a claim lists elements separately, 'the clear implication of the claim language' is that those elements are 'distinct component[s]' of the patented invention." *Becton, Dickinson & Co. v. Tyco Healthcare Grp., LP*, 616 F.3d 1249, 1254 (Fed. Cir. 2010) (quoting *Gaus v. Conair Corp.*, 363 F.3d 1284, 1288 (Fed. Cir. 2004)). Indeed, interpreting the claims otherwise would be nonsensical: claims 1 and 18 require the collimating optical element "to receive the fluorescent light collected by the collecting optical element," which

is an optical arrangement that would not exist without a distinct collecting optical element and collimating optical element.

The Office fails to treat the claimed collecting optical element and collimating optical element as distinct components in its rejection. In particular, the Office relies on a single structure—Oostman's objective lens 19—in its mappings to both the claimed collecting optical element and the claimed collimating optical element. *See* Action at 3 (contending that "objective lens 19 … is a collecting optical element" and that the "combination of [Oostman's] objective lens 19 and [dichroic mirror] 25 … is a collimating optical element"). But because those are distinct structures in the claim, "the claimed [collecting optical element] and [collimating optical element] cannot be read on the **same** device found in [the prior art]." *Ex parte Masiero*, Appeal No. 2020-003171, slip op. at 4-6, 8-9 (PTAB Oct. 19, 2021).

Nevertheless, in an effort to expedite prosecution and to remove any doubt that the claimed "collecting optical element" and "collimating optical element" are not one and the same, claims 1 and 18 are each amended to recite that the collimating optical element "is separate from the collecting optical element" such that they are two distinct structures. As Examiner Akanbi acknowledged in the interview, Oostman lacks a distinct "collecting optical element" and "collimating optical element" as claimed.

For at least these reasons, **independent claims 1**, **13**, and **18** are patentable over Oostman.[1] Applicant respectfully requests reconsideration and withdrawal of the rejections.

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[1] The Office acknowledges that Oostman also fails to disclose a separate curved mirror and dichroic filter, but contends that it would have been obvious to separate Oostman's dichroic mirror 25 into a dichroic filter and a curved mirror in Oostman's FIG. 1. Action at 5-6. Applicant respectfully disagrees, at least because a POSITA would not have viewed Oostman's dichroic mirror 25 as an optical element that could be separated into a mirror and dichroic filter as an "obvious design variation." Nevertheless, the above arguments are sufficient to overcome the Office's rejections.

IV. Conclusion

The pending claims are in condition for allowance for at least the reasons set forth above. Applicant does not acquiesce to the Office's characterizations of the claim language or the cited references, and reserves the right to challenge any such characterizations in the future. The Examiner is invited to contact the undersigned attorney with any questions or comments relating to this application.

Respectfully submitted,

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APPENDIX A

Focusing and Collimating

Optical Ray Tracing

An introduction to the use of lenses to solve optical applications can begin with the elements of ray tracing. Figure 1 demonstrates an elementary ray trace showing the formation of an image, using an ideal thin lens. The object height is y_1 at a distance s_1 from an ideal thin lens of focal length f. The lens produces an image of height y_2 at a distance s_2 on the far side of the lens.

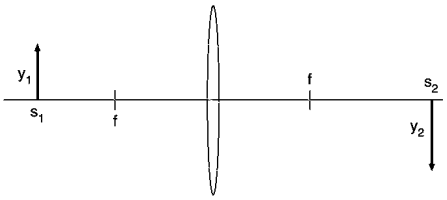


Figure 1

By **ideal thin lens**, we mean a lens whose thickness is sufficiently small that it does not contribute to its focal length. In this case, the change in the path of a beam going through the lens can be considered to be instantaneous at the center of the lens, as shown in the figure. In the applications described here, we will assume that we are working with ideally thin lenses. This should be sufficient for an introductory discussion. Consideration of aberrations and thick-lens effects will not be included here.

Three rays are shown in Figure 1. Any two of these three rays fully determine the size and position of the image. One ray emanates from the object parallel to the optical axis of the lens. The lens refracts this beam through the optical axis at a distance f on the far side of the lens. A second ray passes through the optical axis at a distance f in front of the lens. This ray is then refracted into a path parallel to the optical axis on the far side of the lens. The third ray passes through the center of the lens. Since the surfaces of the lens are normal to the optical axis and the lens is very thin, the deflection of this ray is negligible as it passes through the lens.

In addition to the assumption of an ideally thin lens, we also work in the paraxial approximation. That is, angles are small and we can substitute θ in place of sin θ.

Magnification

We can use basic geometry to look at the magnification of a lens. In Figure 2, we have the same ray tracing figure with some particular line segments highlighted. The ray through the center of the lens and the optical axis intersect at an angle ϕ. Recall that the opposite angles of two intersecting lines are equal. Therefore, we have two similar triangles. Taking the ratios of the sides, we have

$$\phi = y_1/s_1 = y_2/s_2$$

This can then be rearranged to give

$$y_2/y_1 = s_2/s_1 = M.$$

The quantity M is the **magnification** of the object by the lens. The magnification is the ratio of the image size to the object size, and it is also the ratio of the image distance to the object distance.

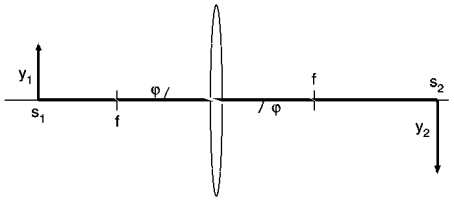


Figure 2

This puts a fundamental limitation on the geometry of an optics system. If an optical system of a given size is to produce a particular magnification, then there is only one lens position that will satisfy that requirement. On the other hand, a big advantage is that one does not need to make a direct measurement of the object and image sizes to know the magnification; it is determined by the geometry of the imaging system itself.

Gaussian Lens Equation

Let's now go back to our ray tracing diagram and look at one more set of line segments. In Figure 3, we look at the optical axis and the ray through the front focus. Again looking at similar triangles sharing a common vertex and, now, angle η, we have $y_2/f = y_1/(s_1\text{-}f)$.

Rearranging and using our definition of magnification, we find

$$y_2/y_1 = s_2/s_1 = f/(s_1\text{-}f).$$

Rearranging one more time, we finally arrive at

$$1/f = 1/s_1 + 1/s_2.$$

This is the **Gaussian lens equation**. This equation provides the fundamental relation between the focal length of the lens and the size of the optical system. A specification of the required magnification and the Gaussian lens equation form a system of two equations with three unknowns: f, s_1, and s_2. The addition of one final condition will fix these three variables in an application.

This additional condition is often the focal length of the lens, f, or the size of the object to image distance, in which case the sum of $s_1 + s_2$ is given by the size constraint of the system. In either case, all three variables are then fully determined.

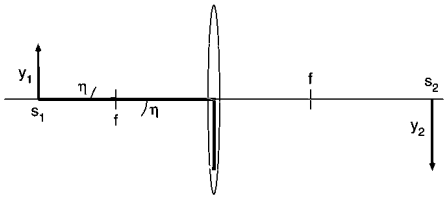


Figure 3

Optical Invariant

Now we are ready to look at what happens to an arbitrary ray that passes through the optical system. Figure 4 shows such a ray. In this figure, we have chosen the maximal ray, that is, the ray that makes the maximal angle with the optical axis as it leaves the object, passing through the lens at its maximum clear aperture. This choice makes it easier, of course, to visualize what is happening in the system, but this maximal ray is also the one that is of most importance in designing an application. While the figure is drawn in this fashion, the choice is completely arbitrary and the development shown here is true regardless of which ray is actually chosen.

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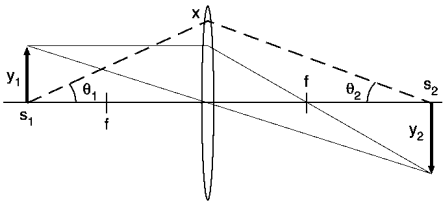


Figure 4

This arbitrary ray goes through the lens at a distance x from the optical axis. If we again apply some basic geometry, we have, using our definition of the magnification,

$\theta_1 = x/s_1$ and $\theta_2 = x/s_2 = (x/s_1)(y_1/y_2)$.

Rearranging, we arrive at

$y_2\theta_2 = y_1\theta_1$.

This is a fundamental law of optics. In any optical system comprising only lenses, the product of the image size and ray angle is a constant, or invariant, of the system. This is known as the **optical invariant**. The result is valid for any number of lenses, as could be verified by tracing the ray through a series of lenses. In some optics textbooks, this is also called the Lagrange Invariant or the Smith-Helmholz Invariant.

This is valid in the paraxial approximation in which we have been working. Also, this development assumes perfect, aberration-free lenses. The addition of aberrations to our consideration would mean the replacement of the equal sign by a greater-than-or-equal sign in the statement of the invariant. That is, aberrations could increase the product but nothing can make it decrease.

Application 1: Focusing a Collimated Laser Beam

As a first example, we look at a common application, the focusing of a laser beam to a small spot. The situation is shown in Figure 5. Here we have a laser beam, with radius y_1 and divergence θ_1 that is focused by a lens of focal length f. From the figure, we have $\theta_2 = y_1/f$. The optical invariant then tells us that we **must** have $y_2 = \theta_1 f$, because the product of radius and divergence angle must be constant.

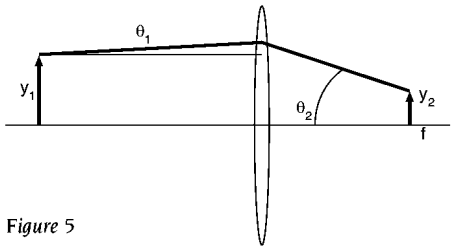


Figure 5

As a numerical example, let's look at the case of the output from a Newport R-31005 HeNe laser focused to a spot using a Newport KPX043 plano-convex lens. This laser has a beam diameter of 0.63 mm and a divergence of 1.3 mrad. Note that these are beam diameter and full divergence, so in the notation of our figure, $y_1 = 0.315$ mm and $\theta_1 = 0.65$ mrad. The KPX043 lens has a focal length of 25.4 mm. Thus, at the focused spot, we have a radius $\theta_1 f = 16.5$ µm. So, the diameter of the spot will be 33 µm.

This is a fundamental limitation on the minimum size of the focused spot in this application. We have already assumed a perfect, aberration-free lens. No improvement of the lens can yield any improvement in the spot size. The only way to make the spot size smaller is to use a lens of shorter focal length or expand the beam. If this is not possible because of a limitation in the geometry of the optical system, then this spot size is the smallest that could be achieved. In addition, diffraction may limit the spot to an even larger size (see Gaussian Beam Optics section beginning on page 484), but we are ignoring wave optics and only considering ray optics here.

Application 2: Collimating Light from a Point Source

Another common application is the collimation of light from a very small source, as shown in Figure 6. The problem is often stated in terms of collimating the output from a "point source." Unfortunately, nothing is ever a true point source and the size of the source must be included in any calculation. In figure 6, the point source has a radius of y_1 and has a maximum ray of angle θ_1. If we collimate the output from this source using a lens with focal length f, then the result will be a beam with a radius $y_2 = \theta_1 f$ and divergence angle $\theta_2 = y_1/f$. Note that, no matter what lens is used, the beam radius and beam divergence have a reciprocal relation. For example, to improve the collimation by a factor of two, you need to increase the beam diameter by a factor of two.

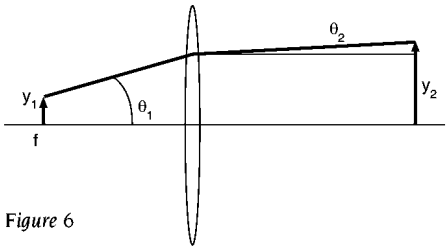


Figure 6

Since a common application is the collimation of the output from an optical fiber, let's use that for our numerical example. The Newport F-MBB fiber has a core diameter of 200 µm and a numerical aperture (NA) of 0.37. The radius y_1 of our source is then 100 µm. NA is defined in terms of the half-angle accepted by the fiber, so $\theta_1 = 0.37$. If we again use the KPX043, 25.4 mm focal length lens to collimate the output, we will have a beam with a radius of 9.4 mm and a half-angle divergence of 4 mrad. We are locked into a particular relation between the size and divergence of the beam. If we want a smaller beam, we must settle for a larger divergence. If we want the beam to remain collimated over a large distance, then we must accept a larger beam diameter in order to achieve this.

Application 3: Expanding a Laser Beam

It is often desirable to expand a laser beam. At least two lenses are necessary to accomplish this. In Figure 7, a laser beam of radius y_1 and divergence θ_1 is expanded by a negative lens with focal length $-f_1$. From Applications 1.1 and 1.2 we know $\theta_2 = y_1/|-f_1|$, and the optical invariant tells us that the radius of the virtual image formed by this lens is $y_2 = \theta_1|-f_1|$. This image is at the focal point of the lens, $s_2 = -f_1$, because a well-collimated laser yields $s_1 \sim \infty$, so from the Gaussian lens equation $s_2 = f$. Adding a second lens with a positive focal length f_2 and separating the two lenses by the sum of the two focal lengths $-f_1 + f_2$, results in a beam with a radius $y_3 = \theta_2 f_2$ and divergence angle $\theta_3 = y_2/f_2$.

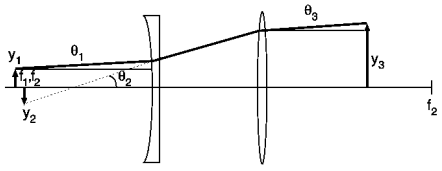


Figure 7

The expansion ratio

$y_3/y_1 = \theta_2 f_2/\theta_2|-f_1| = f_2/|-f_1|,$

or the ratio of the focal lengths of the lenses. The expanded beam diameter

$2y_3 = 2\theta_2 f_2 = 2y_1 f_2/|-f_1|.$

The divergence angle of the resulting expanded beam

$\theta_3 = y_2/f_2 = \theta_1|-f_1|/f_2$

is reduced from the original divergence by a factor that is equal to the ratio of the focal lengths $|-f_1|/f_2$. So, to expand a laser beam by a factor of five we would select two lenses whose focal lengths differ by a factor of five, and the divergence angle of the expanded beam would be 1/5th the original divergence angle.

As an example, consider a Newport R-31005 HeNe laser with beam diameter 0.63 mm and a divergence of 1.3 mrad. Note that these are beam diameter and full divergence, so in the notation of our figure, $y_1 = 0.315$ mm and $\theta_1 = 0.65$ mrad. To expand this beam ten times while reducing the divergence by a factor of ten, we could select a plano-concave lens KPC043 with $f_1 = -25$ mm and a plano-convex lens KPX109 with $f_2 = 250$ mm. Since real lenses differ in some degree from thin lenses, the spacing between the pair of lenses is actually the sum of the back focal lengths $BFL_1 + BFL_2 = -26.64$ mm + 247.61 mm = 220.97 mm.

The expanded beam diameter

$2y_3 = 2y_1 f_2/|-f_1|$

$= 2(0.315 \text{ mm})(250 \text{ mm})/|-25 \text{ mm}|$

$= 6.3$ mm.

The divergence angle

$\theta_3 = \theta_1|-f_1|/f_2$

$= (0.65 \text{ mrad})|-25 \text{ mm}|/250 \text{ mm}$

$= 0.065$ mrad.

For minimal aberrations, it is best to use a plano-concave lens for the negative lens and a plano-convex lens for the positive lens with the plano surfaces facing each other. To further reduce aberrations, only the central portion of the lens should be illuminated, so choosing oversized lenses is often a good idea. This style of beam expander is called Galilean. Two positive lenses can also be used in a Keplerian beam expander design, but this configuration is longer than the Galilean design.

Application 4: Focusing an Extended Source to a Small Spot

This application is one that will be approached as an imaging problem as opposed to the focusing and collimation problems of the previous applications. An example might be a situation where a fluorescing sample must be imaged with a CCD camera. The geometry of the application is shown in Figure 8. An extended source with a radius of y_1 is located at a distance s_1 from a lens of focal length f. The figure shows a ray incident upon the lens at a radius of R. We can take this radius R to be the maximal allowed ray, or clear aperture, of the lens.

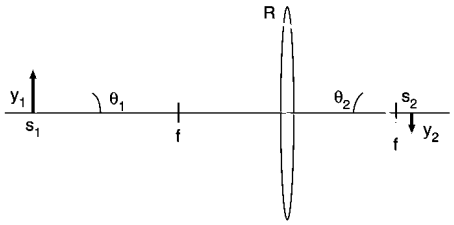


Figure 8

If s_1 is large, then s_2 will be close to f, from our Gaussian lens equation, so for the purposes of approximation we can take $\theta_2 \sim R/f$. Then from the optical invariant, we have

$y_2 = y_1\theta_1/\theta_2 = y_1(R/s_1)(f/R)$ or

$y_2 = 2y_1(R/s_1)f/\#.$

where f/2R = f/D is the f-number, f/#, of the lens. In order to make the image size smaller, we could make f/# smaller, but we are limited to f/# = 1 or so. That leaves us with the choice of decreasing R (smaller lens or aperture stop in front of the lens) or increasing s_1. However, if we do either of those, it will restrict the light gathered by the lens. If we either decrease R by a factor of two or increase s_1 by a factor of two, it would decrease the total light focused at s_2 by a factor of four due to the restriction of the solid angle subtended by the lens.

Fiber Optic Coupling

The problem of coupling light into an optical fiber is really two separate problems. In one case, we have the problem of coupling into multimode fibers, where the ray optics of the previous section can be used. In the other case, coupling into single-mode fibers, we have a fundamentally different problem. In this case, one must consider the problem of matching the mode of the incident laser light into the mode of the fiber. This cannot be done using the ray optics approach, but must be done using the concepts of Gaussian beam optics (see page 484).

Application 5: Coupling Laser Light into a Multimode Fiber

When we look at coupling light from a well-collimated laser beam into a multimode optical fiber, we return to the situation that was illustrated in Figure 5. The radius of the fiber core will be our y_2. We will have to make sure that the lens focuses to a spot size less than this parameter. An even more important restriction is that the angle from the lens to the fiber θ_2 must be less than the NA of the optical fiber.

Let's consider coupling the light from a Newport R-30990 HeNe laser into an F-MSD fiber. The laser has a beam diameter of 0.81 mm and divergence .0 mrad. The fiber has a core diameter of 50 µm and an NA of 0.20. Let's look at the coupling from the beam into the fiber when a Newport M-20X objective lens is used in an F-915 or F-915T fiber coupler.

The objective lens has an effective focal length of 9 mm. In this case, the focused beam will have a diameter of 9 µm and a maximal ray of angle 0.05, so both the

Optics Glossary

Abbe Number: The constant of an optical medium that describes the ratio of its refractivity to its dispersion.

Specifically, $V_d = (n_d-1)/(n_F-n_C)$, where n is the index of refraction at the Fraunhofer d, F, and C lines, respectively.

Aberration: An optical defect resulting from design or fabrication error that prevents the lens from achieving precise focus. The primary aberrations are spherical, coma, astigmatism, field curvature, distortion, and chromatic aberration.

Achromatic Lens: Lens in which chromatic aberration has been corrected at a minimum of two wavelengths.

Airy Disc: A pattern of illumination caused by diffraction at the edge of a circular aperture, consisting of a central core of light surrounded by concentric rings of gradually decreasing intensity.

Anamorphic: Distorted, as in an optical system with different magnification levels or with focal lengths perpendicular to the optical axis.

Angle of Incidence: The angle formed by a ray of light striking a surface and the normal to that surface.

Antireflection (AR) Coating: A thin layer of material that, when applied to a lens or window, increases its transmittance by reduction of its reflectance. AR coatings may be multilayer or single layer coatings.

Aperture: An opening through which light may pass. The clear aperture is that area in an optical system limiting the bundle of light able to pass through the system.

Aspheric: Not spherical. To reduce spherical aberration, a lens may be altered slightly so that one or more surfaces are Aspheric.

Astigmatism: An aberration in a lens in which the tangential and sagittal (horizontal and vertical) lines are focused at two different points along the optical axis.

Back Focal Length (BFL): The distance between the last surface of a lens to its image focal plane.

Bandpass: The range of wavelengths that passes through a filter or other optical component.

Bandwidth: Range of wavelengths over which the specified transmission or reflection occurs.

Beam Deviation: See Deviation.

Beamsplitter: An optical device that divides an incident beam into at least two distinct beams.

Bi-Concave: Having two outer surfaces that curve inward.

Bi-Convex: Having two outer surfaces that curve outward.

Birefringence: The change in refractive index with the polarization of light. A birefringent crystal, such as calcite or quartz, will divide an unpolarized beam into two beams (ordinary and extraordinary) having opposite polarization.

Blocking: Refers to filter transmittance outside the bandpass region. It is the rejection of out-of-band wavelengths by a filter.

Blur Circle: The image of a point-source object formed by an optical system on its focal surface. The precision level of the lens and its state of focus determine the size of the blur.

Borosilicate Glass: An optical glass containing boric oxide, along with silica and other ingredients. BK 7 and Pyrex® are examples of borosilicate glasses.

Brewster's Angle: For light incident on a plano boundary between two materials having different index of refraction; that angle of incidence at which the reflectance is zero for light that has its electrical field vector in the plane defined by the direction of propagation and the normal to the surface. For propagation from material 1 to material 2, Brewster's angle is given as $\tan^{-1}(n_2/n_1)$.

Broadband Coating: A multilayer coating with specified reflection or transmission over a broad spectral band. Newport's AR.14 is a broadband AR coating, while Newport BD.1 is broadband mirror coating.

Cavity: A periodic structure of thin films comprised of two quarter-wave stack reflectors separated by a dielectric spacer. Cavities are the building blocks of bandpass filters.

Center Wavelength: The center of the wavelength band of a coating.

Centration: The deviation between the optical axis and the mechanical axis of a lens. Centration is specified in terms of the deflection of a beam directed along the mechanical axis of the lens.

Chromatic Aberration: An optical defect in a lens resulting in different wavelengths of light focusing at different distances from the lens. Corrected by achromatic lenses.

Circle of Least Confusion: The smallest cross-section of a focused beam of light at the point of best focus for the image.

Clear Aperture: The area of an optical component that controls the amount of light incident on a given surface. In Newport lenses and mirrors, the clear aperture gives the diameter over which specifications are guaranteed.

Coefficient of Thermal Expansion: A material property defined as the fractional change in length per original length (or fractional change in volume) with a change in temperature.

Collimated Beam: A beam of light in which all of the rays are parallel to each other.

Coma: An aberration that occurs in a lens when rays emanating from points not on the optical axis do not converge, causing the image of a point to appear comet-shaped.

Cone Angle: The central angle of a cone of rays converging to or diverging from a point. See Numerical Aperture.

Conjugate Ratio: The ratio of the object distance to the image distance.

Continuous Wave Irradiation: Emission of radiant energy (light) in a continuous wave, rather than pulsed.

Contrast: The difference in light intensity in an object or image; defined as $(I_{max} - I_{min})/(I_{max} + I_{min})$, where I_{max} and I_{min} are the maximum and minimum intensities.

Converging: The bending of light rays toward one another, achieved with a positive (convex) lens.

Critical Angle: The smallest angle of incidence at which total internal reflectance takes place. Maximum angle of incidence formed by a ray of light as it passes from a denser to a less dense medium. When the critical angle is exceeded, total internal reflection occurs, and all the incident light reflects back in to the more dense media.

Crown Glass: A silicate glass containing oxides of sodium and potassium, used in lenses and windows. Harder than flint glass, it has low index and low dispersion, such as BK 7.

Crystal Quartz: Crystalline form of silicon dioxide; used in wave plates.

Cut-Off Wavelength: For a filter, the wavelength where the transmission falls below 50%.

Cut-On Wavelength: For a filter, the wavelength where the transmission increases above 50%.

Cylindrical Lens: A lens with at least one surface shaped like a portion of a cylinder. A typical application is reducing the astigmatism of laser diodes.

Damage Threshold: The maximum energy density to which an optical surface may be subjected without failure.

Decentration: The failure of one or more lens surfaces to align their centers of curvature with the geometric axis of a lens system.

Density, Optical: A measure of the transmittance (T) through an optical medium; expressed as $D = -\log(T)$ or $T = 10^{-D}$.

Depth of Field: The distance along the optical axis through which an object can be located and clearly defined when the lens is in focus.

Depth of Focus: The distance along the optical axis through which an image can be clearly focused.

Deviation: The angle between the paths of a ray of light before and after passing through one or more optics.

Dielectric Coatings: Thin-film optical coatings made up of alternating layers of non-conductive material. The key factor in whether one uses a dielectric coating or another technology to accomplish the filtering effect is whether or not absorption is desired. Dielectric coatings typically have low to non-existent absorption whereas coatings using metals often exhibit some level of absorption.

Diffraction: The sidewise or sideways spread of light as it passes the edge of an object or emerges from a small aperture; causes halos or blurring of the image.

Diffraction Limited: Describes an optical system in which the quality of the image is determined only by the effects of diffraction and not by lens aberrations.

Dispersion: The separation of a beam into its various wavelength components due to wavelength dependent speed of propagation in the material.

Distortion: Variations in magnification from the center to the edge of an image, making straight lines look curved. Barrel, or negative, distortion causes a square grid to appear barrel-shaped; pincushion, or positive, distortion increases in proportion to the distance from the center of the image.

Diverging: The bending of light rays away from each other, achieved with a negative (concave) lens.

Edging: Grinding, or finishing, the edge of an optical element or lens.

Effective (or Equivalent) Focal Length (EFL): The focal length of an infinitely thin lens having the same paraxial imaging properties as a thick lens or multiple-element lens system.

Entrance Pupil: The image of the aperture stop as viewed through the object side of the lens.

Erect Image: An image whose spatial orientation is the same as that of the object.

Extinction Ratio: The ratio of the intensities along the polarization axes of a plane-polarized beam that is transmitted through a polarizer; expressed as T_p/T_s.

F-Number: A measure of the ability of a lens to gather light. Represented by f/# and also called its "speed". The ratio of the focal length of the lens to its effective aperture. Related to numerical aperture by $f/\# = 1/(2NA)$.

Field Curvature: An aberration in which the edges of a field seem to be out of focus when the center is focused clearly.

Field of View: The maximum visible space seen through a lens or optical instrument.

Figure: See Surface Figure.

Flatness: See Surface Flatness.

Flint Glass: An optical glass with higher dispersion and higher refractive index than crown glass; a heavy, brilliant glass, softer than crown glass. For example, SF Series glasses are used in Newport achromatic lenses.

Focal Length (FL): See Effective Focal Length.

Front Focal Length (FFL): The distance from the objective plane of a lens to its first surface.

Fused Silica: Crystal quartz melted at a high temperature to make an amorphous, non-birefringent glass of low refractive index. Used in high-energy components and optical components designed for UV. It can be used down to 195 nm.

FWHM: Full Width Half Maximum. The bandwidth of an optical instrument as measured at the half-power points.

Gaussian Optics: Optical characteristics limited to infinitesimally small pencils of light; also called paraxial or first-order optics.

Geometric Optics: That branch of optics dealing with the tracing of ray paths through optical systems. Geometric optics ignores the nature of the electromagnetic modes of light.

High-Efficiency Coating: Specialized coating applied to optics to improve transmission or reflection.

Homogeneity: The state in which all volume components of a substance are identical in optical properties and composition.

Hybrid: Anything formed out of heterogeneous elements.

Image Circle: The circular image field over which image quality is acceptable; can be defined in terms of its angular subtense. Alternately known as circle of coverage.

Image Inversion: Change in the orientation of an image in one meridian.

Image Plane: The plane perpendicular to the optical axis at the image point.

Image Transposition: The flipping of an image's orientation, such as inversion of an image's orientation in one axis or the reversion of an image's orientation in two axes.

Index of Refraction: The ratio of the speed of light in air to its velocity in another medium; determines how much light bends as it passes through a lens, e.g., high-index flint glass bends light more than low-index crown glass does.

Infrared: The long wavelength portion of the spectrum whose wavelengths are invisible to the human eye (the range is approximately 780 nm and longer wavelengths).

Interference Filter: A filter that controls the spectral composition of transmitted energy by interference. Several types of filters can be constructed using interference, including bandpass, beamsplitter, dichroic, and edge filters.

Interferometer: An instrument that uses the interference of light waves to measure small displacements or deformation.

Iris Diaphragm: A mechanical device for varying the effective diameter of an optical system.

Irregularity: Refers to figure deviations that are not spherical in nature. Using a test plate, irregularity is measured by counting the difference in the number of fringes in two orthogonal axes.

Knoop Hardness: A measure of hardness determined by the depth of penetration of a diamond stylus under a specified load. Similar to the Rockwell hardness test.

Lateral Color: A chromatic aberration resulting in image size variation as a function of wavelength. Also known as chromatic difference of magnification.

Limit of Resolution: The limit to the performance of a lens imposed by the diffraction pattern resulting from the finite aperture of the optical system.

Long Pass: Filter that efficiently passes radiation whose wavelengths are longer than a specific wavelength, but not shorter.

Longitudinal Color: The longitudinal variation of focus (or image position) with wavelength; often referred to as axial chromatic aberration.

Magnesium Fluoride: Material used as antireflection coating for lenses because of its low refractive index. Also used as an optical substrate material for UV and infrared applications.

Magnification: The enlargement of an object by an optical instrument; ratio of the size of the image to the actual size of the object.

Meniscus: Describes a lens having one convex and one concave surface.

Meridional Plane: The plane in an optical system containing its optical axis and the chief ray.

Metallic Coating: A thin layer of metal applied to a substrate by evaporation to create a mirrored surface.

Micro Optics: A term referring to small (less than 5 mm in size) lenses, beamsplitters, prisms, cylinders or other optical components commonly found in endoscopes or microscopes. Micro optics are also used to focus light in semiconductor laser and fiber optic applications.

Microscope Eyepiece: An eyepiece located at the near end of the microscope tube. Often a simple Huygen's eyepiece, though other varieties (negative eyepieces, flat field projection eyepieces) are common, depending on application.

Microscope Objective: The lens located at the object end of a microscope tube. Many types of objectives are used in microscopy; simple achromats and color-corrected apochromats are popular choices.

MIL-C-675: Specifies that a coating will not show degradation to the naked eye after 20 strokes with a rubber pumice eraser. Coatings meeting MIL-C-675 can be cleaned repeatedly and survive moderate to severe handling.

MIL-C-14806: Specifies durability of surfaces under environmental stress. Coatings are tested at high humidity, or in brine solutions to determine resistance to chemical attack. These coatings can survive in humid or vapor filled areas.

MIL-M-13508: Sets the durability standards for metallic coatings. Coatings will not peel away from the substrate when pulled with cellophane tape. Further, no damage visible to the naked eye will appear after 50 strokes with a dry cheesecloth pad. Gentle, nonabrasive cleaning is advised.

Modulation Transfer Function (MTF): A measure of the ability of an optical lens or system to transfer detail of the object to the image. Given as degree of contrast (or modulation depth) in the image as a function of spatial frequency.

Multi-Element System: An assembly of single and/or compound lenses optimized to provide certain optical characteristics.

Multilayer Coating: Coating composed of several layers of coating material. Different multilayer designs are used to produce a variety of coating components such as mirrors, AR coatings, bandpass coatings, dichroic coatings, and beamsplitters.

Narrowband Coating: A coating designed to provide transmittance (or reflectance) over a very restricted band of wavelengths.

Neutral Density: A coating or absorbing glass, which has a flat or nearly flat absorption curve throughout a specified spectrum. Neutral density filters decrease the intensity of light without changing the relative spectral distribution of energy.

Newton's Rings: Used to measure the fit of a lens surface against the surface of a test glass. The rings result when two adjacent polished surfaces are placed together with an air space between them and the light beams they reflect interfere.

Nodal Points: The two points at which the nodal planes appear to intersect with the optical axis. When a ray is directed at the first nodal point in an optical system, it appears to emerge from a second nodal point on the optical axis with no deviation in its angle.

Numerical Aperture: Defines the maximum cone angle of light accepted or emitted by an optical system. Given by sine of the half-angle of the maximum angle. Related to f-number by NA = 1/(2f/#).

Object-to-Image Distance: Also known as the total conjugate distance or track length. Can be finite or infinite depending on the application.

Objective: The optical element that receives light from the object and forms the first or primary image in telescopes, microscopes, and other optical systems.

Oblique Ray: A ray of light that is neither perpendicular nor parallel, but inclined.

Optical Axis: A line passing through the centers of curvature of a lens or other optical components.

Optical Density: See Density, Optical.

Optical Flat: A piece of glass with one or both surfaces polished flat. Also known as a test plate, test glass or reference flat.

Optical Interference: The additive process, whereby the amplitudes of two or more overlapping light waves are systematically attenuated and reinforced.

Optical Path Difference: For a perfect optical system, the optical path or distance from an object point to a corresponding image point will be equal for all rays. In near-perfect systems, slight differences will exist between rays resulting in an optical path difference, usually expressed in fractions of the wavelength being analyzed.

Orthogonal: Mutually perpendicular. Out-of-Band Blocking; See Blocking.

Paraxial Image Plane: Image plane located by using first-order geometric optics. See Gaussian Optics.

Pinhole Aperture: A small, sharp-edged hole that functions as an aperture, for example, in a spatial filter.

Plane of Incidence: The plane that is defined by the incident and reflected rays.

Plano-Concave: A lens with one flat (plano) surface and one inward-curved (concave) surface.

Plano-Convex: A lens with one flat (plano) surface and the other outward-curved (convex) surface.

Plano Elements: Lenses or mirrors with flat surfaces.

Polarized, Circularly: Light whose electric field vector describes a circle as a function of time.

Polarized, Linearly: See Polarized, Plane.

Polarized, Plane: Light whose electric field vector vibrates in only one plane.

Polychromatic Aberrations: The separation of an image into planes of distinct color, caused by the variation of the index of refraction of glass, and the focal length of a lens, with the wavelength of light; in a given plane, all colors but one are unfocused.

Power: 1) Lens, See Magnification (magnification power). 2) Refers to figure deviations that are spherical in nature. Using a test plate, power is measured by counting the number of fringes in two orthogonal axes. Power comprises the majority of figure deviations in a lens. Sometimes called Spherical Error.

Primary Reflections: The principal, intended reflections at optical surfaces, as differentiated from secondary, usually unintended or unwanted reflections occurring in an optical system.

Principal Planes: In a thick lens or multiple-lens system, the plane at which the entering rays and exiting rays appear to intersect the position of the equivalent thick lens.

Pulse Modulation: The process of periodically or intermittently varying the amplitude of a pulse of light.

Q: The Q of a resonator is defined as: (2π x average energy stored in the resonator)/(energy dissipated per cycle)

Q-Switched: In an optical resonator, the higher the reflectivity of its surfaces, the higher the Q. A Q-switch rapidly changes the Q in the optical resonator of a laser to prevent lasing until a high level of optical gain and energy storage has been reached in the lasing medium; a giant pulse is generated when the Q is rapidly decreased.

Quarter Wave Optical Thickness: Common thin-film term. The QWOT (Quarter Wave Optical Thickness) is the wavelength at which the optical thickness, defined as the index of refraction, n, multiplied by the physical thickness, d, of a coating evaporant layer; is one quarter wavelength, or n x d=$\lambda/4$.

Radius of Curvature: One-half the diameter of a circle defining the convex or concave shape of a lens.

Real Image: Light rays reproduce an object, called an image, by gathering a beam of light diverging from an object point and transforming it into a beam converging toward another point. If the beam is converging, it produces a real image.

Reference Flat: An optical flat used as a test glass.

Refraction: The change in direction of a ray of light as it passes from one optical medium to another with a different optical density. See Snell's Law.

Refractive Index: The ratio between the speed of light through vacuum to the speed of light through the particular medium. The index determines how much a ray of light will bend as it passes from one given medium to another. See Snell's law.

Resolution: The ability of a lens to image the points, lines, and surfaces of an object so they are perceived as discrete entities.

Reticle: An optical element containing a pattern placed at the image plane of a system. The reticle facilitates system alignment or the measurement of target characteristics.

Reverted Image: An image in which left and right seem to be reversed.

Rockwell Hardness: Resistance of a substance to penetration by a pyramidal stylus pressed in under a specific load; also see Knoop hardness.

Sag: An abbreviation for "sagitta," the Latin word for "arrow." Used to specify the distance on the normal from the surface of a concave lens to the center of the curvature. It refers to the height of a curve measured from the chord,

$$\text{Sag} = R - \sqrt{R^2 - Y^2}$$

where R = radius of curvature of the surface and Y = radius of the aperture of the surface.

Sagittal Focus: The focus of rays lying in the sagittal plane, which is the plane perpendicular to the meridional plane.

Scratch-Dig: A measure of the visibility of surface defects as defined by several U.S. military standards including MIL-PRF-13830B, MIL-F-48616, and MIL-C-48497. Unless otherwise noted, specifications for surface quality of our products are in accordance with MIL-PRF-13830. Using MIL-PRF-13838B, the ratings consist of two numbers, the first denoting the visibility of scratches, the second, of digs (small pits). A 0-0 scratch-dig number indicates a surface free of visible defects. Numbers increase as the visibility of blemishes increases. Scratches and digs are evaluated for size by comparison to standards fabricated in accordance with US Army ARDEC drawing C7641866. No absolute measurement of defect size is made or implied by the scratch-dig standard. MIL-F-48616 and MIL-C-48497 use alphabetical notations to designate defect size and prescribe physical measurement of defects to determine conformance. A specification of F/F using MIL-C or MIL-F is approximately equivalent to 80/50 with the exception that measurement is used to characterize defects rather than comparison to a set of standards.

Short Pass: Filter that efficiently passes radiation whose wavelengths are shorter than a specific wavelength, but not longer.

Slit: An aperture, typically rectangular in shape, whose length is large compared to its width.

Snell's Law of Refraction: Gives the ratio of bend angles as light passes from one medium to another; expressed as $n_1 \sin\theta_1 = n_2 \sin\theta_2$, where n is the index of refraction.

Spatial Filtering: Enhancing an image by increasing or decreasing its spatial frequencies.

Spectrophotometry: Measuring the reflection or transmission of light for each component wavelength in the spectrum of a specimen.

Spherical Error: See Power.

Spot Size: Minimum image size to which a lens may focus a collimated beam.

Striae: An imperfection in optical glass characterized by streaks of transparent material of a different refractive index than the body.

Substrate: The underlying material to which an optical coating is applied.

Surface Contour: The outline or profile of a surface.

Surface Figure: A measure of how closely the surface of an optical element matches a reference surface. Since geometrical errors will cause distortion of a transmitted or reflected wave, deviations from the ideal are measured in terms of wavelengths of light.

Surface Flatness: The amount by which an optical surface differs from a perfect plane. It is typically measured by an interferometric technique.

Surface Roughness: A measure of the texture of a surface on a microscopic scale. It is usually denoted as a root mean square (rms) value and measured in units of length, such as angstroms.

Surface Quality: See Scratch-Dig.

Total Internal Reflection (TIR): When the angle of incidence of light striking the boundary surface of a substance exceeds the critical angle, the result is total internal reflection.

Transmission: Amount of light that is passed through an optical component or system. Given as fraction or percentage of input light.

Truncation Ratio: The dimensionless ratio of the Gaussian beam diameter at the $1/e^2$ intensity point to the limiting aperture of the lens.

Ultraviolet: The short wavelength of the electromagnetic spectrum invisible to the human eye. The range is approximately 400 nm and shorter wavelengths.

V-Coating: A narrowband coating for specific laser wavelengths. This term is usually applied in reference to AR coatings.

Vignetting: The gradual reduction of image illuminance with an increasing off-axis angle, resulting from limitations of the clear apertures of elements within an optical system.

Virtual Image: Light rays that diverge from an object point can be captured by an optical system to form an image. Depending on the optical system, the light beam can either converge to another point or diverge from another point. In the case that the light converges, it will form a real image. In the case that the light diverges it will form a virtual image.

V-Value: See Abbe Number.

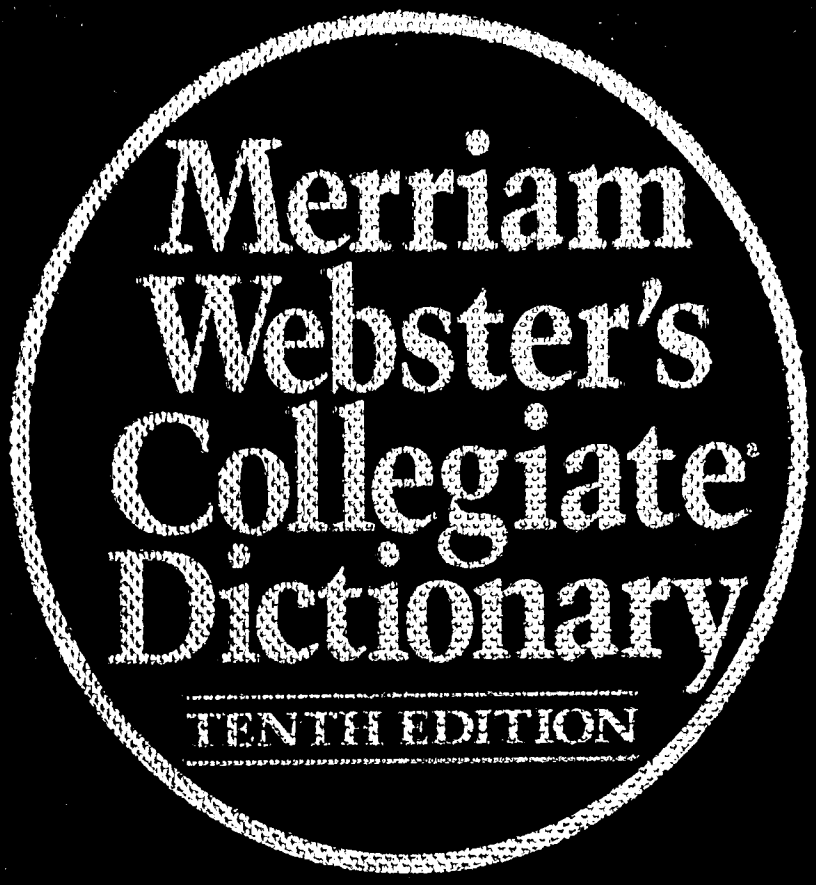
Wavefront Distortion: Departure of a wavefront from ideal (usually spherical or planar) caused by surface errors or design limitations.

Wavelength: The distance light travels in one cycle of its electromagnetic wave.

Wedge: An optical element with its faces inclined toward each other at very small angles, diverting light toward the thicker parts of the element.

Young's Modulus: Modulus of elasticity; the amount of stress required to produce a unit change in length (strain); expressed in pounds per square inch (PSI) or dynes per square cm.

APPENDIX B


Merriam
Webster's
Collegiate®
Dictionary
TENTH EDITION



Merriam-Webster's Collegiate® Dictionary

TENTH EDITION

Merriam-Webster, Incorporated
Springfield, Massachusetts, U.S.A.



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flying start *n* (1851) 1 : a start in racing in which the participants are already moving when they cross the starting line or receive the starting signal 2 : a favorable start of something
flying wedge *n* (1909) : a moving formation (as of guards or police)
fly-leaf \'flī-,lēf\ *n, pl* **fly-leaves** \-,lēvz\ (1832) : one of the free end-sheets of a book
fly-man \-,man\ *n* (1883) : a worker in the flies of a theater who manipulates curtains and scenery
fly net *n* (bef. 12c) : a net to exclude or keep off insects (as from a harness)
fly-paper \-,pā-pər\ *n* (1847) : paper coated with a sticky often poisonous substance for killing flies
fly-rod \-,räd\ *n* (1914) *chiefly Brit* : FLYBY 1
fly rod *n* (1684) : a light springy fishing rod used in fly casting
fly rock \-,räk\ *n* [*G dial.*] (1853) : a thick and extensive deposit largely of anhydrite that is formed in a geosyncline adjacent to a rising mountain range and is esp. common in the Alpine region of Europe
fly sheet *n* (1833) 1 : a small loose advertising sheet : HANDBILL 2 : a sheet of a folder, booklet, or catalog giving directions for the use of the material that follows
fly speck *n* (ca. 1847) 1 : a speck made by fly excrement 2 : something small and insignificant — **flyspeck** *vt*
fly-specked \-,spekt\ *adj*
fly-speck \-,spek\ *n* (1940) : infestation with fly maggots — **fly-specked** *adj*
fly strike \-,strīk\ *n* (1917) : a device for killing insects that consists of a flat piece of perforated rubber or plastic or fine-mesh wire attached to a handle
fly swatter \-,swä-tər\ *n* [*fly* + *tier* (one that ties)] (1881) : a person who ties flies for fishing
fly tie \-,tī\ *n* [Sc, lit., contention, gerund of *flyte* to contend, ar-
fly-tier \-,tī(-ə)r\ *n* [*fly* + *tier* (one that ties)] (1881) : a person who
flyting \'flī-tiŋ\ *n* [Sc, lit., contention, gerund of *flyte* to contend, ar-
flyte \'flīt\ *vb* [ME *flīten*, fr. OE *flītan*; akin to OHG *flīzan* to argue] (1508) : a
flyway \'flī-,wā\ *n* (1891) : an established air route of migratory birds
fly weight \-,wāt\ *n* (1911) : a boxer in a weight division having a maximum limit of 112 pounds — compare BANTAMWEIGHT
flywheel \-,hwēl, -,wēl\ *n* (1784) : a heavy wheel for opposing and evening by its inertia any fluctuation of speed in the machinery with which it revolves; *also* : a similar wheel used for storing kinetic energy (as for motive power)
fly whisk *n* (1841) : a whisk for brushing away flies
FM \'ef-'em\ *n, often attrib* [frequency *m*odulation] (1940) : a broadcasting system using frequency modulation; *also* : a radio receiver of such a system
FMN \,ef-,em-'en\ *n* [flavin *m*ononucleotide] (ca. 1953) : a yellow crystalline phosphoric ester $C_{17}H_{21}N_4O_9P$ of riboflavin that is a coenzyme of several flavoprotein enzymes
f-number \'ef-,nəm-bər\ *n* [*f*ocal length] (ca. 1903) 1 : the ratio of the focal length to the aperture in an optical system 2 : a number following the symbol *f*/ that expresses the effectiveness of the aperture of a camera lens in relation to brightness of image so that the smaller the number the brighter the image and therefore the shorter the exposure required
foal \'fōl\ *n* [ME *fole*, fr. OE *fola*; akin to L *pullus* young of an animal, *pullus* child — more at FEW] (bef. 12c) : the young of an animal of the horse family; *esp* : one under one year — **in foal** : PREGNANT 3
foal *vb* (14c) : to give birth to a foal
foam \'fōm\ *n* [ME *fome*, fr. OE *fām*; akin to OHG *feim* foam, L *spuma* foam, *pumex* pumice] (bef. 12c) 1 : a light frothy mass of fine bubbles formed in or on the surface of a liquid: as **a** : a frothy mass formed in salivating or sweating **b** : a stabilized froth produced chemically or mechanically and used esp. in fighting oil fires **c** : a material in a lightweight cellular form resulting from introduction of gas bubbles during manufacture 2 : SEA 3 : something resembling foam — **foamless** \-ləs\ *adj*
foam *vb* (bef. 12c) 1 **a** : to produce or form foam **b** : to froth at the mouth esp. in anger; *broadly* : to be angry 2 : to gush out in foam 3 : to become covered with or as if with foam ⟨streets . . . *~ing* with life —Thomas Wolfe⟩ ~ *vt* 1 : to cause to foam; *specif* : to cause air bubbles to form in 2 : to convert (as a plastic) into a foam — **foamable** \'fō-mə-bəl\ *adj* — **foamer** \'fō-mər\ *n*
foamed plastic *n* (1945) : EXPANDED PLASTIC
foamflower \'fōm-,flau̇(-ə)r\ *n* (1895) : an American woodland spring-flowering herb (*Tiarella cordifolia*) that has white flowers with very long stamens and no stem leaves — called also *false miterwort*
foam rubber *n* (ca. 1939) : spongy rubber of fine texture made from latex by foaming (as by whipping) before vulcanization
foamy \'fō-mē\ *adj* **foam·i·er; -est** (bef. 12c) 1 : covered with foam 2 : FULL 2; full of, consisting of, or resembling foam — **foam·i·ly** \-mē-lē\ *adv* — **foam·i·ness** \-mē-nəs\ *n*
fob \'fäb\ *vt* **fobbed; fob·bing** [ME *fobben*] (14c) *archaic* : DECEIVE, CHEAT
fob [perh. akin to G dial. *Fuppe* pocket] (1653) 1 : WATCH POCKET 2 : a short strap, ribbon, or chain attached esp. to a pocket watch 3 : an ornament attached to a fob chain
fob off *vt* (1597) 1 : to put off with a trick, excuse, or inferior substitute 2 : to pass or offer (something spurious) as genuine 3 : to put aside (now *fob off* what once they would have welcomed eagerly — Walter Lippmann⟩
focaccia \fō-'kä-ch(ē-)ə\ *n* [It, fr. LL *focacia* (neut. pl.), fr. L *focus* hearth] (1969) : a flat Italian bread typically seasoned with herbs and olive oil
focal \'fō-kəl\ *adj* (1693) : of, relating to, being, or having a focus — **focally** \-kə-lē\ *adv*
focal infection *n* (ca. 1923) : a persistent bacterial infection of some tissue or region; *esp* : one causing symptoms elsewhere in the body
focalize \'fō-kə-,līz\ *vb* **-ized; -iz·ing** *vt* (1845) 1 : to bring to a focus 2 : LOCALIZE ~ *vi* 1 : to come to a focus : CONCENTRATE 2 : LOCALIZE — **fo·cal·iza·tion** \,fō-kə-lə-'zā-shən\ *n*
focal length *n* (1753) : the distance of a focus from the surface of a lens or concave mirror
focal plane *n* (1889) : a plane that is perpendicular to the axis of a lens and passes through the focus
focal point *n* (1713) : FOCUS 1a, 5a
focal ratio *n* (1926) : F-NUMBER
fo'c'sle *var of* FORECASTLE
¹fo·cus \'fō-kəs\ *n, pl* **fo·ci** \'fō-,sī *also* -,kī\ *also* **fo·cus·es** [NL, fr. L, hearth] (1644) 1 **a** : a point at which rays (as of light, heat, or sound) converge or from which they diverge or appear to diverge; *specif* : the point where the geometrical lines or their prolongations conforming to the rays diverging from or converging toward another point intersect and give rise to an image after reflection by a mirror or refraction by a lens or optical system **b** : a point of convergence of a beam of particles (as electrons) 2 **a** : FOCAL LENGTH **b** : adjustment for distinct vision; *also* : the area that may be seen distinctly or resolved into a clear image **c** : a state or condition permitting clear perception or understanding ⟨tried to bring the issues into ~⟩ **d** : DIRECTION 6c 3 : one of the fixed points that with the corresponding directrix defines a conic section 4 : a localized area of disease or the chief site of a generalized disease or infection 5 **a** : a center of activity, attraction, or attention ⟨the ~ of the meeting was drug abuse⟩ **b** : a point of concentration 6 : the place of origin of an earthquake or moonquake 7 : directed attention : EMPHASIS — **fo·cus·less** \-ləs\ *adj* — **in focus** : having or giving the proper sharpness of outline due to good focusing — **out of focus** : not in focus
²focus *vb* **fo·cused** *also* **fo·cussed; fo·cus·ing** *also* **fo·cus·sing** *vt* (1775) 1 **a** : to bring into focus **b** : to adjust the focus of (as the eye or a lens) 2 : to cause to be concentrated ⟨*~ed* their attention on the most urgent problems⟩ 3 : to bring (as light rays) to a focus : CONCENTRATE ~ *vi* 1 : to come to a focus : CONVERGE 2 : to adjust one's eye or a camera to a particular range 3 : to concentrate attention or effort — **fo·cus·able** \-kə-sə-bəl\ *adj* — **fo·cus·er** *n*
fod·der \'fä-dər\ *n* [ME, fr. OE *fōdor*; akin to OHG *fuotar* food — more at FOOD] (bef. 12c) 1 : something fed to domestic animals; *esp* : coarse food for cattle, horses, or sheep 2 : inferior or readily available material used to supply a heavy demand ⟨routine entertainment ~⟩ ⟨~ for gossip columnists⟩ — **fodder** *vt*
fod·gel \'fä-jəl\ *adj* [origin unknown] (1724) *Scot* : BUXOM
foe \'fō\ *n* [ME *fo*, fr. OE *fāh*, fr. *fāh*, adj., hostile; akin to OHG *gifēh* hostile] (bef. 12c) 1 : one who has personal enmity for another 2 **a** : an enemy in war **b** : ADVERSARY, OPPONENT 3 : one who opposes on principle ⟨a ~ of needless expenditures⟩ 4 : something prejudicial or injurious
foehn *or* **föhn** \'fə(r)n, 'fœn, 'fān\ *n* [G *Föhn*] (1861) : a warm dry wind blowing down the side of a mountain
foe·man \'fō-mən\ *n* (bef. 12c) : FOE 2
foe·tal, foe·tus *chiefly Brit var of* FETAL, FETUS
foe·tid *var of* FETID
foeto- *or* **foeti-** *chiefly Brit var of* FETO-
¹fog \'fȯg, fäg\ *n* [prob. of Scand origin; akin to Dan *fog* spray, shower] (1544) 1 **a** : vapor condensed to fine particles of water suspended in the lower atmosphere that differs from cloud only in being near the ground **b** : a fine spray or a foam for fire fighting 2 : a murky condition of the atmosphere or a substance causing it 3 **a** : a state of confusion or bewilderment **b** : something that confuses or obscures ⟨hid behind a ~ of rhetoric⟩ 4 : cloudiness or partial opacity in a developed photographic image caused by chemical action or stray radiation — **fog·less** \-ləs\ *adj*
²fog *vb* **fogged; fog·ging** *vt* (1599) 1 : to cover, envelop, or suffuse with or as if with fog ⟨~ the barns with pesticide⟩ 2 : to make obscure or confusing ⟨accusations which *fogged* the real issues⟩ 3 : to make confused 4 : to produce fog on (as a photographic film) during development ~ *vi* 1 : to become covered or thick with fog 2 **a** : to become blurred by a covering of fog or mist **b** : to become indistinct through exposure to light or radiation
fog-bound \'fȯg-,baund, 'fäg-\ *adj* (ca. 1855) 1 : unable to move because of fog ⟨~ ship⟩ 2 : covered with or surrounded by fog ⟨~ coast⟩
fog·bow \-,bō\ *n* (1831) : a nebulous arc or circle of white or yellowish light sometimes seen in fog
fog·gage \'fȯ-gij, 'fä-\ *n* [Sc, fr. ME (Sc) *fogage*, fr. AL *fogagium*, fr. ME *fogge* second growth of grass + ML *-agium* -age] (1786) *Scot* : a second growth of grass
fog·gy \'fȯ-gē, 'fä-\ *adj* **fog·gi·er; -est** (15c) 1 **a** : filled or abounding with fog **b** : covered or made opaque by moisture or grime 2 : blurred or obscured as if by fog ⟨hadn't the *foggiest* notion⟩ — **fog·gi·ly** \'fȯ-gə-lē, 'fä-\ *adv* — **fog·gi·ness** \'fȯ-gē-nəs, 'fä-\ *n*
Foggy Bottom *n* [*Foggy Bottom*, district in Washington, D.C.] (1951) : the U.S. Department of State
fog·horn \'fȯg-,hȯrn, 'fäg-\ *n* (1858) 1 : a horn (as on a ship) sounded in a fog to give warning 2 : a loud hoarse voice
fo·gy *also* **fo·gey** \'fō-gē\ *n, pl* **fogies** *also* **fogeys** [origin unknown] (1780) : a person with old-fashioned ideas — usu. used with *old* — **fo·gy·ish** \-gē-ish\ *adj* — **fo·gy·ism** \-gē-,i-zəm\ *n*
foi·ble \'fȯi-bəl\ *n* [obs. F (now *faible*), fr. obs. *foible* weak, fr. OF *feble* feeble] (ca. 1648) 1 : the part of a sword or foil blade between the middle and point 2 : a minor flaw or shortcoming in character or behavior : WEAKNESS *syn* see FAULT
foie gras \'fwä-'grä\ *n* [F, lit., fat liver] (1818) : the fatted liver of an animal and esp. of a goose usu. served as a pâté
¹foil \'fȯi(ə)l\ *vt* [ME, to trample, full cloth, fr. MF *fouler* — more at FULL] (14c) 1 *obs* : TRAMPLE 2 **a** : to prevent from attaining an end : DEFEAT **b** : to bring to naught : THWART *syn* see FRUSTRATE
²foil *n* [ME, leaf, fr. MF *foille* (fr. L *folia*, pl. of *folium*) & *foil*, fr. L *folium* — more at BLADE] (14c) 1 : very thin sheet metal ⟨aluminum ~⟩ 2 : a thin piece of material (as metal) put under an inferior or paste stone to add color or brilliance 3 : someone or something that serves as a contrast to another ⟨acted as a ~ for a comedian⟩ 4 **a** : an indentation between cusps in Gothic tracery **b** : one of several arcs that enclose a complex figure 5 : HYDROFOIL 1

Doc Code: A.NE.AFCP
Document Description: After Final Consideration Program Request

PTO/SB/434 (3-22)

CERTIFICATION AND REQUEST FOR CONSIDERATION UNDER THE AFTER FINAL CONSIDERATION PILOT PROGRAM 2.0

Practitioner Docket No.:	Application No.:	Filing Date:
BECC.P0002US.CIP.D2C1/1001193453	17/645,727	December 22, 2021
First Named Inventor:	**Title:**	
Yong Qin Chen	Flow Cytometer	

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS CONSIDERATION UNDER THE AFTER FINAL CONSIDERATION PILOT PROGRAM 2.0 (AFCP 2.0) OF THE ACCOMPANYING RESPONSE UNDER 37 CFR 1.116.

1. The above-identified application is (i) an original utility, plant, or design nonprovisional application filed under 35 U.S.C. 111(a) [a continuing application (*e.g.*, a continuation or divisional application) is filed under 35 U.S.C. 111(a) and is eligible under (i)], or (ii) an international application that has entered the national stage in compliance with 35 U.S.C. 371(c).
2. The above-identified application contains an outstanding final rejection.
3. Submitted herewith is a response under 37 CFR 1.116 to the outstanding final rejection. The response includes an amendment to at least one independent claim, and the amendment does not broaden the scope of the independent claim in any aspect.
4. This certification and request for consideration under AFCP 2.0 is the only AFCP 2.0 certification and request filed in response to the outstanding final rejection.
5. Applicant is willing and available to participate in any interview requested by the examiner concerning the present response.
6. This certification and request is being filed electronically using the USPTO's patent electronic filing system.
7. Any fees that would be necessary consistent with current practice concerning responses after final rejection under 37 CFR 1.116, *e.g.*, extension of time fees, are being concurrently filed herewith. [There is no additional fee required to request consideration under AFCP 2.0.]
8. By filing this certification and request, applicant acknowledges the following:
    - Reissue applications and reexamination proceedings are not eligible to participate in AFCP 2.0.
    - The examiner will verify that the AFCP 2.0 submission is compliant, *i.e.*, that the requirements of the program have been met (see items 1 to 7 above). For compliant submissions:
        - The examiner will review the response under 37 CFR 1.116 to determine if additional search and/or consideration (i) is necessitated by the amendment and (ii) could be completed within the time allotted under AFCP 2.0. If additional search and/or consideration is required but cannot be completed within the allotted time, the examiner will process the submission consistent with current practice concerning responses after final rejection under 37 CFR 1.116, *e.g.*, by mailing an advisory action.
        - If the examiner determines that the amendment does not necessitate additional search and/or consideration, or if the examiner determines that additional search and/or consideration is required and could be completed within the allotted time, then the examiner will consider whether the amendment places the application in condition for allowance (after completing the additional search and/or consideration, if required). If the examiner determines that the amendment does not place the application in condition for allowance, then the examiner will contact the applicant and request an interview.
            - The interview will be conducted by the examiner, and if the examiner does not have negotiation authority, a primary examiner and/or supervisory patent examiner will also participate.
            - If the applicant declines the interview, or if the interview cannot be scheduled within ten (10) calendar days from the date that the examiner first contacts the applicant, then the examiner will proceed consistent with current practice concerning responses after final rejection under 37 CFR 1.116.

Signature	Date	Practitioner Registration No.
/Michael Pohl/	June 4, 2024	72,871
Name (Print/Typed)	**Telephone Number**	
Michael Pohl	(512) 536-3113	

***Note**: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.*

☐ * Total of _____ forms are submitted.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor: Yong Qin Chen	Group Art Unit: 2877
Serial No.: 17/645,727	Examiner: ISIAKA O AKANBI
Filed: December 22, 2021	Atty. Dkt. No.: BECC.P0002US.CIP.D2C1
For: FLOW CYTOMETER	Confirmation No.: 1145

CERTIFICATE OF ELECTRONIC TRANSMISSION (37 C.F.R. § 1.8)
I, Olivia Weber, hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office via Patent Center on June 10, 2024. Signed: /Olivia Weber/

INFORMATION DISCLOSURE STATEMENT

In compliance with the duty of disclosure under 37 C.F.R. § 1.56, it is respectfully requested that this Information Disclosure Statement be entered and the documents listed on attached Form PTO-1449 be considered by the Examiner and made of record.

In accordance with 37 C.F.R §§ 1.97(g), (h), this Information Disclosure Statement is not to be construed as a representation that a search has been made, and is not to be construed to be an admission that the information cited is, or is considered to be, material to patentability as defined in 37 C.F.R. § 1.56(b).

Timing and Fees

☐ Under 37 C.F.R. § 1.97(b), **no fee or statement is required** for filing this Information Disclosure Statement because it is filed:

- ☐ within three months of the filing date of a national application other than a CPA under § 1.53(d); **OR**
- ☐ within three months of the actual filing date of the national phase of a PCT application; **OR**
- ☐ before the mailing of a first substantive office action (including after filing of an RCE).

☐ Under 37 C.F.R. § 1.97(c), this Information Disclosure Statement is filed after the periods specified in 37 C.F.R. § 1.97(b), but **before** the mailing date of:

- ☐ a final rejection under 37 C.F.R. § 1.113; **OR**
- ☐ termination of prosecution, e.g. Ex Parte Quayle, M.P.E.P. § 609(B)(2); **OR**
- ☐ a notice of allowance under 37 C.F.R. § 1.311;

AND is accompanied by:

☐ the statement as specified in 37 C.F.R. § 1.97(e) set out below; **OR**

☐ payment covering the fee of $_____ under 37 C.F.R. § 1.17(p).

☒ Under 37 C.F.R. § 1.97(d), this Information Disclosure Statement is filed **after** the mailing date of the following actions which have not been withdrawn:

☒ a final action under 37 C.F.R. § 1.113; **OR**

☐ termination of prosecution; e.g. Ex Parte Quayle, M.P.E.P. § 609(B)(2); **OR**

☐ a notice of allowance under 37 C.F.R. § 1.311 and is filed on or before payment of the issue fee;

AND is accompanied by:

the statement as specified in 37 C.F.R. § 1.97(e) as set forth below, **AND** payment covering the fee of $260.00 (large entity) under 37 C.F.R. § 1.17(p).

Statements Under 37 C.F.R. § 1.97(e) (if applicable)

☒ Each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the present Information Disclosure Statement; **OR**

☐ No item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application, and to the knowledge of the undersigned attorney after making reasonable inquiry, no item of information contained in this Information Disclosure Statement was known to any individual designated in 37 C.F.R. § 1.56(c) more than three months prior to the filing date of the Information Disclosure Statement.

Statement Under 37 C.F.R. § 1.704(d) (if applicable)

☐ Each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application and that this communication was not received by any individual designated in 37 C.F.R. § 1.56(c) more than thirty days prior to the filing of this Information Disclosure Statement.

Copies of Cited Materials (if applicable)

☐ Copies of materials listed but not attached were cited in benefit (35 U.S.C. § 120) ancestor application Serial No. _____ on Form 892 by the Examiner and/or Form 1449 by the applicant; see 37 C.F.R. § 1.98(d).

☐ This application may be related by inventorship and/or subject matter to co-pending U.S. application Serial No. _____, filed _____.

Payment of Fees Due (if applicable)

☐ Payment is made by credit card via EFS-Web for $_____ covering the fee identified above.

☐ Please charge Deposit Account No. 50-1212/_____ $_____ for the fee identified above.

☒ The Commissioner is hereby authorized to charge or credit any overpayment fees, related to this Information Disclosure Statement, to Deposit Account 50-1212/BECC.P0002US.CIP.D2C1.

Respectfully submitted,

/Michael Pohl/

Michael Pohl
Reg. No. 72,871
Attorney for Applicant

NORTON ROSE FULBRIGHT US LLP
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701
(512) 252-3218

Date: June 10, 2024

Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT	Applicant: IRIS INTERNATIONAL, INC.	
(Use several sheets if necessary)	Filing Date: December 22, 2021	Group: 2877

U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1	*None*	*See Page 1*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A1	6198864	3/6/01	Lemoff et al.
	A2	2002/131180	9/9/19	Goodman
	A3	2004/101247	05/27/04	Chen et al.

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language

Other Art (Including Author, Title, Date Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C1	Extended European Search Report issued by the European Patent Office in corresponding European Application No. 24151670.7 dated April 9, 2024.

EXAMINER:	DATE CONSIDERED:

EXAMINER: INITIAL IF REFERENCE CONSIDERED, WHETHER OR NOT CITATION IS IN CONFORMANCE WITH MPEP609; DRAW LINE THROUGH CITATION IF NOT IN CONFORMANCE AND NOT CONSIDERED. INCLUDE COPY OF THIS FORM WITH NEXT COMMUNICATION TO APPLICANT.

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**06/10/2024 12:31:24 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Olivia Weber
PATENT CENTER #	65897306	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Michael Pohl

Documents

TOTAL DOCUMENTS: 3

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
BECCP0002USCIPD2C1_SIDS.pdf		4	-	49 KB
BECCP0002USCIPD2C1_SIDS-IDS.R197.REL.pdf	(1-3)	3	Letter specifying the conditions for filing under 37 CFR 1.97	35 KB
BECCP0002USCIPD2C1_SIDS-IDS.pdf	(4-4)	1	Information Disclosure Statement (IDS) Form (SB08)	35 KB
BECCP0002EPD2_Extended_Euro_Search_Report_4_9_2024.pdf		11	Non Patent Literature	781 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
BECCP0002USCIPD2C1_SIDS.pdf	A24BFBEEF3864CC7B0D6A4C4471E6C15A63013C833B81B475DEC12DEE3FB3B3CFF2AED3F4247DB38FD2310A58BBF4D3928D612768B35691FD35C3EDDA62814D6
BECCP0002USCIPD2C1_SIDS-IDS.R197.REL.pdf	B5FB9128CF19BADAE0890E0D72DDBD2C88E64816635945AA65F661711E68E64335B1869C6B8916B9951F1CB5EE4F1DCFDAE5CE372270FA6222FA51A6C06A4403
BECCP0002USCIPD2C1_SIDS-IDS.pdf	F948EE7B63B4C453A874A44CBF8DB07DC1671EDC6B5175E10C6BF709C026FC8032AF409E2C2E1361BFEA5277E41069C86469D6481716DB9E8C659E736FD95BAB
BECCP0002EPD2_Extended_Euro_Search_Report_4_9_2024.pdf	51845CA70C8434663A6C67C31ADEBF71AE196D6F086BAE548D0316DC7C59B6CCFE0D831574F1542B70FB8253C6AC7697A5E59EB8558C1F239C2195E20064C5DD

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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PATENT AND TRADEMARK OFFICE

P.O. Box 1450
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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	06/10/2024 12:31:24 PM Z ET	BECC.P0002US.CIP.D2C1

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Olivia Weber
PATENT CENTER #	65897306	AUTHORIZED BY	Michael Pohl
CUSTOMER #	129381	FILING DATE	12/22/2021
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Yong Qin Chen

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 5413	E202460C32056664	Olivia Weber

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1806	SUBMISSION OF AN INFORMATION DISCLOSURE STATEMENT	260.00	1	260.00
			TOTAL AMOUNT:	$260.00

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1	1145

129381 7590 06/17/2024
NORTON ROSE FULBRIGHT US LLP - BCI
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

EXAMINER	
AKANBI, ISIAKA O	

ART UNIT	PAPER NUMBER
2877	

NOTIFICATION DATE	DELIVERY MODE
06/17/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

PatentDocket@Beckman.com
aoipdocket@nortonrosefulbright.com

Advisory Action Before the Filing of an Appeal Brief	**Application No.** 17/645,727	**Applicant(s)** Chen, Yong Qin	
	Examiner ISIAKA O AKANBI	**Art Unit** 2877	**AIA (FITF) Status** No

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 04 June 2024 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.

NO NOTICE OF APPEAL FILED

1. ☑ The reply was filed after a final rejection. No Notice of Appeal has been filed. To avoid abandonment of this application, applicant must timely file one of the following replies: (1) an amendment, affidavit, or other evidence, which places the application in condition for allowance; (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41.31; or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1.114 if this is a utility or plant application. Note that RCEs are not permitted in design applications. The reply must be filed within one of the following time periods:
   a) ☐ The period for reply expires ____ months from the mailing date of the final rejection.
   b) ☑ The period for reply expires on: (1) the mailing date of this Advisory Action; or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.
   c) ☐ A prior Advisory Action was mailed more than 3 months after the mailing date of the final rejection in response to a first after-final reply filed within 2 months of the mailing date of the final rejection.The current period for reply expires ____ months from the mailing date of *the prior Advisory Action* or SIX MONTHS from the mailing date of the final rejection, whichever is earlier.
   Examiner Note: If box 1 is checked, check either box (a), (b) or (c). ONLY CHECK BOX (b) WHEN THIS ADVISORY ACTION IS THE FIRST RESPONSE TO APPLICANTS FIRST AFTER-FINAL REPLY WHICH WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. ONLY CHECK BOX (c) IN THE LIMITED SITUATION SET FORTH UNDER BOX (c). See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) or (c) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

NOTICE OF APPEAL

2. ☐ The Notice of Appeal was filed on _____. A brief in compliance with 37 CFR 41.37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41.37(a)), or any extension thereof (37 CFR 41.37(e)), to avoid dismissal of the appeal. Since a Notice of Appeal has been filed, any reply must be filed within the time period set forth in 37CFR 41.37(a).

AMENDMENTS

3. ☑ The proposed amendments filed after a final rejection, but prior to the date of filing a brief, will not be entered because
   a) ☐ They raise new issues that would require further consideration and/or search (see NOTE below);
   b) ☑ They raise the issue of new matter (see NOTE below);
   c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or
   d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims.
   NOTE: See Continuation Sheet (See 37 CFR 1.116 and 41.33(a)).
4. ☐ The amendments are not in compliance with 37 CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).
5. ☐ Applicant's reply has overcome the following rejection(s): _____
6. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).
7. ☐ For purposes of appeal, the proposed amendment(s):(a)☐ will not be entered, or (b)☐ will be entered, and an explanation of how the new or amended claims would be rejected is provided below or appended.

AFFIDAVIT OR OTHER EVIDENCE

8. ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____
9. ☐ The affidavit or other evidence filed after final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented. See 37 CFR 1.116(e).
10. ☐ The affidavit or other evidence filed after the date of filing the Notice of Appeal, but prior to the date of filing a brief, will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing of good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).
11. ☐ The affidavit or other evidence is entered. An explanation of the status of the claims after entry is below or attached.

REQUEST FOR RECONSIDERATION/OTHER

12. ☑ The request for reconsideration has been considered but does NOT place the application in condition for allowance because: See Continuation Sheet.
13. ☑ Note the attached Information *Disclosure Statement*(s). (PTO/SB/08) Paper No(s). PTO-1449 (06/10/2024) attached
14. ☑ Other: PTO-413/413B.

STATUS OF CLAIMS

15. The status of the claim(s) is (or will be) as follows:
    Claim(s) allowed:_____.
    Claim(s) objected to:_____.
    Claim(s) rejected:1-5 and 7-21.
    Claim(s) withdrawn from consideration:_____.

/ISIAKA O AKANBI/ Primary Examiner, Art Unit 2877	

Continuation of 3. NOTE: Based on the context of the applicant disclosure as found in (i.e. [pars. 0219], Applicant has described "a collimating optical element" as function to captures light from the extended light source and projects a magnified image of the object as a first light beam
and in [par. 0409] has described "a collimating optical element," as an achromatic doublet lens 902, that may capture the light from source 901, and project a magnified image of the object near a final focusing lens 905, **these disclosure is not the same as** "a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light," as currently amended. The newly amended limitations will require further consideration and/or search to define patentability.

Continuation of REQUEST FOR RECONSIDERATION/OTHER 12. The request for reconsideration has been considered but does NOT place the application in condition for allowance because: In response to Applicant's arguments that in particular the cited reference(s) do not disclose or suggest in particular "a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light,", it is respectfully pointed out to applicant that while the examiner agreed that the prior art Oostman's appears to lacking this/these limitation(s) the limitation(s) raises a new matter based on applicant disclosure in [par. 0409] that ".. collimating optical element," as (i.e. an achromatic doublet lens 902), ... capture the light from source ..., and project a magnified image of the object near a final focusing lens 905, this is not the same as "a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light,". As such, the argument/remarks for request for reconsideration does not appear to place the application in condition for allowance.The newly amended limitations will require further consideration and/or search to define patentability.

Examiner-Initiated Interview Summary	**Application No.** 17/645,727	**Applicant(s)** Chen, Yong Qin		
	Examiner ISIAKA O AKANBI	**Art Unit** 2877	**AIA (First Inventor to File) Status** No	**Page** 1 of 2

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
ISIAKA O AKANBI	Primary Examiner	Telephonic
Michael Pohl	Attorney	

Date of Interview: 12 June 2024

Issues Discussed:

Other

Examiner initiated an interview on June 12, 2024 providing explanation to Applicant's representative that After Final Consideration Pilot Program for AFCP 2.0 request filed on 06/04/2024 is denied because the scope of the amendment, the limitations "a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light," narrow the independent claims 1 and 18, which not only changes the scope of the independent claims but also the dependent claims, the examiner agree with the Applicant's representative that the prior art Oostman's appears to lacking this/these limitation(s).

However, based on the context of the applicant disclosure as found in (i.e. [pars. 0219], Applicant has described "a collimating optical element" **as function to** captures light from the extended light source and projects a magnified image of the object as a first light beam
and in [par. 0409] applicant has described "a collimating optical element," as an achromatic doublet lens 902, that may capture the light from source 901, and project a magnified image of the object near a final focusing lens 905, **these disclosure is not the same as** "a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light, " as currently amended, thus raise a new matter. As such, Applicant's request for entry into AFCP 2.0 is acknowledged, but is denied because the scope of the amendment narrows the independent claim and raise a new matter issue. The newly amended limitations will require further consideration and/or search to define patentability. Therefore, the response is being reviewed under pre-pilot practice. No agreement is reached

Examiner-Initiated Interview Summary	**Application No.** 17/645,727	**Applicant(s)** Chen, Yong Qin		
	Examiner ISIAKA O AKANBI	**Art Unit** 2877	**AIA (First Inventor to File) Status** No	**Page** **2 of 2**

/ISIAKA O AKANBI/ Primary Examiner, Art Unit 2877	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: It is not necessary for applicant to provide a separate record of the substance of interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

AFCP 2.0 Decision

Application No.	Applicant(s)	
17/645,727	Chen, Yong Qin	
Examiner	**Art Unit**	**AIA (FITF) Status**
ISIAKA O AKANBI	2877	No

This is in response to the After Final Consideration Pilot request filed 04 June 2024.

1. **Improper Request** – The AFCP 2.0 request is improper for the following reason(s) and the after final amendment submitted with the request will be treated under pre-pilot procedure.

   ☐ An AFCP 2.0 request form PTO/SB/434 (or equivalent document) was not submitted.

   ☐ A non-broadening amendment to at least one independent claim was not submitted.

   ☐ The request is not the first proper AFCP 2.0 request submitted in response to the most recent final rejection.

   ☐ Other: _____

2. **Proper Request**

   A. After final amendment submitted with the request will not be treated under AFCP 2.0.
   The after final amendment cannot be reviewed and a search conducted within the guidelines of the pilot program.

   ☐ The after final amendment will be treated under pre-pilot procedure.

   B. Updated search and/or completed additional consideration.
   The examiner performed an updated search and/or completed additional consideration of the after final amendment within the time authorized for the pilot program. The result(s) of the updated search and/or completed additional consideration are:

   ☐ 1. All of the rejections in the most recent final Office action are overcome and a Notice of Allowance is issued herewith.

   ☐ 2. The after final amendment would not overcome all of the rejections in the most recent final Office action . See attached interview summary for further details.

   ☑ 3. The after final amendment was reviewed, and it raises a new issue(s). See attached interview summary for further details.

   ☐ 4. The after final amendment raises new issues, but would overcome all of the rejections in the most recent final Office action. A decision on determining allowability could not be made within the guidelines of the pilot. See attached interview summary for further details, including any newly discovered prior art.

   ☐ 5. Other: _____

   Examiner Note: Please attach an interview summary when necessary as described above.

Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT	Applicant: IRIS INTERNATIONAL, INC.	
(Use several sheets if necessary)	Filing Date: December 22, 2021	Group: 2877

U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1	*None*	*See Page 1*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A1	6198864	3/6/01	Lemoff et al.
	A2	2002/131180	9/9/19	Goodman
	A3	2004/101247	05/27/04	Chen et al.

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language

Other Art (Including Author, Title, Date Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C1	Extended European Search Report issued by the European Patent Office in corresponding European Application No. 24151670.7 dated April 9, 2024.

EXAMINER: /ISIAKA O AKANBI/	DATE CONSIDERED: 06/11/2024

EXAMINER: INITIAL IF REFERENCE CONSIDERED, WHETHER OR NOT CITATION IS IN CONFORMANCE WITH MPEP609; DRAW LINE THROUGH CITATION IF NOT IN CONFORMANCE AND NOT CONSIDERED. INCLUDE COPY OF THIS FORM WITH NEXT COMMUNICATION TO APPLICANT.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /I.O.A/

DO NOT ENTER: /I.O.A/

/I.O.A/ (06/11/2024)

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Iris International, Inc.	Group Art Unit: 2877
Serial No.: 17/645,727	Examiner: Isiaka O. Akanbi
Filed: December 22, 2021	Atty. Dkt. No.: BECC.P0002US.CIP.D2C1
For: Flow Cytometer	Confirmation No.: 1145

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

CERTIFICATE OF ELECTRONIC TRANSMISSION
37 C.F.R. § 1.8

I hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office via Patent Center on the date below:

June 4, 2024	/Michael Pohl/
Date	Michael Pohl

RESPONSE TO FINAL OFFICE ACTION SENT MAY 2, 2024

Applicant submits this paper in response to the Final Office Action sent May 2, 2024 along with a request for reconsideration under the After Final Consideration Pilot 2.0 (AFCP 2.0). Should any fees be required for any reason relating to the filing of this paper and not otherwise be paid, Applicant authorizes the Commissioner to deduct them from Norton Rose Fulbright US LLP's Deposit Account No. 50-1212/BECC.P0002US.CIP.D2C1.

Claim Amendments begin on page **2**;

Remarks begin on page **8**;

Appendices begin following page **12**.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/645,727	Filing Date 12/22/2021	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

	(Column 1)	(Column 2)			
FOR	NUMBER FILED	NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $480 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	07/18/2024	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/VERNON A TOWLER/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/SB/30 (11-23)
Approved for use through 05/31/2024. OMB 0651-0031
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Request for Continued Examination (RCE) Transmittal

Address to:
Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Application Number	17/645,727
Filing Date	December 22, 2021
First Named Inventor	Yong Qin CHEN
Art Unit	2877
Examiner Name	Isiaka O. AKANBI
Attorney Docket Number	BECC.P0002US.CIP.D2C1

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. See Instruction Sheet for RCEs (not to be submitted to the USPTO) on page 2.

1. Submission required under 37 CFR 1.114 Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

   a. ☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

      i. ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

      ii. ☐ Other _____

   b. ☑ Enclosed

      i. ☑ Amendment/Reply

      ii. ☐ Affidavit(s)/ Declaration(s)

      iii. ☐ Information Disclosure Statement (IDS)

      iv. ☑ Other Track 1 Request

2. Miscellaneous

   a. ☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of _____ months. (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

   b. ☐ Other _____

3. Fees The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.

   a. ☑ The Director is hereby authorized to charge the following fees, any underpayment of fees, or credit any overpayments, to Deposit Account No. 50-1212.

      i. ☑ RCE fee required under 37 CFR 1.17(e)

      ii. ☐ Extension of time fee (37 CFR 1.136 and 1.17)

      iii. ☐ Other _____

   b. ☐ Check in the amount of $ _____ enclosed

   c. ☐ Payment by credit card (Form PTO-2038 enclosed)

   d. ■ Payment by USPTO patent electronic filing system.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

Signature	/Michael Pohl/	Date	July 18, 2024
Name (Print/Type)	Michael Pohl	Registration No.	72,871

CERTIFICATE OF MAILING OR TRANSMISSION

I hereby certify that this correspondence is transmitted by the USPTO patent electronic filing system, or by facsimile to (571) 273-8300, to the USPTO, or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Mail Stop RCE, Commissioner for Patents, P. O. Box 1450, Alexandria, VA 22313-1450, on the date shown below.

Signature	/Michael Pohl/		
Name (Print/Type)	Michael Pohl	Date	July 18, 2024

A Federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with an information collection subject to the requirements of the Paperwork Reduction Act of 1995, unless the information collection has a currently valid OMB Control Number. The OMB Control Number for this information collection is 0651-0031. Public burden for this form is estimated to average 12 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Send comments regarding this burden estimate or any other aspect of this information collection, including suggestions for reducing this burden to the Chief Administrative Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 or email InformationCollection@uspto.gov. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **If filing this completed form by mail, send to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Instruction Sheet for RCEs

(not to be submitted to the USPTO)

NOTES:

An RCE is not a new application, and filing an RCE will not result in an application being accorded a new filing date.

Filing Qualifications:

The application must be a utility or plant application filed on or after June 8, 1995. The application cannot be a provisional application, a utility or plant application filed before June 8, 1995, a design application, or a patent under reexamination. See 37 CFR 1.114(e).

Filing Requirements:

Prosecution in the application must be closed. Prosecution is closed if the application is under appeal, or the last Office action is a final action, a notice of allowance, or an action that otherwise closes prosecution in the application (e.g., an Office action under *Ex parte Quayle*). See 37 CFR 1.114(b).

A submission and a fee are required at the time the RCE is filed. If reply to an Office action under 35 U.S.C. 132 is outstanding (e.g., the application is under final rejection), the submission must meet the reply requirements of 37 CFR 1.111. If there is no outstanding Office action, the submission can be an information disclosure statement, an amendment, new arguments, or new evidence. See 37 CFR 1.114(c). The submission may be a previously filed amendment (e.g., an amendment after final rejection).

WARNINGS:

Request for Suspension of Action:

All RCE filing requirements must be met before suspension of action is granted. A request for a suspension of action under 37 CFR 1.103(c) does not satisfy the submission requirement and does not permit the filing of the required submission to be suspended.

Improper RCE will NOT toll Any Time Period:

Before Appeal **-** If the RCE is improper (e.g., prosecution in the application is not closed or the submission or fee has not been filed) and the application is not under appeal, the time period set forth in the last Office action will continue to run and the application will be abandoned after the statutory time period has expired if a reply to the Office action is not timely filed. No additional time will be given to correct the improper RCE.

Under Appeal **-** If the RCE is improper (e.g., the submission or the fee has not been filed) and the application is under appeal, the improper RCE is effective to withdraw the appeal. Withdrawal of the appeal results in the allowance or abandonment of the application depending on the status of the claims. If there are no allowed claims, the application is abandoned. If there is at least one allowed claim, the application will be passed to issue on the allowed claim(s). See MPEP 1215.01.

See MPEP 706.07(h) for further information on the RCE practice.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013). https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf

Routine uses of the information in this record may include disclosure to:

1) law enforcement, in the event that the system of records indicates a violation or potential violation of law;

2) a federal, state, local, or international agency, in response to its request;

3) a contractor of the USPTO having need for the information in order to perform a contract;

4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record;

5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record;

6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations;

7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals;

8) another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c));

9) the Office of Personnel Management (OPM) for personnel research purposes; and

10) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

Claim Amendments

1. (Currently Amended) A flow cytometer, comprising:

a light source arranged to illuminate a stream of particles in a viewing zone of a flow cell in the flow cytometer;

a collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source such that the fluorescent light leaving the collecting optical element converges; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light,

a first semiconductor detector configured to detect and quantitate a first color band in the fluorescent light,

a first curved mirror arranged to receive at least a portion of the fluorescent light after the fluorescent light has passed through the collimating optical element, the first curved mirror configured to reflect the portion of the fluorescent light towards the first semiconductor detector, and

a first dichroic filter optically disposed between the first curved mirror and the first semiconductor detector, the dichroic filter configured to allow the first color band in the fluorescent light to pass through the first dichroic filter onto the first semiconductor detector, and to reflect a second color band in the fluorescent light away from the first semiconductor detector.

2. (Original) The flow cytometer of claim 1, further comprising an optical fiber optically disposed between the collecting optical element and the WDM, the optical fiber arranged and configured to deliver the fluorescent light collected by the collecting optical element to the WDM.

3. (Previously Presented) The flow cytometer of claim 1, further comprising a first focusing optical element optically disposed between the first dichroic filter and the first semiconductor detector, the first focusing optical element configured to focus the first color band in the fluorescent light passing through the first dichroic filter onto the first semiconductor detector.

4. (Previously Presented) The flow cytometer of claim 3, further comprising a second semiconductor detector arranged and configured to detect and quantitate the second color band in the fluorescent light reflected by the first dichroic filter.

5. (Previously Presented) The flow cytometer of claim 4, further comprising:

a second curved mirror and a second dichroic filter, the second curved mirror arranged and configured to reflect at least a portion of the fluorescent light reflected by the first dichroic filter towards the second semiconductor detector, the second dichroic filter arranged and configured to allow the second color band in the fluorescent light to pass through the second dichroic filter onto the second semiconductor, and to reflect a third color band in the fluorescent light away from the second semiconductor detector; and

a third semiconductor detector arranged and configured to detect and quantitate the third color band in the fluorescent light reflected by the second dichroic filter.

6. (Cancelled).

7. (Previously Presented) The flow cytometer of claim 1, wherein the first curved mirror reflects the portion of the fluorescent light to form an image.

8. (Original) The flow cytometer of claim 7, wherein the formed image is an image of the collimating optical element.

9. (Original) The flow cytometer of claim 1, wherein the light source is arranged and configured to illuminate the stream of particles from one side of the flow cell, and wherein the collecting optical element is arranged and configured to collect fluorescent light from another side of the flow cell.

10. (Original) The flow cytometer of claim 9, wherein the collecting optical element is further configured to collect and focus side-scatter light scattered by the illuminated particle in the stream.

11. (Original) The flow cytometer of claim 1, wherein the light source comprises a plurality of lasers.

12. (Original) The flow cytometer of claim 11, wherein the plurality of lasers comprises a first laser configured to illuminate a particle in the stream at a first location in the viewing zone, and a second laser configured to illuminate the particle at a second location in the viewing zone.

13. (Currently Amended) A flow cytometer comprising:

a light source arranged to illuminate a stream of particles in a viewing zone;

a collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source such that the fluorescent light leaving the collecting optical element converges; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a row of mirrors arranged and configured to sequentially reflect different color bands of the fluorescent light collected by the collecting optical element, the row of mirrors including at least one curved mirror;

a row of dichroic filters opposed to the row of mirrors, each dichroic filter configured to pass one color band of the fluorescent light reflected by a mirror in the row of mirrors, and to reflect another color band of the fluorescent light reflected by the mirror;

a row of semiconductor detectors, each semiconductor detector arranged and configured to detect and quantitate the band of fluorescent light passing through a dichroic filter in the row of dichroic filters.

14. (Original) The flow cytometer of claim 13, further comprising a row of focusing optical elements, each focusing optical element in the row arranged and configured to focus the band of fluorescent light passing through a dichroic filter in the row of dichroic filters onto the corresponding semiconductor detector.

15. (Original) The flow cytometer of claim 14, wherein the row of mirrors includes at least one curved mirror configured to form an image in the fluorescent light reflected by said curved mirror.

16. (Previously Presented) The flow cytometer of claim 15, wherein the image formed by said curved mirror is an image of a collimating optical element that is arranged to receive the fluorescent light collected by the collecting optical element and configured to collimate the fluorescent light.

17. (Previously Presented) The flow cytometer of claim 13, wherein the row of mirrors and row of dichroic filters are arranged such that fluorescent light received by the WDM is reflected back and forth between the row of mirrors and the row of dichroic filters in a zig-zag pattern.

18. (Currently Amended) A flow cytometer, comprising:

a light source arranged to illuminate a flow-stream of particles in a viewing zone from a first side of the flow stream;

a collecting optical element arranged on a second side of the flow stream, the collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source such that the fluorescent light leaving collecting optical element converges; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light,

a first semiconductor detector configured to detect and quantitate a first color band in the fluorescent light,

a first curved mirror arranged to receive at least a portion of the fluorescent light after the fluorescent light has passed through the collimating optical element, the first curved mirror configured to reflect the portion of the fluorescent light towards the first semiconductor detector, and

a first dichroic filter disposed between the first curved mirror and the first semiconductor detector, the dichroic filter configured to allow the first color band in the fluorescent light to pass through the first dichroic filter onto the first semiconductor detector, and to reflect a second color band in the fluorescent light away from the first semiconductor detector.

19. (Previously Presented) The flow cytometer of claim 18, wherein the first side of the flow stream is orthogonal to the second side of the flow stream.

20. (Original) The flow cytometer of claim 19, wherein the collecting optical element is further configured to collect and focus side-scatter light scattered by the illuminated particle.

21. (Previously Presented) The flow cytometer of claim 1, wherein the first curved mirror is arranged to receive the portion of the fluorescent light when the portion of the fluorescent light is collimated.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Iris International, Inc.	Group Art Unit: 2877
Serial No.: 17/645,727	Examiner: Isiaka O. Akanbi
Filed: December 22, 2021	Atty. Dkt. No.: BECC.P0002US.CIP.D2C1
For: Flow Cytometer	Confirmation No.: 1145

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

CERTIFICATE OF ELECTRONIC TRANSMISSION
37 C.F.R. § 1.8

I hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office via Patent Center on the date below:

July 18, 2024	/Michael Pohl/
Date	Michael Pohl

RESPONSE TO THE MAY 2, 2024 FINAL OFFICE ACTION AND THE JUNE 17, 2024 ADVISORY ACTION

Applicant submits this paper in response to the Final Office Action sent May 2, 2024 and the Advisory Action sent June 17, 2024, along with a request for continued examination (RCE), a request for prioritized examination under 37 C.F.R. § 1.102(e), and appropriate fees. Should any fees be required for any reason relating to the filing of this paper and not otherwise be paid, Applicant authorizes the Commissioner to deduct them from Norton Rose Fulbright US LLP's Deposit Account No. 50-1212/BECC.P0002US.CIP.D2C1.

Claim Amendments begin on page **2**;

Remarks begin on page **8**.

Remarks

I. Status of the Claims

Claims 1, 13, and 18 are amended in the manner set forth in the previously-presented amendments, which the Office did not enter (Advisory Action at 1). Support for the claim amendments can be found in, for example, 35:30-36:15, 43:23-44:7, 52:25-53:2, 53:21-54:5, 54:18-54:31, 68:6-69:2, and FIGs. 1, 9A, 10, and 25 of the originally-filed application. Claims 1-5 and 7-21 are pending. No new matter is added.

II. Summary of Examiner Interview

Applicant thanks Examiner Akanbi for the examiner-initiated interview with Applicant's representative—Michael Pohl—on June 12, 2024. Examiner Akanbi agreed that the proposed amendments overcame Oostman but believed that the amendments raised a new matter issue and would require further consideration and/or search beyond what is allotted for under the AFCP 2.0 program. Mr. Pohl explained that the amendments did not introduce new matter, but Examiner Akanbi indicated that such arguments would need to be set forth in a response with a RCE. No agreement was reached.

III. The Amendments to Independent Claims 1 and 18 Do Not Introduce New Matter

In the Advisory Action, the Office contends that the amendments to independent claims 1 and 18 submitted with the prior AFCP 2.0 request—which are re-presented in this response—"raise the issue of new matter" because the "collimating optical element" described in ¶¶ [0219] and [0409] of the published Application "**is not the same as** 'a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light." Advisory Action at 2 (emphasis original). Applicant respectfully disagrees that the claim amendments introduce new matter.

A. The Original Claims Themselves Support Separate Collecting and Collimating Optical Elements

At the outset, original independent claims 1 and 18 each recited "a collimating optical element arranged to receive the fluorescent light collected by the collecting optical element." That limitation thus cannot constitute new matter. *See* MPEP § 2163.06 ("information contained in any one of the specification, claims or drawings of the application as filed may be added to any other part of the application without introducing new matter" (emphasis added)).

Nor is the limitation that the present amendments introduce into claims 1 and 18—that the "collimating optical element [] is separate from the collecting optical element"—new matter. While two elements in a claim are not always or necessarily separate, here the original claims had separate collimating and collecting optical elements because they recited that the "collimating optical element [is] arranged to receive the fluorescent light collected by the collecting optical element." Applicant added the "is separate from" limitation at the Office's request simply to clarify this point and expedite prosecution, although Applicant respectfully maintains that the limitation is unnecessary to convey that the "collecting optical element" and "collimating optical element" are not one and the same.

B. The Original Specification Describes Examples of Separate Collecting and Collimating Optical Elements

Second, the originally-filed Specification describes embodiments including a "collimating optical element" that "is separate from" a "collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source," as claims 1 and 18 recite. For example, as shown in FIG. 1 (annotated below), the Specification describes a "flow cytometer 40 [that] may include" (1) a "composite microscope objective 60" that "gather[s] and

imag[es] light scattered and/or fluoresced by particles in the viewing zone" and (2) "a wavelength division multiplexer 90 ('WDM 90')." Specification at 43:23-44:7, FIG. 1.[1]

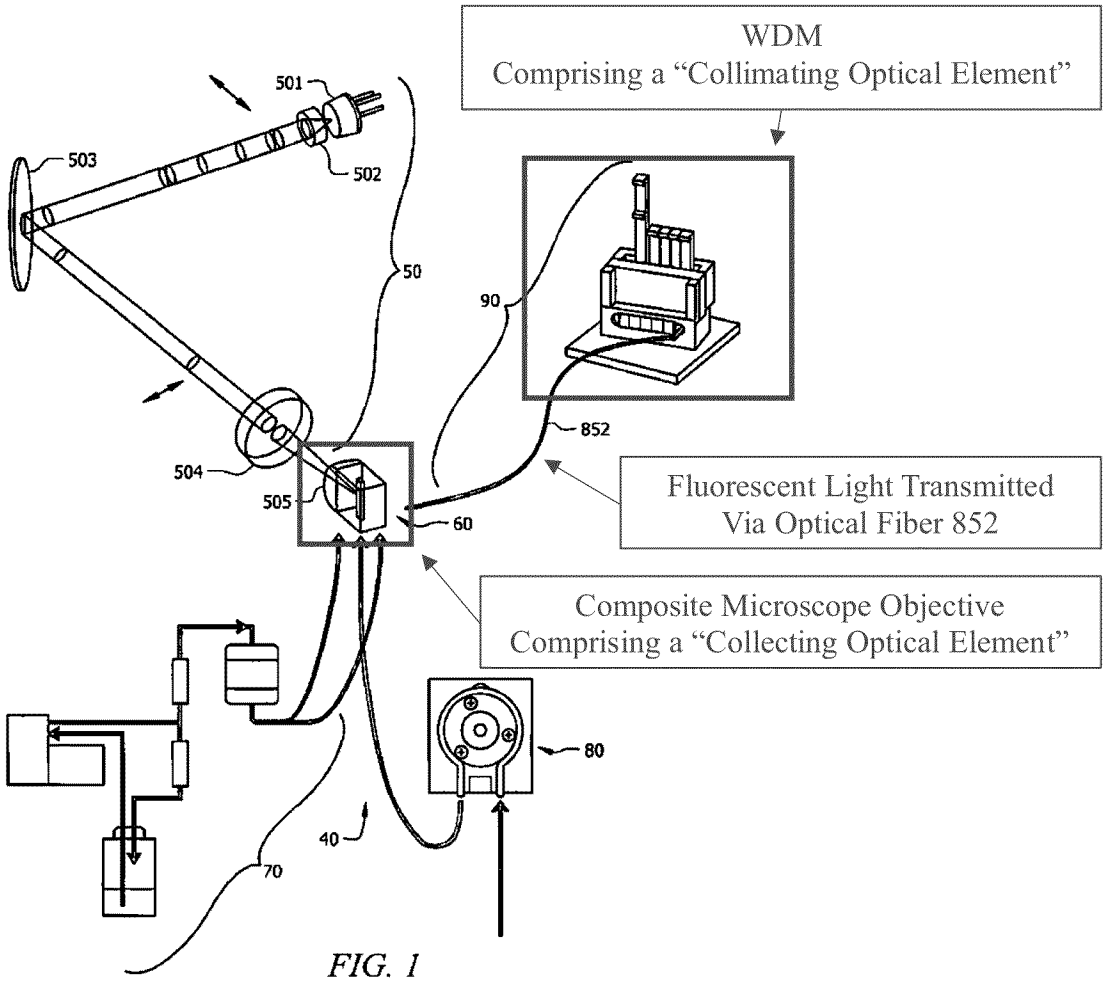


FIG. 1

1. The Exemplary Composite Microscope Objective Comprises a "Collecting Optical Element"

The Specification describes embodiments where the "composite microscope objective 60" can comprise "a collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source." *See, e.g.*, Specification at 52:25-53:2, 53:21-54:5,

[1] Paragraphs [0313]-[0319] of the published application.

54:18-54:31, FIGs. 9A and 10.[2] As one exemplary illustration (shown below in FIG. 9A), "fluorescence emissions from" the "illuminate[d] particles in the sample":

"1. initially propagate toward back-surface mirror 601 and pass first through cuvette 603 to be internally reflected by the back-surface mirror 601;

2. then pass through the cuvette 603;

3. subsequently pass through the aspheric corrector plate 602; and

4. finally forms … images near an image plane 605."

Id. at 52:25-53:2, 53:21-54:5, FIG. 9A. Thus, composite microscope objective 60 can comprise a "collecting optical element" such that "fluorescent light emitted by a particle" in flow channel 604 is "collect[ed] and focus[ed]" to converge for image formation on "image plane 605." *See id.*

Composite Microscope Objective Comprising a "Collecting Optical Element" That Focuses Fluorescent Light Onto Image Plane 605

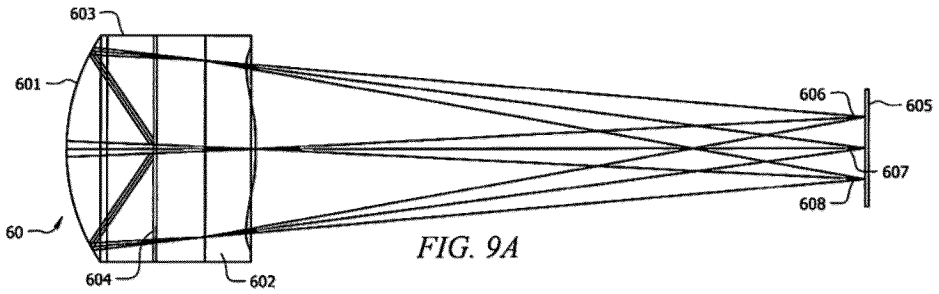


FIG. 9A

As another illustration (shown below in FIG. 10), in some embodiments "back-surface mirror 601' and the aberration corrector plate 602'" may be "modified slightly to produce collimated afocal images of the emission locations" but "the composite microscope objective 60' may include a chromatic compensating doublet lens 609 inserted between the corrector plate 602'

[2] Paragraphs [0347], [0349]-[0354], and [0356] of the published application.

and the image plane 605'" such that the doublet lens "focus[es] the light … onto the image plane." Specification at 54:18-54:31, FIG. 10. Thus, in these embodiments, composite microscope objective 60' comprises a "collecting optical element" such that "fluorescent light emitted by a particle" in flow channel 604 is likewise "collect[ed] and focus[ed]" to converge for image formation on "image plane 605.'" *See id.*

Composite Microscope Objective Comprising a "Collecting Optical Element" That Focuses Fluorescent Light Onto Image Plane 605'

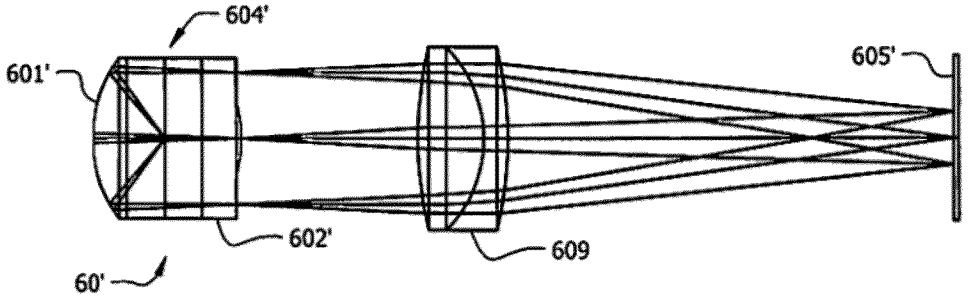


FIG. 10

2. The Exemplary WDM Comprises a Collimating Optical Element

The Specification further describes embodiments where WDM 90 comprises a "collimating optical element" that is "arranged to receive the fluorescent light collected by the collecting optical element" of composite microscope objective 60. *See, e.g.*, Specification at 35:30-36:15, 43:23-44:7, 68:6-69:2, FIGs. 1 and 25.[3] For example, the Specification describes that this can occur via "an optical fiber 852 that receives light … fluoresced by particles in the viewing zone that the composite microscope objective 60"—which comprises a collecting optical element (*supra*)—"gathers and images," where WDM 90 receives the "fluoresced light [] from the

[3] Paragraphs ¶¶ [0225]-[0230], [0313]-[0319], and [0408]-[0409] of the published application.

optical fiber 852" that "forms an extended object or light source at location 901, i.e. the optical input of the WDM 90." *See id.* at 68:6-10, FIGs. 1 and 25. And the Specification then explains that the WDM's "collimating optical element … may capture the light from source 901" to collimate the light. *Id.* at 68:21-26, FIG. 25. Because, as annotated below, "the light from source 901" that the collimating optical element "capture[s]" can be the fluorescent light that "composite microscope objective 60 gather[ed] and imag[ed]"—and thus that the collecting optical element thereof collected—for transmission to WDM 90 via optical fiber 852, the Specification describes the "collimating optical element" of WDM 90 being arranged to receive the fluorescent light collected by the composite microscope objective's collecting element. *See id.* at 35:30-36:15, 43:23-44:7, 68:6-69:2, FIGs. 1 and 25.

Notably, the Specification describes embodiments where WDM 90 and thus its collimating optical element are separate from composite microscope objective 60 and thus its collecting optical element. *See* Specification at 35:30-36:15, 43:23-44:7, 68:6-69:2, FIGs. 1 and 25.

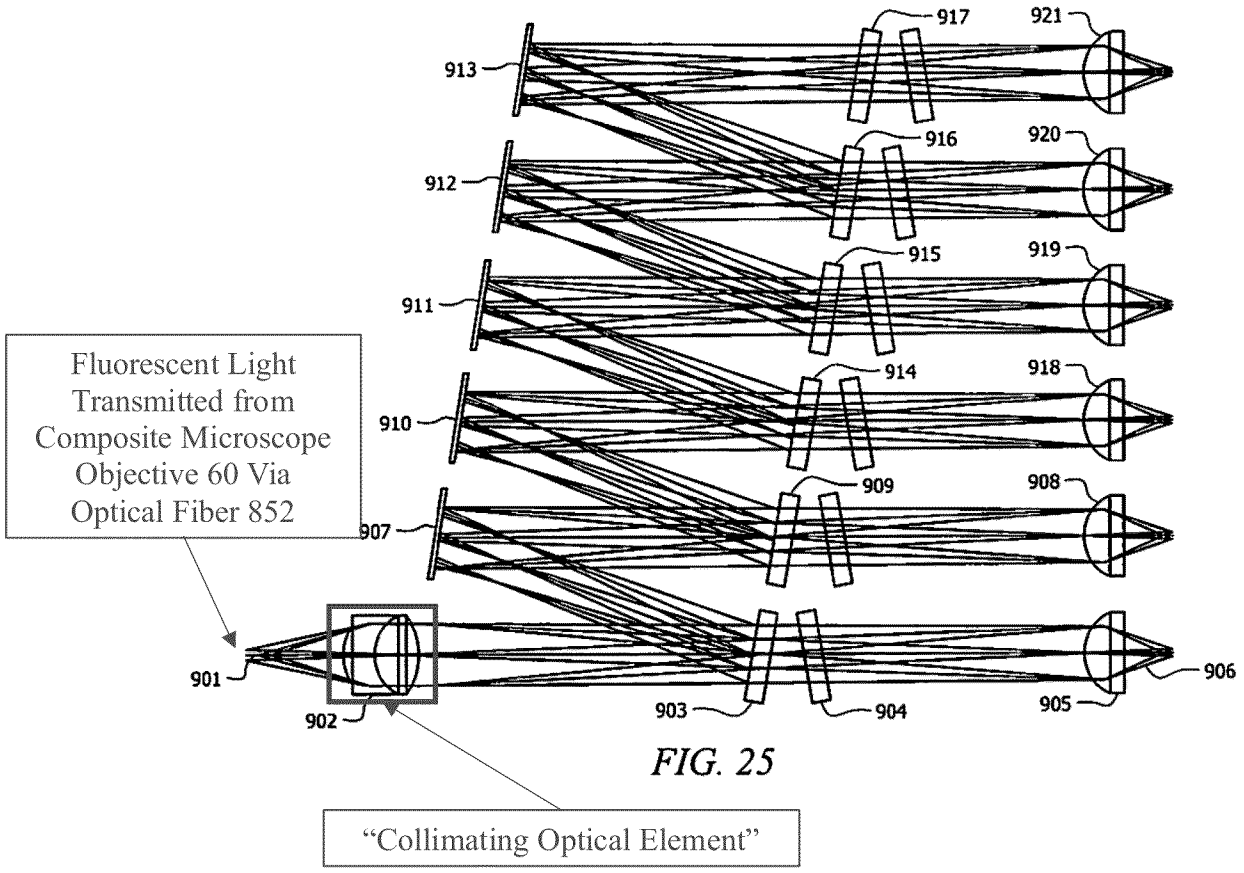


FIG. 25

Accordingly, the amendment reciting that the "collimating optical element" is "separate from" the "collecting optical element" does not introduce new matter.

IV. The Claims Are Patentable Over Oostman

The Office rejects all claims under 35 U.S.C. § 103 as allegedly obvious over Pub. No. US 2003/0048539 ("Oostman"). Action at 3-9. Applicant respectfully disagrees.

A. A Collecting Optical Element Configured to "Focus" Fluorescent Light

Independent claims 1, 13, and 18 each recite "a light source arranged to illuminate … particles" and "a collecting optical element" that is "configured to collect and focus fluorescent light emitted by a particle illuminated by the light source." The Office contends that the apparatus disclosed in Oostman's FIG. 1 has a light source—"air cooled argon ion laser 11" whose "beam 12 … impinge[s] upon a fluorescent substance in a flow cell 41" to "caus[e] fluorescent excitation"—

that is arranged to illuminate particles. Action at 3; Oostman at ¶ [0003]. And, per the Office, "[o]bjective lens 19" of Oostman's FIG. 1 is a "collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source" as claimed. Action at 3; Oostman at ¶ [0003].

As explained in the previous response sent June 4, 2024 ("Prior Response"), Applicant respectfully disagrees that Oostman's objective lens 19 is configured to "focus fluorescent light" because the objective lens "collimate[s]" rather than focuses "the fluorescent signal from the target substance." Oostman at ¶ [0003] (emphasis added). A POSITA would have understood that collimation means generally maintaining the width of a beam for some distance, including by, for example, limiting its convergence or divergence. *E.g.*, Specification at 4:46-63. Oostman's objective lens 19's collimation—while not necessarily maintaining parallelism, given that achieving perfectly parallel rays of light is not realizable in practice—is not "focus[ing]" the fluorescent light, which instead involves converging the light. *See, e.g.*, Excerpts from Newport Catalog at 480, *available at* http://rpdata.caltech.edu/courses/aph162/2007 (attached as APPENDIX A to the Prior Response) (distinguishing between "Focusing" and "Collimating" in "Application 1" and "Application 2").

Nevertheless, in an effort to expedite prosecution, independent claims 1, 13, and 18 are each amended to recite "that the fluorescent light leaving the collecting optical element converges," which makes clear that the fluorescent light "focus[ed]" by the "collecting optical element" converges instead of being collimated. Because Oostman's objective lens 19 collimates the fluorescent light, it is not configured to "focus [the] fluorescent light … such that the fluorescent light leaving [the objective lens] converges" as the claims require. *See* Oostman at ¶ [0003]; *supra*.

B. Separate Collecting Optical Element and Collimating Optical Element

Independent claims 1 and 18 each recite, in addition to the "collecting optical element," a "wavelength division multiplexer (WDM)" that includes "a collimating optical element … arranged to receive the fluorescent light collected by the collecting optical element." Based on the relevant claim language in these claims, the separate descriptions of the collecting optical element and collimating optical element in these claims means that those are distinct components because "'the clear implication of the claim language' is that those elements are 'distinct component[s]' of the patented invention." *Becton, Dickinson & Co. v. Tyco Healthcare Grp., LP*, 616 F.3d 1249, 1254 (Fed. Cir. 2010) (quoting *Gaus v. Conair Corp.*, 363 F.3d 1284, 1288 (Fed. Cir. 2004)).

The Office fails to treat the claimed collecting optical element and collimating optical element as distinct components in its rejection. In particular, the Office relies on a single structure—Oostman's objective lens 19—in its mappings to both the claimed collecting optical element and the claimed collimating optical element. *See* Action at 3 (contending that "objective lens 19 … is a collecting optical element" and that the "combination of [Oostman's] objective lens 19 and [dichroic mirror] 25 … is a collimating optical element"). But because those are distinct structures in the claim, "the claimed [collecting optical element] and [collimating optical element] cannot be read on the **same** device found in [the prior art]." *Ex parte Masiero*, Appeal No. 2020-003171, slip op. at 4-6, 8-9 (PTAB Oct. 19, 2021).

Nevertheless, in an effort to expedite prosecution and to remove any doubt that the claimed "collecting optical element" and "collimating optical element" are not one and the same, claims 1 and 18 are each amended to recite that the collimating optical element "is separate from the collecting optical element" such that they are two distinct structures. As noted in the Advisory Action, Oostman lacks a distinct "collecting optical element" and "collimating optical element" as

claimed. *See* Advisory Action at 2 ("the examiner agreed that the prior art Oostman's appears to lacking this/these limitation(s)").

For at least these reasons, **independent claims 1**, **13**, and **18** are patentable over Oostman.[4] Applicant respectfully requests reconsideration and withdrawal of the rejections.

V. Conclusion

The pending claims are in condition for allowance for at least the reasons set forth above. Applicant does not acquiesce to the Office's characterizations of the claim language or the cited references, and reserves the right to challenge any such characterizations in the future. The Examiner is invited to contact the undersigned attorney with any questions or comments relating to this application.

Respectfully submitted,

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/Michael Pohl/

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Reg. No. 72,871
Attorney

Date: July 18, 2024

[4] The Office acknowledges that Oostman also fails to disclose a curved mirror and dichroic filter, but contends that it would have been obvious to separate Oostman's dichroic mirror 25 into a dichroic filter and a curved mirror in Oostman's FIG. 1. Action at 5-6. Applicant respectfully disagrees, at least because (1) the Office has not shown that Oostman teaches any curved mirror, (2) a POSITA would not have viewed a curved mirror as an "obvious design variation" of Oostman's (non-curved) dichroic mirror 25, and (3) Oostman does not suggest placing a curved mirror at the location of its dichroic mirror 25 "to reflect a portion of the fluorescent light towards the [alleged] first semiconductor detector" with "a first dichroic filter optically disposed between the [] curved mirror and the [alleged] first semiconductor detector" to "allow [a] first color band in the fluorescent light to pass through the first dichroic filter onto the [alleged] first semiconductor detector" and "reflect a second color band in the fluorescent light away from the [alleged] first semiconductor detector" as claimed. Nevertheless, the above arguments are sufficient to overcome the Office's rejections.

Doc Code: TRACK1.REQ
Document Description: TrackOne Request

PTO/AIA/424 (04-14)

CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e) (Page 1 of 1)

First Named Inventor:	Yong Qin Chen	Nonprovisional Application Number (if known):	17/645,727
Title of Invention:	Flow Cytometer		

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i)(1) and the prioritized examination fee set forth in 37 CFR 1.17(c) have been filed with the request. The publication fee requirement is met because that fee, set forth in 37 CFR 1.18(d), is currently $0. The basic filing fee, search fee, and examination fee are filed with the request or have been already been paid. I understand that any required excess claims fees or application size fee must be paid for the application.

2. I understand that the application may not contain, or be amended to contain, more than four independent claims, more than thirty total claims, or any multiple dependent claims, and that any request for an extension of time will cause an outstanding Track I request to be dismissed.

3. The applicable box is checked below:

I. ☐ Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)

i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.

---OR---

(b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.

ii. An executed inventor's oath or declaration under 37 CFR 1.63 or 37 CFR 1.64 for each inventor, **or** the application data sheet meeting the conditions specified in 37 CFR 1.53(f)(3)(i) is filed with the application.

II. ☑ Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)

i. A request for continued examination has been filed with, or prior to, this form.
ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature /Michael Pohl/	Date July 18, 2024
Name (Print/Typed) Michael Pohl	Practitioner Registration Number 72,871

Note: *This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required.**

☐ *Total of _____ forms are submitted.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

UNITED STATES
PATENT AND TRADEMARK OFFICE

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Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**07/18/2024 04:45:50 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Susan Lien
PATENT CENTER #	66427260	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Michael Pohl

Documents

TOTAL DOCUMENTS: 5

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
BECCP0002USCIPD2C1_Response.pdf		17	-	478 KB
BECCP0002USCIPD2C1_Response-A.NE.pdf	(1-1)	1	Response After Final Action	134 KB
BECCP0002USCIPD2C1_Response-IACS.pdf	(2-7)	6	Amendment Copy Claims/Response to Suggested Claims	145 KB
BECCP0002USCIPD2C1_Response-REM.pdf	(8-17)	10	Applicant Arguments/Remarks Made in an Amendment	425 KB
BECCP0002USCIPD2C1_RC		3	Request for Continued	652 KB

E.pdf		Examination (RCE)	
Warning: This is not a USPTO supplied RCE fillable form. Data in the form cannot be automatically loaded to other USPTO systems.			
BECCP0002USCIPD2C1_TrackOne_Request.pdf	2	Track One Request	126 KB

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This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as

described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	07/18/2024 04:45:50 PM Z ET	BECC.P0002US.CIP.D2C1

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Susan Lien
PATENT CENTER #	66427260	AUTHORIZED BY	Michael Pohl
CUSTOMER #	129381	FILING DATE	12/22/2021
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Yong Qin Chen

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 3346	E20247HG46266933	Susan Lien

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1817	REQUEST FOR PRIORITIZED EXAMINATION	4200.00	1	4200.00
1801	REQUEST FOR CONTINUED EXAMINATION (RCE) - 1ST REQUEST (SEE 37 CFR 1.114)	1360.00	1	1360.00
			TOTAL AMOUNT:	$5,560.00

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Title:	FLOW CYTOMETER
Appl. No.:	17/645,727
Applicant:	IRIS INTERNATIONAL, INC.
Filed:	December 22, 2021
Group Art Unit:	2877
Examiner:	Isiaka O. Akanbi
Docket No.:	BECC.P0002US.CIP.D2C1
Confirmation No.:	1145

CERTIFICATE OF ELECTRONIC TRANSMISSION (37 C.F.R. § 1.8)
I, Sarah Calzia, hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office via Patent Center on August 12, 2024. Signed: /Sarah Calzia/

INFORMATION DISCLOSURE STATEMENT

In compliance with the duty of disclosure under 37 C.F.R. § 1.56, it is respectfully requested that this Information Disclosure Statement be entered and the documents listed on attached Form PTO-1449 be considered by the Examiner and made of record.

In accordance with 37 C.F.R §§ 1.97(g), (h), this Information Disclosure Statement is not to be construed as a representation that a search has been made, and is not to be construed to be an admission that the information cited is, or is considered to be, material to patentability as defined in 37 C.F.R. § 1.56(b).

Timing and Fees

☒ Under 37 C.F.R. § 1.97(b), **no fee or statement is required** for filing this Information Disclosure Statement because it is filed:

- ☐ within three months of the filing date of a national application other than a CPA under § 1.53(d); **OR**
- ☐ within three months of the actual filing date of the national phase of a PCT application; **OR**
- ☒ before the mailing of a first substantive office action (including after filing of an RCE).

☐ Under 37 C.F.R. § 1.97(c), this Information Disclosure Statement is filed after the periods specified in 37 C.F.R. § 1.97(b), but **before** the mailing date of:

- ☐ a final rejection under 37 C.F.R. § 1.113; **OR**
- ☐ termination of prosecution, e.g. Ex Parte Quayle, M.P.E.P. § 609(B)(2); **OR**
- ☐ a notice of allowance under 37 C.F.R. § 1.311;

AND is accompanied by:

- ☐ the statement as specified in 37 C.F.R. § 1.97(e) set out below; **OR**
- ☐ payment covering the fee of $_____ under 37 C.F.R. § 1.17(p).

☐ Under 37 C.F.R. § 1.97(d), this Information Disclosure Statement is filed **after** the mailing date of the following actions which have not been withdrawn:

- ☐ a final action under 37 C.F.R. § 1.113; **OR**
- ☐ termination of prosecution; e.g. Ex Parte Quayle, M.P.E.P. § 609(B)(2); **OR**
- ☐ a notice of allowance under 37 C.F.R. § 1.311 and is filed on or before payment of the issue fee;

AND is accompanied by:

the statement as specified in 37 C.F.R. § 1.97(e) as set forth below, **AND** payment covering the fee of $_____ under 37 C.F.R. § 1.17(p).

Statements Under 37 C.F.R. § 1.97(e) (if applicable)

☐ Each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the present Information Disclosure Statement;

Copies of Cited Materials (if applicable)

☐ Copies of materials listed but not attached were cited in benefit (35 U.S.C. § 120) ancestor application Serial No. _____ on Form 892 by the Examiner and/or Form 1449 by the applicant; see 37 C.F.R. § 1.98(d).

☐ This application may be related by inventorship and/or subject matter to co-pending U.S. application Serial No. _____, filed _____.

Payment of Fees Due (if applicable)

☐ Payment is made by credit card via Patent Center for $_____ covering the fee identified above.

☒ The Commissioner is hereby authorized to charge or credit any overpayment to Deposit Account 50-1212/BECC.P0002US.CIP.D2C1.

Respectfully submitted,

/Michael Pohl/

Michael Pohl
Reg. No. 72,871
Attorney for Applicant

NORTON ROSE FULBRIGHT US LLP
98 San Jacinto Blvd. Suite 1100
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(512) 536-3113
Date: August 12, 2024

Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT (Use several sheets if necessary)	Applicant: IRIS INTERNATIONAL, INC.	
	Filing Date: December 22, 2021	Group: 2877

U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1	*See Page 1*	*See Page 1*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A1			

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language
	B1				

Other Art (Including Author, Title, Date, Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C1	Shapiro, H. M. (2003). Practical Flow Cytometry Fourth Edition. John Wiley & Sons.

202451021.1

EXAMINER:	DATE CONSIDERED:

EXAMINER: INITIAL IF REFERENCE CONSIDERED, WHETHER OR NOT CITATION IS IN CONFORMANCE WITH MPEP609; DRAW LINE THROUGH CITATION IF NOT IN CONFORMANCE AND NOT CONSIDERED. INCLUDE COPY OF THIS FORM WITH NEXT COMMUNICATION TO APPLICANT.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**08/12/2024 02:34:31 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Sarah Calzia
PATENT CENTER #	66748205	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Michael Pohl

Documents

TOTAL DOCUMENTS: 41

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
2024.08.12_IDS_BECC.P0002US.CIP.D2C1.pdf		3	-	234 KB
2024.08.12_IDS_BECC.P0002US.CIP.D2C1-TRAN.LET.pdf	(1-2)	2	Transmittal Letter	141 KB
2024.08.12_IDS_BECC.P0002US.CIP.D2C1-IDS.pdf	(3-3)	1	Information Disclosure Statement (IDS) Form (SB08)	196 KB
NPL_Practical_Flow_Cytometry_Shapiro_Part13.pdf		17	Non Patent Literature	8883 KB
NPL_Practical_Flow_Cytometry_Shapiro_Part12.pdf		18	Non Patent Literature	8876 KB
NPL_Practical_Flow_Cytometry_Shapiro_Part10.pdf		18	Non Patent Literature	8850 KB

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Digest

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NPL_Practical_Flow_Cytometry_Shapiro_Part5.pdf	8288EF35070E975EB1498CD27CA465653FFEF946B17DE454F 5C7C22D0B060F702B5A7CC7FFCA59096ACF7078649E4B5D1 5BA6D396D130EF9261569082CDE7025
NPL_Practical_Flow_Cytometry_Shapiro_Part7.pdf	85A20AD69933B8C442E6CAF283B58E6D606BA7334D35A4CB CE6C0ECC0823F570FE0EB4EFF04AEB5C860CAD89AA044B7 0C17B38B52241B2B71A01B2A0EBDB4926
NPL_Practical_Flow_Cytometry_Shapiro_Part8.pdf	C3E500FD7D56D07FAC4814985E7FFCD59CCF8C2A65E20788 F2D4189B4C6F411A1874DB6A45B26FBFC2082B14C5EF3545A 73C9CA89E892476E87EB985EB7FCCC1
NPL_Practical_Flow_Cytometry_Shapiro_Part11.pdf	CA679EDEFBA2CA6301EA6F26DC9339ACB8A3D40B2C5A025 34256FBDF44C80C41F50D0F5B4274A489DCA31678457172249 5CCC737287C448F197CE19652C5DAD0
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NPL_Practical_Flow_Cytometry_Shapiro_Part19.pdf	509056CC42A23366128FDA2706171B42787D390EC2D8E32DF E119C29C4AE5ADA5F6AFFF97F70F56F9A23C4289CF85C7AF 7F5D59E6BE72D9C032AB8DCE876CFEE
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NPL_Practical_Flow_Cytometry_Shapiro_Part3.pdf	3E0B95E5530C7C642F345EF57959E43415D853DA24DEAA678 3347B8C1CAD610DD8E76B39C72A9FDAC3054D35ED0B02CA 149FE2FBA02960AAFE8585E813897067

NPL_Practical_Flow_Cytometry_Shapiro_Part6.pdf	F98AFC18E39D58A825271A960E8683521251603124E1A882A922247D87CD767E9953B0F439B68004F85FA164C8976520BF7C153E4D89CD4B992FFD9E047932DA
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NPL_Practical_Flow_Cytometry_Shapiro_Part29.pdf	61519CF7B1666889E557B3709A7D6E1DCDED5632A6C9F2928AED9FF65263324FA077B824A9B292C706EBBC98DB904D0D2A51C42DB7781AFD8D6369ED082F0C62

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Iris International, Inc.	Group Art Unit: 2877
Serial No.: 17/645,727	Examiner: Isiaka O. Akanbi
Filed: December 22, 2021	Atty. Dkt. No.: BECC.P0002US.CIP.D2C1
For: Flow Cytometer	Confirmation No.: 1145

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

CERTIFICATE OF ELECTRONIC TRANSMISSION
37 C.F.R. § 1.8

I hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office via Patent Center on the date below:

August 14, 2024	/Michael Pohl/
Date	Michael Pohl

STATEMENT OF SUBSTANCE OF INTERVIEW UNDER 37 C.F.R. § 1.133

Applicant thanks Examiner Akanbi for conducting an examiner-initiated interview with Applicant's representative, Michael Pohl, on August 9, 2024.

Examiner Akanbi informed Mr. Pohl that the prior response was sufficient to overcome the rejections of independent claims 1 and 18 and their respective dependent claims, but indicated that he would issue a rejection of claims 13-15 and 17 and object to claim 16 unless claim 13 was amended to recite the "collimating optical element" in addition to the "collecting optical element." Mr. Pohl inquired as to what the basis of the rejection would be, given that—as set forth in the prior response—the relied-on embodiment of US 2003/0048539 ("Oostman") lacked a "collecting optical element" that is arranged and configured in the manner claimed. Examiner Akanbi indicated that Oostman's disclosure of lens light collector 111 in another embodiment of Oostman would support an obviousness position. Mr. Pohl disagreed and maintained that independent claim 13 and its dependent claims were allowable as written, but indicated that Applicant would

consider amending independent claim 13 to recite the "collimating optical element" for the purpose of expediting allowance.

On August 12, 2024, Mr. Pohl reached out to Examiner Akanbi via e-mail and phone and indicated that Applicant was willing to amend independent claim 13 to recite the "collimating optical element" per Examiner Akanbi's request. Mr. Pohl included proposed amendments—attached as Appendix A to this paper—and sought confirmation that the amendments accorded with what Examiner Akanbi proposed in the August 9, 2024 interview. Applicant maintains that independent claim 13 and its dependent claims were allowable over the prior art without the amendments, but submitted the proposed amendments for the purpose of expediting allowance.

On August 14, 2024, Examiner Akanbi responded "Thank you" and indicated he would "process accordingly."

Respectfully submitted,

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/Michael Pohl/

Michael Pohl
Reg. No. 72,871
Attorney

Date: August 14, 2024

APPENDIX A

Claim Amendments

1. (Previously Presented) A flow cytometer, comprising:

a light source arranged to illuminate a stream of particles in a viewing zone of a flow cell in the flow cytometer;

a collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source such that the fluorescent light leaving the collecting optical element converges; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light,

a first semiconductor detector configured to detect and quantitate a first color band in the fluorescent light,

a first curved mirror arranged to receive at least a portion of the fluorescent light after the fluorescent light has passed through the collimating optical element, the first curved mirror configured to reflect the portion of the fluorescent light towards the first semiconductor detector, and

a first dichroic filter optically disposed between the first curved mirror and the first semiconductor detector, the dichroic filter configured to allow the first color band in the fluorescent light to pass through the first dichroic filter onto the first semiconductor detector, and to reflect a second color band in the fluorescent light away from the first semiconductor detector.

2. (Original) The flow cytometer of claim 1, further comprising an optical fiber optically disposed between the collecting optical element and the WDM, the optical fiber arranged and configured to deliver the fluorescent light collected by the collecting optical element to the WDM.

3. (Previously Presented) The flow cytometer of claim 1, further comprising a first focusing optical element optically disposed between the first dichroic filter and the first semiconductor detector, the first focusing optical element configured to focus the first color band in the fluorescent light passing through the first dichroic filter onto the first semiconductor detector.

4. (Previously Presented) The flow cytometer of claim 3, further comprising a second semiconductor detector arranged and configured to detect and quantitate the second color band in the fluorescent light reflected by the first dichroic filter.

5. (Previously Presented) The flow cytometer of claim 4, further comprising:

a second curved mirror and a second dichroic filter, the second curved mirror arranged and configured to reflect at least a portion of the fluorescent light reflected by the first dichroic filter towards the second semiconductor detector, the second dichroic filter arranged and configured to allow the second color band in the fluorescent light to pass through the second dichroic filter onto the second semiconductor, and to reflect a third color band in the fluorescent light away from the second semiconductor detector; and

a third semiconductor detector arranged and configured to detect and quantitate the third color band in the fluorescent light reflected by the second dichroic filter.

6. (Cancelled).

7. (Previously Presented) The flow cytometer of claim 1, wherein the first curved mirror reflects the portion of the fluorescent light to form an image.

8. (Original) The flow cytometer of claim 7, wherein the formed image is an image of the collimating optical element.

9. (Original) The flow cytometer of claim 1, wherein the light source is arranged and configured to illuminate the stream of particles from one side of the flow cell, and wherein the collecting optical element is arranged and configured to collect fluorescent light from another side of the flow cell.

10. (Original) The flow cytometer of claim 9, wherein the collecting optical element is further configured to collect and focus side-scatter light scattered by the illuminated particle in the stream.

11. (Original) The flow cytometer of claim 1, wherein the light source comprises a plurality of lasers.

12. (Original) The flow cytometer of claim 11, wherein the plurality of lasers comprises a first laser configured to illuminate a particle in the stream at a first location in the viewing zone, and a second laser configured to illuminate the particle at a second location in the viewing zone.

13. (Currently Amended) A flow cytometer comprising:

a light source arranged to illuminate a stream of particles in a viewing zone;

a collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source such that the fluorescent light leaving the collecting optical element converges; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light;

a row of mirrors arranged and configured to sequentially reflect different color bands of the fluorescent light collected by the collecting optical element after the fluorescent light has passed through the collimating optical element, the row of mirrors including at least one curved mirror;

a row of dichroic filters opposed to the row of mirrors, each of the dichroic ~~filter~~ filters configured to pass one color band of the fluorescent light reflected by a mirror in the row of mirrors, and to reflect another color band of the fluorescent light reflected by the mirror;

a row of semiconductor detectors, each of the semiconductor ~~detector~~ detectors arranged and configured to detect and quantitate the band of fluorescent light passing through a dichroic filter in the row of dichroic filters.

14. (Currently Amended) The flow cytometer of claim 13, further comprising a row of focusing optical elements, each of the focusing optical ~~element~~ elements in the row arranged and configured to focus the band of fluorescent light passing through a dichroic filter in the row of dichroic filters onto the corresponding semiconductor detector.

15. (Original) The flow cytometer of claim 14, wherein the row of mirrors includes at least one curved mirror configured to form an image in the fluorescent light reflected by said curved mirror.

16. (Currently Amended) The flow cytometer of claim 15, wherein the image formed by said curved mirror is an image of **[[**a**]]** the collimating optical element ~~that is arranged to receive the fluorescent light collected by the collecting optical element and configured to collimate the fluorescent light~~.

17. (Previously Presented) The flow cytometer of claim 13, wherein the row of mirrors and row of dichroic filters are arranged such that fluorescent light received by the WDM is reflected back and forth between the row of mirrors and the row of dichroic filters in a zig-zag pattern.

18. (Previously Presented) A flow cytometer, comprising:

a light source arranged to illuminate a flow-stream of particles in a viewing zone from a first side of the flow stream;

a collecting optical element arranged on a second side of the flow stream, the collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source such that the fluorescent light leaving collecting optical element converges; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light,

a first semiconductor detector configured to detect and quantitate a first color band in the fluorescent light,

a first curved mirror arranged to receive at least a portion of the fluorescent light after the fluorescent light has passed through the collimating optical element, the first curved mirror configured to reflect the portion of the fluorescent light towards the first semiconductor detector, and

a first dichroic filter disposed between the first curved mirror and the first semiconductor detector, the dichroic filter configured to allow the first color

band in the fluorescent light to pass through the first dichroic filter onto the first semiconductor detector, and to reflect a second color band in the fluorescent light away from the first semiconductor detector.

19. (Previously Presented) The flow cytometer of claim 18, wherein the first side of the flow stream is orthogonal to the second side of the flow stream.

20. (Original) The flow cytometer of claim 19, wherein the collecting optical element is further configured to collect and focus side-scatter light scattered by the illuminated particle.

21. (Previously Presented) The flow cytometer of claim 1, wherein the first curved mirror is arranged to receive the portion of the fluorescent light when the portion of the fluorescent light is collimated.

UNITED STATES
PATENT AND TRADEMARK OFFICE

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Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**08/14/2024 04:31:24 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Susan Lien
PATENT CENTER #	66788194	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Michael Pohl

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
BECCP0002USCIPD2C1_Interview_Summary.pdf	9	Applicant summary of interview with examiner	165 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
BECCP0002USCIPD2C1_Interview_Summary.pdf	B6BAF56EF64EA370012051955039D227A9D93058DE6CC55AB0383E65CC529951ED83D1086975384ACE829699FC76F8A5582E201FD491FD4A698AA328CA67A591

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Examiner-Initiated Interview Summary	**Application No.** 17/645,727	**Applicant(s)** Chen, Yong Qin		
	Examiner ISIAKA O AKANBI	**Art Unit** 2877	**AIA (First Inventor to File) Status** No	**Page** 1 of 1

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
ISIAKA O AKANBI	Primary Examiner	Telephonic
Michael Pohl	Attorney	

Date of Interview: 09 August 2024

Issues Discussed:

Other

Examiner initiated an interview on August 09, 2024 proposing suggestion to make the case allowable. The applicant representative indicated that he will contact his/her client(s) in order to decide the proposed suggestion to make the case allowable.

/ISIAKA O AKANBI/ Primary Examiner, Art Unit 2877	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: It is not necessary for applicant to provide a separate record of the substance of interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

Notice of References Cited	Application/Control No. 17/645,727	Applicant(s)/Patent Under Reexamination Chen, Yong Qin	
	Examiner ISIAKA O AKANBI	Art Unit 2877	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Name	CPC Classification	US Classification
*	A	US-5872627-A	1999-02-16	Miers; David R.	G01N15/1431	356/338
*	B	US-20160091484-A1	2016-03-31	YAMADA; Kazuhiro	G01N15/1459	356/40
*	C	US-10261080-B2	2019-04-16	Li; Nan	G01N15/1459	1/1
*	D	US-11169076-B2	2021-11-09	Yan; Ming	G01N21/47	1/1
*	E	US-20180024040-A1	2018-01-25	Yan; Ming	G01J3/021	435/288.7
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
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	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in YYYY-MM-DD format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/645,727	Chen, Yong Qin
	Examiner	**Art Unit**
	ISIAKA O AKANBI	2877

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	02/10/2024	04/29/2024	08/10/2024						
	1	✓	✓	=						
	2	✓	✓	=						
	3	✓	✓	=						
	4	✓	✓	=						
	5	✓	✓	=						
	6	✓	-	=						
	7	✓	✓	=						
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	13	✓	✓	✓						
	14	✓	✓	✓						
	15	✓	✓	✓						
	16	✓	✓	O						
	17	✓	✓	✓						
	18	✓	✓	=						
	19	✓	✓	=						
	20	✓	✓	=						
	21		✓	=						

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/645,727	Chen, Yong Qin
	Examiner	Art Unit
	ISIAKA O AKANBI	2877

CPC - Searched*		
Symbol	Date	Examiner
(G01N15/1436 or F04B11/0025 or G01N15/1434 or G01N15/1459 or G01N35/1095 or G02B6/26 or G02B6/29365 or G02B21/04 or G02B21/361 or G02B27/0025 or G01N2015/1006 or G01N2015/144 or G01N2015/1452).cpc.	08/09/2024	IOA

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
356	338, 335, 339, 336, 340, 625	08/09/2024	IOA

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
PE2E Search (US-PGPUB; USPAT; USOCR; EPO CPC)- See Search History Printout	08/09/2024	IOA
Inventor Search	08/09/2024	IOA
Interference Search	08/09/2024	IOA

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
See .CLM Query Search		08/09/2024	IOA

/ISIAKA O AKANBI/ Primary Examiner, Art Unit 2877	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/645,727	Chen, Yong Qin
	Examiner	**Art Unit**
	ISIAKA O AKANBI	2877

/ISIAKA O AKANBI/ Primary Examiner, Art Unit 2877	

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	1617	((("CHEN") near3 ("Yong"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/02/08 09:01 AM
L2	14	L1 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 09:12 AM
L3	14	L2 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 09:20 AM
L4	14	L3 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 09:21 AM
L5	38	((("IRIS") near3 ("INTERNATIONAL") near3 ("INC"))).AS,AANM.	(USPAT)	OR	ON	ON	2024/02/08 12:34 PM
L6	14	L5 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:35 PM

		(WDM)))					
L7	14	L6 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:35 PM
L8	14	I7 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:36 PM
L9	7	(isiaka NEAR akanbi) AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:36 PM
L10	0	L9 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:38 PM
L11	7	L9 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:38 PM
L12	31	(Hoa NEAR Pham) AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:35 PM

		charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))					
L13	0	L12 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:36 PM
L14	29	L12 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:36 PM
L15	0	L14 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter$3) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:38 PM
L16	10	L14 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter$3) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:38 PM
L17	10	L14 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter$3 concave convex) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:40 PM
L18	103967	(G01N15/1436 or F04B11/0025 or G01N15/1434 or G01N15/1459 or G01N35/1095 or G02B6/26 or G02B6/29365 or G02B21/04 or G02B21/361 or	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,	OR	ON	ON	2024/02/08 05:11 PM

		G02B27/0025 or G01N2015/1006 or G01N2015/144 or G01N2015/1452).cpc.	MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L19	902	I18 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:12 PM
L20	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:13 PM
L21	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:13 PM
L22	21	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:14 PM
L23	46	L19 AND ((color$1 colour$1 spectrum$1	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:14 PM

		spect$3) SAME fluo$8 SAME (concave curv$7 convex diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))					
L24	45	l23 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:15 PM
L25	15	("5411029" | "5540494" | "6573991" | "7471393" | "20050151968" | "20080010019" | "20080215297" | "20080221711" | "20080319680").pn. OR ("9025145").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/02/09 08:01 AM
L26	3	L25 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:08 AM
L27	0	L26 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (concave curv$7 convex diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:09 AM
L28	3	L26 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:10 AM

		(detector$1 sensor$1 receiver$1 imag$3))					
L29	7	L25 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:12 AM
L30	3	L29 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (receiv$3 collect$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:13 AM
L31	5	L29 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:14 AM
L32	79	("2816479" | "3695765" | "3710933" | "3873209" | "4263508" | "4360270" | "4765737" | "4794806" | "4857451" | "5007737" | "5041733" | "5056918" | "5090808" | "5104221" | "5105093" | "5138170" | "5325168").pn. OR ("5540494").urpn. AND (PGPB | USPT |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/02/09 08:15 AM

		USOC).dbnm.					
L33	46	l32 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:16 AM
L34	33	L33 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:16 AM
L35	11208	356/337, 356/338, 356/335, 356/339, 356/336, 356/340, 356/625	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:13 AM
L36	2413	L35 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:13 AM
L37	593	L36 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:14 AM

		multiplexer (WDM)))					
L38	581	L37 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:14 AM
L39	14	L38 AND ((fiber$1 fibre$1) SAME ((plural$3 second first multiple$1) near5 (dichroic filter$1 detector$1)) SAME collimat$3)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:17 AM
L40	3	"20120019825,"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 10:06 AM
L41	3	L40 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 10:06 AM
L42	3	L41 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 10:07 AM
L43	3	l42 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 10:07 AM
L44	249	"6683314," "4727020"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:17 PM
L45	108	L44 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:17 PM
L46	107	L45 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:18 PM

L47	72	L46 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:18 PM
L48	68	"6683314"	(USPAT)	OR	ON	ON	2024/02/09 07:43 PM
L49	54	L48 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:48 PM
L51	46	l49 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 beam$1 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:49 PM
L52	46	L51 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:50 PM
L53	2	"20030048539"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:52 PM
L54	1	L53 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:53 PM

		(detector$1 sensor$1 receiver$1 imag$3))					
L55	1	L54 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 beam$1 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:53 PM
L56	1	L55 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:53 PM
L58	207	"5317162"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/02/10 08:07 AM
L59	116	L58 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:08 AM
L60	59	L59 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 beam$1 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:09 AM
L61	34	L60 AND ((fiber$1 fibre$1) SAME wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:09 AM
L62	59	L60 AND ((fiber$1 fibre$1) wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:11 AM
L63	6	L60 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:12 AM

		SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))					
L64	6	L60 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex curv$2) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:12 AM
L65	11	L60 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5 concave convex curv$2) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:13 AM
L66	11	L60 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5 concave convex curv$2) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:13 AM
L67	14	L3 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/28 07:55 AM
L68	1635	((("CHEN") near3 ("Yong"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/04/29 10:33 AM
L69	14	L1 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:33 AM

		measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))					
L70	14	L2 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:33 AM
L71	105898	(G01N15/1436 or F04B11/0025 or G01N15/1434 or G01N15/1459 or G01N35/1095 or G02B6/26 or G02B6/29365 or G02B21/04 or G02B21/361 or G02B27/0025 or G01N2015/1006 or G01N2015/144 or G01N2015/1452).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/04/29 10:33 AM
L72	925	I18 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:33 AM
L73	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM

		dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))					
L74	11261	356/337, 356/338, 356/335, 356/339, 356/336, 356/340, 356/625	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM
L75	2424	L35 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM
L76	599	L36 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM
L77	587	L37 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM
L78	14	L38 AND ((fiber$1 fibre$1) SAME ((plural$3 second first multiple$1) near5 (dichroic filter$1 detector$1)) SAME collimat$3)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM
L79	1668	((("CHEN") near3 ("Yong"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/08/09 09:32 AM
L80	14	L1 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:32 AM

		(detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))					
L81	14	L2 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:32 AM
L82	14	L3 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:32 AM
L83	107992	(G01N15/1436 or F04B11/0025 or G01N15/1434 or G01N15/1459 or G01N35/1095 or G02B6/26 or G02B6/29365 or G02B21/04 or G02B21/361 or G02B27/0025 or G01N2015/1006 or G01N2015/144 or G01N2015/1452).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/08/09 09:32 AM
L84	952	I18 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:32 AM
L85	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:32 AM

		collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))					
L86	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L87	21	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L88	11336	356/337, 356/338, 356/335, 356/339, 356/336, 356/340, 356/625	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L89	11336	356/337, 356/338, 356/335, 356/339, 356/336, 356/340, 356/625	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L90	2442	L35 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L91	2442	L35 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM

L92	2442	L35 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L93	607	L36 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L94	595	L37 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L95	15	L38 AND ((fiber$1 fibre$1) SAME ((plural$3 second first multiple$1) near5 (dichroic filter$1 detector$1)) SAME collimat$3)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L96	0	(collimating AND optical AND element AND separate AND collecting AND optical AND element AND arranged AND receive AND fluorescent AND light AND collected AND collecting AND optical AND element AND collimating AND optical AND element AND configured AND collimate AND fluorescent AND light).CLM.	(US-PGPUB)	OR	ON	ON	2024/08/09 09:37 AM
L97	2	"20180024040" AND ((fiber$1 fibre$1) SAME ((plural$3 second first multiple$1) near5 (dichroic filter$1	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:26 AM

		detector$1)) SAME collimat$3)					
L98	0	L97 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:26 AM
L99	2	L97 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:26 AM
L100	2	L99 AND ((prism split$4 wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:27 AM
L101	0	L100 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:27 AM
L102	2	L100 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:28 AM
L103	487	(Yan NEAR Ming).in.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:54 AM
L104	10	L103 AND ((fiber$1 fibre$1) SAME	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:54 AM

		((plural$3 second first multiple$1) near5 (dichroic filter$1 detector$1)) SAME collimat$3)					
L105	24	("4954972" | "5394237" | "6097485" | "6201908" | "6563976" | "6683314" | "7245374" | "7280204" | "7605989" | "7724298" | "8184298" | "8284402" | "9746412" | "20030190113" | "20050162648" | "20050285020" | "20060273260" | "20120050533" | "20150247950" | "20150271380" | "20160154318" | "20160169809" | "20170307505" | "20190064535").pn. OR ("11169076").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/08/09 10:55 AM
L106	4	L105 AND ((fiber$1 fibre$1) SAME ((plural$3 second first multiple$1) near5 (dichroic filter$1 detector$1)) SAME collimat$3)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:57 AM
L107	1	L106 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:58 AM
L108	5	L105 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:58 AM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	1486	((("CHEN") near3 ("Yong"))).INV.	(US-PGPUB; USPAT)	OR	ON	ON	2024/08/09 09:37 AM
N2	14	N1 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT)	OR	ON	ON	2024/08/09 09:37 AM
N3	14	N2 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT)	OR	ON	ON	2024/08/09 09:38 AM

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1	1145

129381 7590 08/15/2024

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EXAMINER	
AKANBI, ISIAKA O	

ART UNIT	PAPER NUMBER
2877	

NOTIFICATION DATE	DELIVERY MODE
08/15/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

PatentDocket@Beckman.com
aoipdocket@nortonrosefulbright.com

Office Action Summary	Application No. 17/645,727	Applicant(s) Chen, Yong Qin	
	Examiner ISIAKA O AKANBI	Art Unit 2877	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 07/18/2024.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-5 and 7-21 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☑ Claim(s) 1-5,7-12 and 18-21 is/are allowed.

7) ☑ Claim(s) 13-15 and 17 is/are rejected.

8) ☑ Claim(s) 16 is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 12/22/2021 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☑ Interview Summary (PTO-413) Paper No(s)/Mail Date 08/09/2024.

4) ☐ Other: _____.

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 07/18/2024 has been entered.

Claim Rejections - 35 USC § 103

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis (i.e., changing from AIA to pre-AIA) for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 13-15 and 17 is/are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Oostman, JR. et al. (2003/0048539 A1, previously cited reference).

Regarding claim 13, **Oostman** discloses a flow cytometer **included in analytical instruments for flourescent light analysis (figs. 1-15)** comprising:

a light source **laser 11/ lasers 52 and 54** arranged to illuminate a stream of particles **43/flow cell 78** in a viewing zone **as can be seen in depicted drawing (i.e. figs. 1, 3 and 4)**;

objective lens 19 and/or light collector 111 collect and collimate the fluorescent signal from the target substance is a collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source such that the fluorescent light leaving the collecting optical element converges, **as can be seen in depicted drawing (fig. 4)(i.e. lights from the light collector 111 is such that the fluorescent light leaving the collecting optical element/light collector 111 converges in each of the fibers 123, 125, 127 and 129 which is transmitted to a respective detector cluster 124, 126, 128 and 130 which houses an array of detectors)**; and

plurality of dichroic mirror and/or combination of dichroic mirrors 25-44 is a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light **(28)** collected by the collecting optical element, the WDM including, a row of mirrors arranged and configured to sequentially reflect different color bands of the fluorescent light collected by the collecting optical element, the row of mirrors including at least one curved mirror **shape of the (i.e. first dichroic mirror 25)**; **each of the combination of dichroic mirrors 25-44 make-up** a row of dichroic filters opposed to the row of mirrors, each dichroic filter configured to pass one color band of the fluorescent light reflected by a mirror in the row of mirrors, and to reflect another color band of the fluorescent light reflected by the mirror; **a respective detector cluster 124, 126, 128 and 130 which houses an array of detectors) include** a row of semiconductor detectors, each semiconductor detector arranged and configured to detect and quantitate the band of fluorescent light passing through a dichroic filter in the row of dichroic filters **[pars. 0029-33] (Oostman, claims 1-2 and 8)**.

Oostman fail to explicitly specify the constructional make-up of the dichroic mirror and/or the elements of the dichroic mirror make-up as being separated instead of integrated as a single unit, and the shape of the filter which made-up the dichroic mirror as being curve as claimed above.

However, even though, Oostman fail to teach the constructional changes in the system the dichroic mirror of the claim(s), the constructional/structural change difference(s) is/are considered obvious design variation of separating plurality as one and/or separating integrated single system such as dichroic mirror into multiple elements that make-up the structure of the dichroic mirror, which is a beam-splitter with

some sort of shape integrated filter(s) in order to split a beam into two parts of different wavelength without any appreciable loss of intensity. This makes it very useful for many different purposes, and in fluorescence microscopy (reliance on the knowledge of one of ordinary skill at the time the invention was made in order to provide an enabling disclosure, In re BODE et al, 193 USPQ 12 at 16 (CCPA, 1977).).

It would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to modify Oostman dichroic mirror by separation of the components and changing the shape as desired appropriate in the manner set forth in applicant's claims, since it is well established, whether the element is separated into multiple elements, see *In re Dulberg*, 129 USPQ 348 (CCPA, 1961) or the element is integrated into a single element, see *In re Larson*, 144 USPQ 347 (CCPA, 1965) so long as the same function performed by the prior art and the claimed invention, then the prior art still anticipates or renders obvious the claimed invention.

Therefore, it would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to modify Oostman dichroic mirror by separation of the components and changing the shape as desired appropriate in the manner set forth in applicant's claims, since the propose modification of the prior art would not change the principle of operation of the prior art invention being modified, the dichroic mirror would/will still split a beam into two parts of different wavelength without any appreciable loss of intensity that makes it very useful for many different purposes, for instance, in fluorescence microscopy, a dichroic mirror is used to separate the fluorescence light, with critical image information (... some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge

generally available to one of ordinary skill in the art. See In re Fine, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and In re Jones, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992)) and with some reliance on the knowledge of one of ordinary skill at the time the invention was made in order to provide an enabling disclosure, In re BODE et al, 193 USPQ 12 at 16 (CCPA, 1977).

In addition, since it has been held that the provision of adjustability, where needed, involves only routine skill in the art, In re Stevens, 101 USPQ 284 (CC1954).

For the purposes of clarity, Applicant's attention is further request to apparatus described in U.S. Pat. No. 5,317,162, and U.S. Pat. No. 4,727,020 that is incorporated by reference in [pars. 0003-7] of Oostman for additional disclosure and clarification.

Additionally, based on the context of the applicant disclosure as found in specification, as published [paragraphs 0016 and 0402], Applicant has described collector is a microscope objective. Since Oostman discloses [par. 0030] that light collector means is a microscope and/or the collector lens is a microscope objective lens then Oostman anticipates and/or the claimed limitations "such that the fluorescent light leaving the collecting optical element converges" would have been obviously met by the Oostman collector means.

As to claims 14-15 and 17, **Oostman** also discloses a structure that is use in a flow cytometer/system that is implementing limitations such as, further comprising a row of focusing optical elements **plurality of focusing elements (i.e. 168, 158) in each of detector(s) leg(s)(160, 170, 180, 189, 179,169,159) [pars. 0031-32]**, each focusing optical element in the row arranged and configured to focus the band of fluorescent light passing through a dichroic filter in the row of dichroic filters onto the corresponding

semiconductor detector, **as can be seen in in depicted (fig. 5)** (claim 14); wherein the row of mirrors **(i.e. beam splitting element 151 which is a dichroic mirror)** includes at least one curved **shape** mirror configured to form an image in the fluorescent light reflected by said curved mirror (claim 15); **and** wherein fluorescent light received by the collimating optical element is reflected back and forth between the row of mirrors and the row of dichroic filters in a zig-zag pattern, **as can be seen in depicted drawing (figs. 5-6) [pars. 0031-33]** (claim 17).

Response to Arguments

Applicant's arguments/remarks, (see pages 8-17), filed on 07/18/2024, with respect to the rejection(s) of claim(s) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn.

Applicant argues that the cited reference **Oostman, JR. et al. (2003/0048539 A1)** fail to disclose, as recited in claims 1 and 18 "collecting optical element," a "wavelength division multiplexer (WDM)" that includes "a collimating optical element ... arranged to receive the fluorescent light collected by the collecting optical element." the collimating optical element "is separate from the collecting optical element" such that they are two distinct structures. This argument is persuasive. Therefore, the rejections are withdrawn.

However, Applicant's arguments with respect to claim 13 rejection(s) have been fully considered but are not persuasive. In response to applicant's arguments that the cited references Oostman fails to teach, in particular, that Oostman lacks the limitations

such "collecting optical element", "**such** that the fluorescent light leaving the collecting optical element converges," which makes clear that the fluorescent light "focus[ed]" by the "collecting optical element" converges instead of being collimated. Because Oostman's objective lens 19 collimates the fluorescent light, it is not configured to "focus [the] fluorescent light ... such that the fluorescent light leaving [the objective lens] converges" as the claims require. It is respectfully pointed out to applicant that this argument is not persuasive because based on the context of the applicant disclosure as found in specification, as published [paragraphs 0016 and 0402], Applicant has described collector is a microscope objective. Since Oostman discloses [par. 0030] that light collector means is a microscope and/or the collector lens is a microscope objective lens then Oostman anticipates and/or the claimed limitations "such that the fluorescent light leaving the collecting optical element converges" would have been at least obvious, and thus Oostman collector means has/have ability to perform the same. Therefore, the claim, claim 13 is/are still rejected as detailed above.

Allowable Subject Matter

Claims 1-11 and 19-20 are allowed.

As to claims 1 and 18, the prior art of record, taken alone or in combination, fails to disclose or render obvious a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light, in combination with the rest of the limitations of the claim. Claims 2-5, 7-12 and 18-21 are allowable by virtue of their dependency.

Claim 16 is/are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

As to claim 16, the prior art of record, taken alone or in combination, fails to disclose or render obvious wherein the image formed by said curved mirror is an image of a collimating optical element that is arranged to receive the fluorescent light collected by the collecting optical element and configured to collimate the fluorescent light, in combination with the rest of the limitations of the claim.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the

examiner should be directed to Isiaka Akanbi whose telephone number is (571) 272-8658. The examiner can normally be reached on 8:00 a.m. - 4:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tarifur R. Chowdhury can be reached on (571) 272-2287. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/ISIAKA O AKANBI/
Primary Examiner, Art Unit 2877



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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1	1145

129381 7590 08/27/2024

NORTON ROSE FULBRIGHT US LLP - BCI
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

EXAMINER
AKANBI, ISIAKA O

ART UNIT	PAPER NUMBER
2877	

NOTIFICATION DATE	DELIVERY MODE
08/27/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

PatentDocket@Beckman.com
aoipdocket@nortonrosefulbright.com

Decision Granting Request for Prioritized Examination (Track I)	**Application No.** 17/645,727	**Applicant(s)** Chen, Yong Qin	
	Examiner JoAnne L Burke	**Art Unit** OPET	**AIA (FITF) Status** No

1. THE REQUEST FILED 18 July 2024 IS **GRANTED** .

The above-identified application has met the requirements for prioritized examination

A. ☑ for an original nonprovisional application (Track I).
B. ☐ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination**. The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:

A. filing a **petition for extension of time** to extend the time period for filing a reply;

B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims** , or a multiple dependent claim;

C. filing a **request for continued examination** ;

D. filing a notice of appeal;

E. filing a request for suspension of action;

F. mailing of a notice of allowance;

G. mailing of a final Office action;

H. completion of examination as defined in 37 CFR 41.102; or

I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to JoAnne Burke at (571)272-4584. In his/her absence, calls may be directed to Petition Help Desk at (571) 272-3282.

/JOANNE L BURKE/ Lead Paralegal Specialist, OPET	

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/645,727	Filing Date 12/22/2021	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

	(Column 1)	(Column 2)			
FOR	NUMBER FILED	NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $480 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	08/30/2024	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/ANGELA S WHITE/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: R46C.REQ
Document Description: Request under 37 CFR 1.46(c) to correct, update or change the applicant.

PTO/AIA/41 (04-15)
Approved for use through 05/31/2024. OMB 0651-0031
U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

REQUEST TO CORRECT OR UPDATE THE NAME OF THE APPLICANT UNDER 37 CFR 1.46(c)(1), OR CHANGE THE APPLICANT UNDER 37 CFR 1.46(c)(2)
(FOR USE ONLY IN APPLICATIONS FILED ON OR AFTER SEPTEMBER 16, 2012)

Application Number	17/645,727
Filing Date	2021-12-22
First Named Inventor	Yong Qin Chen
Art Unit	2877
Examiner Name	ISIAKA O AKANBI
Practitioner Docket Number	BECC.P0002US.CIP.D2C1

To: Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Applicant hereby **requests that the name of the applicant be corrected or updated under 37 CFR 1.46(c)(1), or that the applicant be changed under 37 CFR 1.46(c)(2),** in the above-identified application. **Requests under 37 CFR 1.46(c)(1) or (c)(2) cannot be submitted after payment of the issue fee or if the application has been patented.**

Please check the applicable box(es) below.

☐ 1. This request is to **correct or update the name of the applicant (under 37 CFR 1.46(c)(1))** and includes:

☐ An application data sheet (ADS) in accordance with 37 CFR 1.76(c) with the corrected or updated information shown with markings (*e.g.*, underlining for insertions, strikethrough for deletions). A Corrected Web-based ADS may be used.

Note: Requests under 37 CFR 1.46(c)(1) may be filed to correct typographical errors in the name of the § 1.46 applicant, or for updating the name of the § 1.46 applicant (*i.e.*, where there is no change in the applicant itself but just in the applicant's name). See the Manual of Patent Examining Procedure (MPEP) section 605.01.

■ 2. This request is to **change the applicant (under 37 CFR 1.46(c)(2))** and includes:

■ An application data sheet (ADS) in accordance with 37 CFR 1.76(c) that identifies the changes with proper markings (underlining for insertions and strikethrough for deletions). A Corrected Web-based ADS may be used.

■ A Statement Under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent). See MPEP 325.

I am the

☐ applicant* ■ attorney or agent of record Registration number 72,871 ☐ attorney or agent acting under 37 CFR 1.34 Registration number _____

Signature /Michael Pohl/

Typed or printed name Michael Pohl

Date August 30, 2024

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. *Juristic entities must be represented by a patent practitioner (See 37 CFR 1.31, applicable to any paper filed on or after September 16, 2012 that is presented on behalf of a juristic entity, regardless of application filing date). Submit multiple forms if more than one signature is required, see below**.

■ ** Total of 1 forms are submitted.

A Federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with an information collection subject to the requirements of the Paperwork Reduction Act of 1995, unless the information collection has a currently valid OMB Control Number. The OMB Control Number for this information collection is 0651-0031. Public burden for this form is estimated to average 12 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Send comments regarding this burden estimate or any other aspect of this information collection, including suggestions for reducing this burden to the Chief Administrative Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 or email InformationCollection@uspto.gov. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **If filing this completed form by mail, send to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BECC.P0002US.CIP.D2C1
	Application Number	17/645,727
Title of Invention	FLOW CYTOMETER	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Yong	Qin	Chen	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	San Jose	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	4097 Cortona Court
Address 2	

City	San Jose	State/Province	CA
Postal Code	95135	Country	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	~~32425~~ 129381		
Email Address	aoipdocket@nortonrosefulbright.com	Add Email	Remove Email

Application Information:

Title of the Invention	FLOW CYTOMETER		
Attorney Docket Number	BECC.P0002US.CIP.D2C1	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	35	Suggested Figure for Publication (if any)	

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BECC.P0002US.CIP.D2C1
	Application Number	17/645,727
Title of Invention	FLOW CYTOMETER	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	~~32425~~ 129381		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	15/638477	2017-06-30

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BECC.P0002US.CIP.D2C1
	Application Number	17/645,727
Title of Invention	FLOW CYTOMETER	

Prior Application Status	Patented			Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15/638477	Division of	14/455102	2014-11-26	9746412	2017-08-29

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
14/455102	Continuation in part of	PCT/US2013/043453	2013-05-30

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
14/455102	Claims benefit of provisional	61/911859	2013-12-04

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/US2013/043453	Claims benefit of provisional	61/653245	2012-05-30

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/US2013/043453	Claims benefit of provisional	61/653328	2012-05-30

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/US2013/043453	Claims benefit of provisional	61/715819	2012-10-18

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/US2013/043453	Claims benefit of provisional	61/715836	2012-10-19

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/US2013/043453	Claims benefit of provisional	61/816819	2013-04-29

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BECC.P0002US.CIP.D2C1
	Application Number	17/645,727
Title of Invention	FLOW CYTOMETER	

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BECC.P0002US.CIP.D2C1
	Application Number	17/645,727
Title of Invention	FLOW CYTOMETER	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BECC.P0002US.CIP.D2C1
	Application Number	17/645,727
Title of Invention	FLOW CYTOMETER	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:			
If the Applicant is an Organization check here. ☒			
Organization Name	~~IRIS INTERNATIONAL, INC.~~ Beckman Coulter, Inc.		
Mailing Address Information For Applicant:			
Address 1	~~9172 Eton Avenue~~ 250 South Kraemer Boulevard		
Address 2			
City	~~Chatsworth~~ Brea	**State/Province**	CA
Country US		Postal Code	~~91311~~ 92821
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BECC.P0002US.CIP.D2C1
	Application Number	17/645,727
Title of Invention	FLOW CYTOMETER	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☒

Organization Name	~~IRIS INTERNATIONAL, INC.~~ Beckman Coulter, Inc.

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1	~~9172 Eton Avenue~~ 250 South Kraemer Boulevard		
Address 2			
City	~~Chatsworth~~ Brea	**State/Province**	CA
Country i	US	Postal Code	~~91311~~ 92821
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Michael Pohl/			Date (YYYY-MM-DD)	2024-08-30
First Name	Michael	Last Name	Pohl	Registration Number	72,871

Additional Signature may be generated within this form by selecting the Add button.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BECC.P0002US.CIP.D2C1
	Application Number	17/645,727
Title of Invention	FLOW CYTOMETER	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/AIA/80 (07-17)
Approved for use through 09/30/2025. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no person is required to respond to a collection of information unless it displays a valid OMB control number

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

[X] Practitioners associated with Customer Number: 129381

OR

[ ] Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

[X] The address associated with Customer Number: 129381

OR

[ ]

Firm or individual name		
Address		
City	State	Zip
Country		
Telephone	Email	

Assignee name and address: Beckman Coulter, Inc.
250 South Kraemer Boulevard, Brea, CA 92821-6232

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of the practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee.

Signature Anne M. Murphy	Date August, 29, 2024
Name Anne Murphy	Telephone 463.777.6246
Title Chief IP Counsel Beckman Coulter (Life Sciences)	

A Federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with an information collection subject to the requirements of the Paperwork Reduction Act of 1995, unless the information collection has a currently valid OMB Control Number. The OMB Control Number for this information collection is 0651-0035. Public burden for this form is estimated to average 18 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Send comments regarding this burden estimate or any other aspect of this information collection, including suggestions for reducing this burden to the Chief Administrative Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 or email InformationCollection@uspto.gov. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS.** If filing this completed form by mail, send to: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (11-23)
Approved for use through 05/31/2024. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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STATEMENT UNDER 37 CFR 3.73(c)

First Named Inventor/Patent Owner: Yong Qin Chen/Beckman Coulter, Inc.

Application No./Patent No.: 17/645,727 Filed/Issue Date: 2021-12-22

Titled: FLOW CYTOMETER

Beckman Coulter, Inc., a corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached*.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: Yong Qin Chen To: IRIS INTERNATIONAL, INC.

   The document was recorded in the United States Patent and Trademark Office at

   Reel 058466, Frame 0240, or for which a copy thereof is attached*.

2. From: IRIS INTERNATIONAL, INC. To: Beckman Coulter, Inc.

   The document was recorded in the United States Patent and Trademark Office at

   Reel _____, Frame _____, or for which a copy thereof is attached*.

A Federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with an information collection subject to the requirements of the Paperwork Reduction Act of 1995, unless the information collection has a currently valid OMB Control Number. The OMB Control Number for this information collection is 0651-0031. Public burden for this form is estimated to average 12 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Send comments regarding this burden estimate or any other aspect of this information collection, including suggestions for reducing this burden to the Chief Administrative Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 or email InformationCollection@uspto.gov. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached*.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached*.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached*.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached*.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ *As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Michael Pohl/	August 30, 2024
Signature	Date
Michael Pohl	72,871
Printed or Typed Name	Title or Registration Number

[Page 2 of 2]

ASSIGNMENT

WHEREAS, IRIS International, Inc. (hereinafter ASSIGNOR), a corporation having its principal place of business at 250 South Kraemer Boulevard, Brea, California 92821-6232 is the sole owner, by assignment, of the inventions, patents, and applications listed in Schedule A (hereinafter, collectively, "Schedule A IP"); and

WHEREAS, Beckman Coulter, Inc. (hereinafter ASSIGNEE), a corporation having its principal place of business at 250 South Kraemer Boulevard, Brea, California 92821-6232, is desirous of acquiring the entire right, title, and interest in and to said inventions and any and all patents that may be obtained therefor, in and to said patents and in and to said applications and any and all patents that may issue therefrom, and in and to said Schedule A IP;

NOW THEREFORE, for good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, ASSIGNOR does hereby sell, assign, transfer, and set over unto said ASSIGNEE, its successors, assigns, and legal representatives, all right, title, and interest in the Schedule A IP, including all right, title, and interest in and to said inventions throughout the world, and any and all patents and patent applications of the United States and foreign countries that may be obtained therefor, and in and to said applications, including any and all continuations, continuations-in-part, divisionals, reissues, re-examinations, substitutions, and extensions thereof, and any and all patents of the United States and foreign countries that may issue therefrom, all other Schedule A IP, and all US and foreign patents and applications seeking priority to, from, or in common with Schedule A IP, such right, title, and interest including the right to sue for past infringement and obtain past damages and the right to file applications and obtain patents, utility models, industrial models, and designs for said inventions in the name of said ASSIGNEE, its successors, assigns, and legal representatives, throughout the world, including all rights of priority, all rights to publish cautionary notices reserving ownership of said inventions, and all rights to register said inventions in appropriate registries;

ASSIGNOR does hereby covenant that it has the full right to convey the entire right, title, and interest herein assigned, and that it has not and will not execute any agreement in conflict herewith;

ASSIGNOR does hereby authorize and request the Commissioner of Patents and Trademarks to issue any and all Letters Patent of the United States on said inventions or resulting from said applications, including any continuations, continuations-in-part, divisions, reissues, re-examinations, substitutions, and extensions thereof, to said ASSIGNEE, its successors, assigns, and legal representatives as the ASSIGNEE of the entire right, title, and interest herein assigned;

ASSIGNOR also does hereby agree to, at any time, upon request, without further or additional consideration but at the expense of said ASSIGNEE, its successors, assigns, or legal representatives, execute and deliver any and all papers, make all rightful oaths, and do all lawful acts that may be necessary or desirable to perfect the entire right, title, and interest in said applications, including any and all continuations, continuations-in-part, divisionals, reissues, re-examinations, substitutions, and extensions thereof, and any and all patents of the United States and foreign countries that may issue therefrom said ASSIGNEE, its successors, assigns, and legal representatives, and generally do everything possible to vest the entire right, title, and interest herein assigned in said ASSIGNEE, its successors, assigns, and legal representatives;

ASSIGNOR also does hereby grant the following individuals the power to insert on this Assignment any further identification which may be necessary or desirable in order to comply with the rules of the United States Patent and Trademark Office for recordation of this document:

All practitioners at Customer Number 129381

This ASSIGNMENT is effective as of July 19, 2024 .

IN WITNESS WHEREOF, the parties have caused this Assignment to be executed by their duly authorized representatives as of the effective date.

Assignor

Signature: Signed by: Chris Sibley Date: 20-Jul-2024

Signer Name: Chris Sibley
Signing Reason: I approve this document
Signing Time: 20-Jul-2024 | 7:18:28 AM PDT
20E5382E3A864EE7B7100029F981ECC5

Name: Christopher Sibley

Company & Title: Iris International, Inc. Assistant Treasurer

Assignee

Signature: Signed by: Michelle Caron Date: 20-Jul-2024

Signer Name: Michelle Caron
Signing Reason: I approve this document
Signing Time: 20-Jul-2024 | 11:32:37 AM PDT
7EB6E1E2FC624DB481485342A6EEEB7E

Name: Michelle Caron

Company & Title: Beckman Coulter, Inc. Vice President and Chief Financial Officer, Life Sciences

Schedule A

OpCo File #	Title	Country Name	Status	Application #	Patent #	Grant Date
12US0040-EP-DE	Flow Cytometer	Germany	Issued	13796734.5	2861956 (DE60/2013/085,235)	01/24/2024
12US0040-EP-GB	Flow Cytometer	United Kingdom	Issued	13796734.5	2861956	01/24/2024
12US0040-EP-FR	Flow Cytometer	France	Issued	13796734.5	2861956	01/24/2024
	Flow Cytometer	Ireland	Issued	13796734.5	2861956	01/24/2024
12US0040-EP-DIV2	Flow Cytometer	European Patent Office	Published	24151670.7		
12US0040-EP-DIV1	Flow Cytometer	European Patent Office	Issued	17160708.8	3206010	02/21/2024
12US0040-US-DIV3	FLOW CYTOMETER	United States of America	Abandoned	15/639,542		
12US0040-US-DIV2	FLOW CYTOMETER	United States of America	Issued	15/638,477	11255772B2	02/22/2022
12US0040-US-CON1	FLOW CYTOMETER	United States of America	Issued	15/638,461	10330582	06/25/2019
12US0040-US-DIV4	FLOW CYTOMETER	United States of America	Issued	15/639,601	10126227	11/13/2018
12US0040-US-DIV1	FLOW CYTOMETER	United States of America	Issued	15/299,677	10209174	02/19/2019
12US0040-US-CON2	FLOW CYTOMETER	United States of America	Published	17/645,727		
12US0040-US-CON3	FLOW CYTOMETER	United States of America	Issued	17/980,669	11703443	07/18/2023
12US0040-US-CON4	FLOW CYTOMETER	United States of America	Unfiled			
12US0040-EP-DIV1-DE	Flow Cytometer	Germany	Issued	17160708.8	DE60/2013/085,340.1	02/21/2024
12US0040-EP-DIV1-AT	Flow Cytometer	Austria	Issued	17160708.8	3206010	02/21/2024
12US0040-EP-DIV1-DK	Flow Cytometer	Denmark	Issued	17160708.8	3206010	02/21/2024
12US0040-EP-DIV1-FR	Flow Cytometer	France	Issued	17160708.8	3206010	02/21/2024

12US0040-EP-DIV1-IE	Flow Cytometer	Ireland	Issued	17160708.8	3206010	02/21/2024
12US0040-EP-DIV1-IT	Flow Cytometer	Italy	Issued	17160708.8	3206010	02/21/2024
12US0040-EP-DIV1-NL	Flow Cytometer	Netherlands	Issued	17160708.8	3206010	02/21/2024
12US0040-EP-DIV1-ES	Flow Cytometer	Spain	Issued	17160708.8	3206010	02/21/2024
12US0040-EP-DIV1-SE	Flow Cytometer	Sweden	Issued	17160708.8	3206010	02/21/2024
12US0040-EP-DIV1-CH	Flow Cytometer	Switzerland	Issued	17160708.8	3206010	02/21/2024
12US0040-EP-DIV1-GB	Flow Cytometer	United Kingdom	Issued	17160708.8	3206010	02/21/2024
12US0040-CN-DIV2	Flow cytometry	China	Issued	201910068147.7	110031384	03/10/2023
12US0040-CN-DIV1	Flow cytometry	China	Issued	201611102428.2	107014741	07/20/2021
12US0040-JP-DIV1	FLOW CYTOMETER	Japan	Issued	2016-216891	6452660	12/21/2018
12US0040-JP-DIV3	FLOW CYTOMETER	Japan	Issued	2020-206548	7084977	06/07/2022
12US0040-CN-DIV3	FLOW CYTOMETER	China	Published	202310125971.8		
12US0040-JP1-DIV4	FLOW CYTOMETER	Japan	Issued	2022-090719	7406591	12/19/2023
12US0040-JP1-DIV5	FLOW CYTOMETER	Japan	Published	2023-211923		
12US0040-WO	Flow Cytometer	PCT	Completed	PCT/US2013/043453		
	Flow Cytometer	PCT	Completed	PCT/US2014/067682		
12US0040-TW	Flow Cytometer	Taiwan	Abandoned	102119117		
12US0040-PRO	A Pulseless Peristaltic Pump	United States of America	Expired	61/653,245		
12US0040-PRO2	A Composite Microscope Objective with a Dispersion Compensation Plate	United States of America	Expired	61/653,328		

12US0040-PRO3	Wavelength Division Multiplexing Device for Extended Light Source	United States of America	Expired	61/715,819		
12US0040-PRO4	Diode Laser Based Optical Excitation System	United States of America	Expired	61/715,836		
12US0040-PRO5	A Simple Fluidic System for Supplying Pulsation Free Liquid to Flow Cell	United States of America	Expired	61/816,819		
12US0040-EP	Flow Cytometer	European Patent Office	Completed	13796734.5	2861956	01/24/2024
	Flow Cytometer	European Patent Office	Completed	14812696.4	3077790	10/27/2021
	Flow Cytometer	United Kingdom	Completed	14812696.4	3077790	10/27/2021
	Flow Cytometer	France	Completed	14812696.4	3077790	10/27/2021
	Flow Cytometer	Germany	Completed	14812696.4	3077790 (DE60/2014/080,915)	10/27/2021
	Flow Cytometer	Spain	Completed	14812696.4	3077790 (ES2900803)	03/18/2022
	Flow Cytometer	Italy	Completed	14812696.4	3077790	10/27/2021
	Flow Cytometer	Denmark	Completed	14812696.4	3077790	10/27/2021
	Flow Cytometer	Netherlands	Completed	14812696.4	3077790	10/27/2021
	Flow Cytometer	Switzerland	Completed	14812696.4	3077790	10/27/2021
	Flow Cytometer	Ireland	Completed	14812696.4	3077790	10/27/2021
	Flow Cytometer	Sweden	Completed	14812696.4	3077790	10/27/2021
	Flow Cytometer	Austria	Completed	14812696.4	3077790 (AT144221 5)	10/27/2021
	Flow Cytometer	United States of America	Expired	61/911,859		

12US0040-JP	Flow Cytometer	Japan	Abandoned	2015-515208		
12US0040-JP-DIV2	FLOW CYTOMETER	Japan	Issued	2019-149610	6811292	12/16/2020
12US0040-CN	Flow Cytometer	China	Issued	201380039184.6	104641217	02/22/2019
	Flow Cytometer	China	Issued	201480074396.2	105940292	12/08/2020
12US0040-NONP	Flow Cytometer	United States of America	Issued	14/555,102	9746412	08/29/2017
	Flow Cytometer	Hong Kong	Published	4/2023/080,813.1		

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**08/30/2024 12:57:18 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Sarah Calzia
PATENT CENTER #	66993902	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Michael Pohl

Documents

TOTAL DOCUMENTS: 4

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
2024.08.30_Applicant_Update_BECC.P0002US.CIP.D2C1.pdf		1	Request under 37CFR1.46(c) to correct, update, change applicant	373 KB
2024.08.30_ADS-Marked_BECC.P0002US.CIP.D2C1.pdf		9	Application Data Sheet	1585 KB
Warning: This is not a USPTO supplied ADS fillable form. Data in the form cannot be automatically loaded to other USPTO systems.				
2024.08.30_POA_3.73_BECC.P0002US.CIP.D2C1.pdf		9	-	3365 KB
2024.08.30_POA_3.73_BECC.P0002US.CIP.D2C1-PA...pdf	(1-1)	1	Power of Attorney	466 KB

2024.08.30_POA_3.73_BECC.P0002US.CIP.D2C1-R3.73.pdf	(2-9)	8	Assignee showing of ownership per 37 CFR 3.73	2908 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
2024.08.30_Applicant_Update_BECC.P0002US.CIP.D2C1.pdf	2FD1686B2B0B8F53CF6F1B96F6262E4948F6FB2782FC03CF2F7917E38E469E7596FE2AD3BC9F4A4BF4099EF0C2756387EDB9467BB9783A747E5ACBF26B6605C7
2024.08.30_ADS-Marked_BECC.P0002US.CIP.D2C1.pdf	C9AB2C6F4B915FA7125E1D4E9AA2673628D7D97FD610BA6F67C8F32937C45CA09FFFFE82096762AF6AC9280FAD9E01A4A75CCA335959EF3E36987CFEAF8797EC
2024.08.30_POA_3.73_BECC.P0002US.CIP.D2C1.pdf	34F2DE90CDB67CBAF773EC6401DFF32729E05057D295D5FA366551155DAB41026EB56644B133831A9BCE445C7B5BB94A242FA5211DFDF1548021CBDA14911134
2024.08.30_POA_3.73_BECC.P0002US.CIP.D2C1-PA...pdf	66A10CA39358B46B690521EB8202039F18432F8455C631B6311768C9F9074681024740485F672621E1F6DEAD7C7B9DC54296AB8118C5B47C77BDBD627CEAE659
2024.08.30_POA_3.73_BECC.P0002US.CIP.D2C1-R3.73.pdf	B0F7500099CC325BDABD2B1775FB7629BA04062DC09BB3B73F3DF7F0D77C0693FAB8B800971A357A14B92F97D290B44944D494065B806EE4294DD4660AB39EF3

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Beckman Coulter, Inc.	Group Art Unit: 2877
Serial No.: 17/645,727	Examiner: Isiaka O. Akanbi
Filed: December 22, 2021	Atty. Dkt. No.: BECC.P0002US.CIP.D2C1
For: Flow Cytometer	Confirmation No.: 1145

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

CERTIFICATE OF ELECTRONIC TRANSMISSION
37 C.F.R. § 1.8

I hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office via Patent Center on the date below:

August 30, 2024	/Michael Pohl/
Date	Michael Pohl

RESPONSE TO THE AUGUST 15, 2024 OFFICE ACTION

Applicant submits this paper in response to the Office Action sent August 15, 2024. Should any fees be required for any reason relating to the filing of this paper and not otherwise be paid, Applicant authorizes the Commissioner to deduct them from Norton Rose Fulbright US LLP's Deposit Account No. 50-1212/BECC.P0002US.CIP.D2C1.

Claim Amendments begin on page **2**;

Remarks begin on page **8**.

Claim Amendments

1. (Previously Presented) A flow cytometer, comprising:

a light source arranged to illuminate a stream of particles in a viewing zone of a flow cell in the flow cytometer;

a collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source such that the fluorescent light leaving the collecting optical element converges; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light,

a first semiconductor detector configured to detect and quantitate a first color band in the fluorescent light,

a first curved mirror arranged to receive at least a portion of the fluorescent light after the fluorescent light has passed through the collimating optical element, the first curved mirror configured to reflect the portion of the fluorescent light towards the first semiconductor detector, and

a first dichroic filter optically disposed between the first curved mirror and the first semiconductor detector, the dichroic filter configured to allow the first color band in the fluorescent light to pass through the first dichroic filter onto the first semiconductor detector, and to reflect a second color band in the fluorescent light away from the first semiconductor detector.

2. (Original) The flow cytometer of claim 1, further comprising an optical fiber optically disposed between the collecting optical element and the WDM, the optical fiber arranged and configured to deliver the fluorescent light collected by the collecting optical element to the WDM.

3. (Previously Presented) The flow cytometer of claim 1, further comprising a first focusing optical element optically disposed between the first dichroic filter and the first semiconductor detector, the first focusing optical element configured to focus the first color band in the fluorescent light passing through the first dichroic filter onto the first semiconductor detector.

4. (Previously Presented) The flow cytometer of claim 3, further comprising a second semiconductor detector arranged and configured to detect and quantitate the second color band in the fluorescent light reflected by the first dichroic filter.

5. (Previously Presented) The flow cytometer of claim 4, further comprising:

a second curved mirror and a second dichroic filter, the second curved mirror arranged and configured to reflect at least a portion of the fluorescent light reflected by the first dichroic filter towards the second semiconductor detector, the second dichroic filter arranged and configured to allow the second color band in the fluorescent light to pass through the second dichroic filter onto the second semiconductor, and to reflect a third color band in the fluorescent light away from the second semiconductor detector; and

a third semiconductor detector arranged and configured to detect and quantitate the third color band in the fluorescent light reflected by the second dichroic filter.

6. (Cancelled).

7. (Previously Presented) The flow cytometer of claim 1, wherein the first curved mirror reflects the portion of the fluorescent light to form an image.

8. (Original) The flow cytometer of claim 7, wherein the formed image is an image of the collimating optical element.

9. (Original) The flow cytometer of claim 1, wherein the light source is arranged and configured to illuminate the stream of particles from one side of the flow cell, and wherein the collecting optical element is arranged and configured to collect fluorescent light from another side of the flow cell.

10. (Original) The flow cytometer of claim 9, wherein the collecting optical element is further configured to collect and focus side-scatter light scattered by the illuminated particle in the stream.

11. (Original) The flow cytometer of claim 1, wherein the light source comprises a plurality of lasers.

12. (Original) The flow cytometer of claim 11, wherein the plurality of lasers comprises a first laser configured to illuminate a particle in the stream at a first location in the viewing zone, and a second laser configured to illuminate the particle at a second location in the viewing zone.

13. (Currently Amended) A flow cytometer comprising:

a light source arranged to illuminate a stream of particles in a viewing zone;

a collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source such that the fluorescent light leaving the collecting optical element converges; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light;

a row of mirrors arranged and configured to sequentially reflect different color bands of the fluorescent light collected by the collecting optical element after the fluorescent light has passed through the collimating optical element, the row of mirrors including at least one curved mirror;

a row of dichroic filters opposed to the row of mirrors, each of the dichroic ~~filter~~ filters configured to pass one color band of the fluorescent light reflected by a mirror in the row of mirrors, and to reflect another color band of the fluorescent light reflected by the mirror;

a row of semiconductor detectors, each of the semiconductor ~~detector~~ detectors arranged and configured to detect and quantitate the band of fluorescent light passing through a dichroic filter in the row of dichroic filters.

14. (Currently Amended) The flow cytometer of claim 13, further comprising a row of focusing optical elements, each of the focusing optical ~~element~~ elements in the row arranged and configured to focus the band of fluorescent light passing through a dichroic filter in the row of dichroic filters onto the corresponding semiconductor detector.

15. (Original) The flow cytometer of claim 14, wherein the row of mirrors includes at least one curved mirror configured to form an image in the fluorescent light reflected by said curved mirror.

16. (Currently Amended) The flow cytometer of claim 15, wherein the image formed by said curved mirror is an image of **[[**a**]]** the collimating optical element ~~that is arranged to receive the fluorescent light collected by the collecting optical element and configured to collimate the fluorescent light~~.

17. (Previously Presented) The flow cytometer of claim 13, wherein the row of mirrors and row of dichroic filters are arranged such that fluorescent light received by the WDM is reflected back and forth between the row of mirrors and the row of dichroic filters in a zig-zag pattern.

18. (Previously Presented) A flow cytometer, comprising:

a light source arranged to illuminate a flow-stream of particles in a viewing zone from a first side of the flow stream;

a collecting optical element arranged on a second side of the flow stream, the collecting optical element configured to collect and focus fluorescent light emitted by a particle illuminated by the light source such that the fluorescent light leaving collecting optical element converges; and

a wavelength division multiplexer (WDM) configured to separate into color bands the fluorescent light collected by the collecting optical element, the WDM including,

a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light,

a first semiconductor detector configured to detect and quantitate a first color band in the fluorescent light,

a first curved mirror arranged to receive at least a portion of the fluorescent light after the fluorescent light has passed through the collimating optical element, the first curved mirror configured to reflect the portion of the fluorescent light towards the first semiconductor detector, and

a first dichroic filter disposed between the first curved mirror and the first semiconductor detector, the dichroic filter configured to allow the first color band in the fluorescent light to pass through the first dichroic filter onto the first semiconductor detector, and to reflect a second color band in the fluorescent light away from the first semiconductor detector.

19. (Previously Presented) The flow cytometer of claim 18, wherein the first side of the flow stream is orthogonal to the second side of the flow stream.

20. (Original) The flow cytometer of claim 19, wherein the collecting optical element is further configured to collect and focus side-scatter light scattered by the illuminated particle.

21. (Previously Presented) The flow cytometer of claim 1, wherein the first curved mirror is arranged to receive the portion of the fluorescent light when the portion of the fluorescent light is collimated.

Remarks

I. The Claims are Amended to Recite Allowable Subject Matter

Applicant thanks Examiner Akanbi for indicating that claims 1-5, 7-12, and 18-21 are allowable over the prior art, and that amending independent claim 13 to recite "a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light" would render claims 13-17 allowable as well. *See* Action at 1, 8-9; August 14, 2024 Applicant Summary of Interview With Examiner. Applicant respectfully maintains that claims 13-17 are patentable over the prior art as they were written. Nevertheless, in an effort to expedite prosecution, independent claim 13 is amended to recite the separate collimating optical element that, per the Office, is neither disclosed by nor obvious over the prior art of record. *See* Action at 8-9. As set forth in the prior response, support for the claim amendments can be found in, for example, 35:30-36:15, 43:23-44:7, 52:25-53:2, 53:21-54:5, 54:18-54:31, 68:6-69:2, and FIGs. 1, 9A, 10, and 25 of the originally-filed application; no new matter is added. Applicant respectfully requests reconsideration and withdrawal of the rejections.

II. Conclusion

The pending claims are in condition for allowance for at least the reasons set forth above. Applicant does not acquiesce to the Office's characterizations of the claim language or the cited references, and reserves the right to challenge any such characterizations in the future. The Examiner is invited to contact the undersigned attorney with any questions or comments relating to this application.

Respectfully submitted,

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/Michael Pohl/

Michael Pohl
Reg. No. 72,871
Attorney

Date: August 30, 2024

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**08/30/2024 03:06:17 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Susan Lien
PATENT CENTER #	66997661	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Michael Pohl

Documents

TOTAL DOCUMENTS: 3

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
BECCP0002USCIPD2C1_Response.pdf		9	-	206 KB
BECCP0002USCIPD2C1_Response-A....pdf	(1-1)	1	Amendment/Request for Reconsideration-After Non-Final Rejection	129 KB
BECCP0002USCIPD2C1_Response-IACS.pdf	(2-7)	6	Amendment Copy Claims/Response to Suggested Claims	141 KB
BECCP0002USCIPD2C1_Response-REM.pdf	(8-9)	2	Applicant Arguments/Remarks Made in an Amendment	167 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
BECCP0002USCIPD2C1_Response.pdf	9764348822DDA6E0D641FA76BA8CE84A87710D0B27C129803E258B6ADD44CFE73CDC69C9C4903897C76D513AE626320DD164809951FF3F8556E96B50EE3A2121
BECCP0002USCIPD2C1_Response-A....pdf	C228CDAE438445218FEEEEE2F079B8A55F0D947BD7E3C40531B6A783BD98DA4471C00B2FEF9C08A8B31BB19F3E5093BF646338A9F5F6F75A75AFBFAE9554585C
BECCP0002USCIPD2C1_Response-IACS.pdf	F5D4F5ED36058343FF8DA688649D4420C6D5360B7F8D803075AD8140D243EEBD9B85658126D9EAB7870FB053FBD97313A1FB309049969081FF29930C045D27CA
BECCP0002USCIPD2C1_Response-REM.pdf	B5B4B042F38AF204427A9FD4CA02F703DD0D045C0DEEDBA0EBCF90F68D20CD2FC5AE4E6A475ED6E11E39B640100A205AB3BEC136411DA74C30C021A812239674

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1

CONFIRMATION NO. 1145

129381
NORTON ROSE FULBRIGHT US LLP - BCI
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

POA ACCEPTANCE LETTER

OC000000077650102

Date Mailed: 09/10/2024

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 08/30/2024.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/ggasgedom/

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
17/645,727	12/22/2021	2877	1820	BECC.P0002US.CIP.D2C1	20	3

CONFIRMATION NO. 1145

REPLACEMENT FILING RECEIPT

129381
NORTON ROSE FULBRIGHT US LLP - BCI
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Austin, TX 78701

OC00000007650138

Date Mailed: 09/10/2024

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Yong Qin Chen, San Jose, CA;

Applicant(s)

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Assignment For Published Patent Application

Beckman Coulter, Inc., Brea, CA

Power of Attorney: The patent practitioners associated with Customer Number 129381

Domestic Priority data as claimed by applicant

This application is a CON of 15/638,477 06/30/2017 PAT 11,255,772
which is a DIV of 14/555,102 11/26/2014 PAT 9,746,412
which claims benefit of 61/911,859 12/04/2013
and is a CIP of PCT/US2013/043453 05/30/2013
which claims benefit of 61/653,245 05/30/2012
and claims benefit of 61/653,328 05/30/2012
and claims benefit of 61/715,819 10/18/2012
and claims benefit of 61/715,836 10/19/2012
and claims benefit of 61/816,819 04/29/2013

Foreign Applications for which priority is claimed (You may be eligible to benefit from the Patent Prosecution Highway program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 01/05/2022

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/645,727**

Projected Publication Date: 04/14/2022

Non-Publication Request: No

Early Publication Request: No

Title

FLOW CYTOMETER

Preliminary Class

356

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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Applicant-Initiated Interview Summary	**Application No.** 17/645,727	**Applicant(s)** Chen, Yong Qin		
	Examiner ISIAKA O AKANBI	**Art Unit** 2877	**AIA (First Inventor to File) Status** No	**Page** 1 of 1

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
ISIAKA O AKANBI	Primary Examiner	Telephonic
Michael Pohl	Attorney	

Date of Interview: 20 August 2024

Issues Discussed:

Other

Examiner initiated an interview on 08/09/2024 proposing suggestion to make the case allowable. The applicant's representative agreed to amend the claims to make the case allowable 08/30/2024, resulted in compact prosecution.

/ISIAKA O AKANBI/ Primary Examiner, Art Unit 2877	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/645,727	Chen, Yong Qin
	Examiner	Art Unit
	ISIAKA O AKANBI	2877

CPC - Searched*		
Symbol	Date	Examiner
(G01N15/1436 or F04B11/0025 or G01N15/1434 or G01N15/1459 or G01N35/1095 or G02B6/26 or G02B6/29365 or G02B21/04 or G02B21/361 or G02B27/0025 or G01N2015/1006 or G01N2015/144 or G01N2015/1452).cpc.	08/26/2024	IOA

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
356	338, 335, 339, 336, 340, 625	08/26/2024	IOA

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
PE2E Search (US-PGPUB; USPAT; USOCR; EPO CPC)- See Search History Printout	08/26/2024	IOA
Inventor Search	08/26/2024	IOA
Interference Search	09/04/2024	IOA

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
See .CLM Query Search		09/04/2024	IOA

/ISIAKA O AKANBI/ Primary Examiner, Art Unit 2877	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/645,727	Chen, Yong Qin
	Examiner	**Art Unit**
	ISIAKA O AKANBI	2877

/ISIAKA O AKANBI/ Primary Examiner, Art Unit 2877	

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/645,727	Chen, Yong Qin
	Examiner	**Art Unit**
	ISIAKA O AKANBI	2877

CPC						
Symbol					**Type**	**Version**
G01N	/	15	/	1436	F	2013-01-01
G01N	/	15	/	1434	I	2013-01-01
G02B	/	6	/	29365	I	2013-01-01
G02B	/	6	/	26	I	2013-01-01
G01N	/	15	/	1459	I	2013-01-01
F04B	/	11	/	0025	I	2013-01-01
G01N	/	35	/	1095	I	2013-01-01
G02B	/	21	/	04	I	2013-01-01
G02B	/	21	/	361	I	2013-01-01
G02B	/	27	/	0025	I	2013-01-01
G01N	/	2015	/	1452	A	2013-01-01
G01N	/	2015	/	144	A	2013-01-01
G01N	/	2015	/	1006	A	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

Use images from artifact folder? (•) Yes ( ) No

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/ISIAKA O AKANBI/ Primary Examiner, Art Unit 2877	26 August 2024	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/645,727	Chen, Yong Qin
	Examiner	**Art Unit**
	ISIAKA O AKANBI	2877

INTERNATIONAL CLASSIFICATION					
CLAIMED					
G02B21/04	/	21	/	04	

NON-CLAIMED					
	/		/		

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
356	337

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					
356	338	335	339	340	625	

Use images from artifact folder? (•) Yes ( ) No

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 20	
/ISIAKA O AKANBI/ Primary Examiner, Art Unit 2877 (Primary Examiner)	26 August 2024 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/645,727	Chen, Yong Qin
	Examiner	**Art Unit**
	ISIAKA O AKANBI	2877

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	9	10	19	19										
2	2	10	11	20	20										
3	3	11	12	12	21										
4	4	13	13												
5	5	14	14												
	6	15	15												
6	7	16	16												
7	8	17	17												
8	9	18	18												

Use images from artifact folder? ◉ Yes ○ No

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 20
/ISIAKA O AKANBI/ Primary Examiner, Art Unit 2877 (Primary Examiner)	26 August 2024 (Date)	O.G. Print Claim(s): 1 O.G. Print Figure: 1

Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT (Use several sheets if necessary)	Applicant: IRIS INTERNATIONAL, INC.	
	Filing Date: December 22, 2021	Group: 2877

U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1	*See Page 1*	*See Page 1*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A1			

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language
	B1				

Other Art (Including Author, Title, Date, Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C1	Shapiro, H. M. (2003). Practical Flow Cytometry Fourth Edition. John Wiley & Sons.

202451021.1

EXAMINER: /ISIAKA O AKANBI/	DATE CONSIDERED: 08/26/2024

EXAMINER: INITIAL IF REFERENCE CONSIDERED, WHETHER OR NOT CITATION IS IN CONFORMANCE WITH MPEP609; DRAW LINE THROUGH CITATION IF NOT IN CONFORMANCE AND NOT CONSIDERED. INCLUDE COPY OF THIS FORM WITH NEXT COMMUNICATION TO APPLICANT.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /I.O.A/

Bibliographic Data

Application No: 17/645,727

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /ISIAKA O AKANBI/ Examiner's Signature | Initials

Title: FLOW CYTOMETER

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/22/2021	356	2877	BECC.P0002US.CIP.D2C1
RULE			

APPLICANTS

IRIS INTERNATIONAL, INC., Chatsworth, CA, UNITED STATES

INVENTORS

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CONTINUING DATA

This application is a CON of 15638477 06/30/2017 PAT 11255772

15638477 is a DIV of 14555102 11/26/2014 PAT 9746412

14555102 has PRO of 61911859 12/04/2013

14555102 is a CIP of PCT/US2013/043453 05/30/2013

PCT/US2013/043453 has PRO of 61816819 04/29/2013

PCT/US2013/043453 has PRO of 61715836 10/19/2012

PCT/US2013/043453 has PRO of 61715819 10/18/2012

PCT/US2013/043453 has PRO of 61653245 05/30/2012

PCT/US2013/043453 has PRO of 61653328 05/30/2012

FOREIGN APPLICATIONS

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$1,820

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	1617	((("CHEN") near3 ("Yong"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/02/08 09:01 AM
L2	14	L1 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 09:12 AM
L3	14	L2 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 09:20 AM
L4	14	L3 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 09:21 AM
L5	38	((("IRIS") near3 ("INTERNATIONAL") near3 ("INC"))).AS,AANM.	(USPAT)	OR	ON	ON	2024/02/08 12:34 PM
L6	14	L5 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:35 PM

		(WDM)))					
L7	14	L6 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:35 PM
L8	14	I7 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:36 PM
L9	7	(isiaka NEAR akanbi) AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:36 PM
L10	0	L9 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:38 PM
L11	7	L9 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 12:38 PM
L12	31	(Hoa NEAR Pham) AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:35 PM

		charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))					
L13	0	L12 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:36 PM
L14	29	L12 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:36 PM
L15	0	L14 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter$3) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:38 PM
L16	10	L14 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter$3) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:38 PM
L17	10	L14 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter$3 concave convex) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 02:40 PM
L18	103967	(G01N15/1436 or F04B11/0025 or G01N15/1434 or G01N15/1459 or G01N35/1095 or G02B6/26 or G02B6/29365 or G02B21/04 or G02B21/361 or	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,	OR	ON	ON	2024/02/08 05:11 PM

		G02B27/0025 or G01N2015/1006 or G01N2015/144 or G01N2015/1452).cpc.	MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L19	902	I18 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:12 PM
L20	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:13 PM
L21	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:13 PM
L22	21	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:14 PM
L23	46	L19 AND ((color$1 colour$1 spectrum$1	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:14 PM

		spect$3) SAME fluo$8 SAME (concave curv$7 convex diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))					
L24	45	l23 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/08 05:15 PM
L25	15	("5411029" | "5540494" | "6573991" | "7471393" | "20050151968" | "20080010019" | "20080215297" | "20080221711" | "20080319680").pn. OR ("9025145").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/02/09 08:01 AM
L26	3	L25 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:08 AM
L27	0	L26 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (concave curv$7 convex diverg$4 collimat$3 converg$5) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:09 AM
L28	3	L26 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:10 AM

		(detector$1 sensor$1 receiver$1 imag$3))					
L29	7	L25 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:12 AM
L30	3	L29 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (receiv$3 collect$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:13 AM
L31	5	L29 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:14 AM
L32	79	("2816479" | "3695765" | "3710933" | "3873209" | "4263508" | "4360270" | "4765737" | "4794806" | "4857451" | "5007737" | "5041733" | "5056918" | "5090808" | "5104221" | "5105093" | "5138170" | "5325168").pn. OR ("5540494").urpn. AND (PGPB | USPT |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/02/09 08:15 AM

		USOC).dbnm.					
L33	46	l32 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:16 AM
L34	33	L33 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 08:16 AM
L35	11208	356/337, 356/338, 356/335, 356/339, 356/336, 356/340, 356/625	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:13 AM
L36	2413	L35 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:13 AM
L37	593	L36 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:14 AM

		multiplexer (WDM)))					
L38	581	L37 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:14 AM
L39	14	L38 AND ((fiber$1 fibre$1) SAME ((plural$3 second first multiple$1) near5 (dichroic filter$1 detector$1)) SAME collimat$3)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 09:17 AM
L40	3	"20120019825,"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 10:06 AM
L41	3	L40 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 10:06 AM
L42	3	L41 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 10:07 AM
L43	3	l42 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 10:07 AM
L44	249	"6683314," "4727020"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:17 PM
L45	108	L44 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:17 PM
L46	107	L45 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:18 PM

L47	72	L46 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:18 PM
L48	68	"6683314"	(USPAT)	OR	ON	ON	2024/02/09 07:43 PM
L49	54	L48 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:48 PM
L51	46	l49 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 beam$1 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:49 PM
L52	46	L51 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:50 PM
L53	2	"20030048539"	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:52 PM
L54	1	L53 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:53 PM

		(detector$1 sensor$1 receiver$1 imag$3))					
L55	1	L54 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 beam$1 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:53 PM
L56	1	L55 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/09 07:53 PM
L58	207	"5317162"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/02/10 08:07 AM
L59	116	L58 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:08 AM
L60	59	L59 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 beam$1 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:09 AM
L61	34	L60 AND ((fiber$1 fibre$1) SAME wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:09 AM
L62	59	L60 AND ((fiber$1 fibre$1) wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:11 AM
L63	6	L60 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:12 AM

		SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))					
L64	6	L60 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex curv$2) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:12 AM
L65	11	L60 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5 concave convex curv$2) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:13 AM
L66	11	L60 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5 concave convex curv$2) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/02/10 08:13 AM
L67	14	L3 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/28 07:55 AM
L68	1635	((("CHEN") near3 ("Yong"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/04/29 10:33 AM
L69	14	L1 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:33 AM

		measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))					
L70	14	L2 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:33 AM
L71	105898	(G01N15/1436 or F04B11/0025 or G01N15/1434 or G01N15/1459 or G01N35/1095 or G02B6/26 or G02B6/29365 or G02B21/04 or G02B21/361 or G02B27/0025 or G01N2015/1006 or G01N2015/144 or G01N2015/1452).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/04/29 10:33 AM
L72	925	I18 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:33 AM
L73	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM

		dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))					
L74	11261	356/337, 356/338, 356/335, 356/339, 356/336, 356/340, 356/625	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM
L75	2424	L35 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM
L76	599	L36 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM
L77	587	L37 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM
L78	14	L38 AND ((fiber$1 fibre$1) SAME ((plural$3 second first multiple$1) near5 (dichroic filter$1 detector$1)) SAME collimat$3)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/04/29 10:34 AM
L79	1668	((("CHEN") near3 ("Yong"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/08/09 09:32 AM
L80	14	L1 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:32 AM

		(detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))					
L81	14	L2 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:32 AM
L82	14	L3 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:32 AM
L83	107992	(G01N15/1436 or F04B11/0025 or G01N15/1434 or G01N15/1459 or G01N35/1095 or G02B6/26 or G02B6/29365 or G02B21/04 or G02B21/361 or G02B27/0025 or G01N2015/1006 or G01N2015/144 or G01N2015/1452).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/08/09 09:32 AM
L84	952	I18 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:32 AM
L85	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:32 AM

		collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))					
L86	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L87	21	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L88	11336	356/337, 356/338, 356/335, 356/339, 356/336, 356/340, 356/625	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L89	11336	356/337, 356/338, 356/335, 356/339, 356/336, 356/340, 356/625	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L90	2442	L35 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L91	2442	L35 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM

L92	2442	L35 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L93	607	L36 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L94	595	L37 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L95	15	L38 AND ((fiber$1 fibre$1) SAME ((plural$3 second first multiple$1) near5 (dichroic filter$1 detector$1)) SAME collimat$3)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 09:33 AM
L96	0	(collimating AND optical AND element AND separate AND collecting AND optical AND element AND arranged AND receive AND fluorescent AND light AND collected AND collecting AND optical AND element AND collimating AND optical AND element AND configured AND collimate AND fluorescent AND light).CLM.	(US-PGPUB)	OR	ON	ON	2024/08/09 09:37 AM
L97	2	"20180024040" AND ((fiber$1 fibre$1) SAME ((plural$3 second first multiple$1) near5 (dichroic filter$1	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:26 AM

		detector$1)) SAME collimat$3)					
L98	0	L97 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:26 AM
L99	2	L97 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:26 AM
L100	2	L99 AND ((prism split$4 wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:27 AM
L101	0	L100 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:27 AM
L102	2	L100 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:28 AM
L103	487	(Yan NEAR Ming).in.	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:54 AM
L104	10	L103 AND ((fiber$1 fibre$1) SAME	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:54 AM

		((plural$3 second first multiple$1) near5 (dichroic filter$1 detector$1)) SAME collimat$3)					
L105	24	("4954972" | "5394237" | "6097485" | "6201908" | "6563976" | "6683314" | "7245374" | "7280204" | "7605989" | "7724298" | "8184298" | "8284402" | "9746412" | "20030190113" | "20050162648" | "20050285020" | "20060273260" | "20120050533" | "20150247950" | "20150271380" | "20160154318" | "20160169809" | "20170307505" | "20190064535").pn. OR ("11169076").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/08/09 10:55 AM
L106	4	L105 AND ((fiber$1 fibre$1) SAME ((plural$3 second first multiple$1) near5 (dichroic filter$1 detector$1)) SAME collimat$3)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:57 AM
L107	1	L106 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:58 AM
L108	5	L105 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/09 10:58 AM
L109	1671	((("CHEN") near3 ("Yong"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO;	OR	ON	ON	2024/08/26 01:12 PM

			DERWENT)				
L110	14	L1 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/26 01:12 PM
L111	14	L2 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/26 01:12 PM
L112	108291	(G01N15/1436 or F04B11/0025 or G01N15/1434 or G01N15/1459 or G01N35/1095 or G02B6/26 or G02B6/29365 or G02B21/04 or G02B21/361 or G02B27/0025 or G01N2015/1006 or G01N2015/144 or G01N2015/1452).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/08/26 01:12 PM
L113	956	I18 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/26 01:13 PM

		(receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))					
L114	956	I18 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/26 01:13 PM
L115	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/26 01:13 PM
L116	14	L19 AND ((color$1 colour$1 spectrum$1 spect$3) SAME fluo$8 SAME (diverg$4 collimat$3 converg$5) SAME (concave curv$7 convex) SAME (split$4 dichroic half$5 mirror) SAME filter SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/26 01:13 PM
L117	11339	356/337, 356/338, 356/335, 356/339, 356/336, 356/340, 356/625	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/26 01:13 PM
L118	2443	L35 AND ((color$1 colour$1 spectrum$1 spect$3 fluo$8) SAME (concave curv$7 convex diverg$4 collimat$3 converg$5 split$4 dichroic half$5 mirror filter) SAME (detector$1 sensor$1 receiver$1 imag$3))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/26 01:13 PM

L119	607	L36 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7 analy$4 sens$3) SAME (prism wave$6 division dichroic filter$1 multiplexer (WDM)))	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/26 01:13 PM
L120	595	L37 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/26 01:13 PM
L121	15	L38 AND ((fiber$1 fibre$1) SAME ((plural$3 second first multiple$1) near5 (dichroic filter$1 detector$1)) SAME collimat$3)	(US-PGPUB; USPAT; USOCR; EPO)	OR	ON	ON	2024/08/26 01:13 PM
L122	0	(collimating AND optical AND element AND separate AND collecting AND optical AND element AND arranged AND receive AND fluorescent AND light AND collected AND collecting AND optical AND element AND collimating AND optical AND element AND configured AND collimate AND fluorescent AND light).CLM.	(US-PGPUB)	OR	ON	ON	2024/08/26 01:14 PM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	1486	((("CHEN") near3 ("Yong"))).INV.	(US-PGPUB; USPAT)	OR	ON	ON	2024/08/09 09:37 AM
N2	14	N1 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4	(US-PGPUB; USPAT)	OR	ON	ON	2024/08/09 09:37 AM

		radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))					
N3	14	N2 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT)	OR	ON	ON	2024/08/09 09:38 AM
N4	1489	((("CHEN") near3 ("Yong"))).INV.	(US-PGPUB; USPAT)	OR	ON	ON	2024/08/26 01:13 PM
N5	14	N1 AND ((flow$5 cyto$5 fliud$5 aerosol) SAME (mist particle$1 droplet$1 gas$4 aerosol dust grain$1) SAME (illuminat$3 light laser$1 diode$1 emitter$1 emit$4 radiat$3) SAME (detect$3 determin$3 measur$3 estimat$3 charact$7) SAME (receiv$3 collect$3) SAME (prism wave$6 division multiplexer (WDM)))	(US-PGPUB; USPAT)	OR	ON	ON	2024/08/26 01:14 PM
N6	14	N2 AND (fiber$1 fibre$1 wave$6)	(US-PGPUB; USPAT)	OR	ON	ON	2024/08/26 01:14 PM

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NOTICE OF ALLOWANCE AND FEE(S) DUE

129381 7590 09/11/2024

NORTON ROSE FULBRIGHT US LLP - BCI
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Austin, TX 78701

EXAMINER	
AKANBI, ISIAKA O	
ART UNIT	PAPER NUMBER
2877	

DATE MAILED: 09/11/2024

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1	1145

TITLE OF INVENTION: FLOW CYTOMETER

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	12/11/2024

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

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Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

129381 7590 09/11/2024

NORTON ROSE FULBRIGHT US LLP - BCI
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1	1145

TITLE OF INVENTION: FLOW CYTOMETER

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	12/11/2024

EXAMINER	ART UNIT	CLASS-SUBCLASS
AKANBI, ISIAKA O	2877	356-337000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via the USPTO patent electronic filing system ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1	1145

129381 7590 09/11/2024

NORTON ROSE FULBRIGHT US LLP - BCI
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

EXAMINER	
AKANBI, ISIAKA O	

ART UNIT	PAPER NUMBER
2877	

DATE MAILED: 09/11/2024

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013).
https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf

Routine uses of the information in this record may include disclosure to:

1) law enforcement, in the event that the system of records indicates a violation or potential violation of law;
2) a federal, state, local, or international agency, in response to its request;
3) a contractor of the USPTO having need for the information in order to perform a contract;
4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record;
5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record;
6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations;
7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals;
8) another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c));
9) the Office of Personnel Management (OPM) for personnel research purposes; and
10) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

Notice of Allowability	Application No. 17/645,727	Applicant(s) Chen, Yong Qin	
	Examiner ISIAKA O AKANBI	Art Unit 2877	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 08/20/2024.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1-5 and 7-21 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information , please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 08/12/2024.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☑ Interview Summary (PTO-413), Paper No./Mail Date. 08/20/2024.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/ISIAKA O AKANBI/
Primary Examiner, Art Unit 2877

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

DETAILED ACTION

Amendment

The amendment filed on 08/30/2024 has been entered into this application.

Information Disclosure Statement

The information disclosure statement filed on 08/12/2024 has been entered and considered by the examiner.

Response to Arguments

Applicant's arguments/remarks, see interview summary dated 08/20/2024, with respect to proposed amendment have been fully considered and are persuasive.

Applicant's arguments/remarks, (see page 9), filed on 08/30/2024, with respect to the rejection(s) of claim(s) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn.

Allowable Subject Matter

Claims 1-5, and 7-21 are allowed.

As to claims 1-5, 7-12 and 18-21, the examiner's statement of reasons for allowance is indicated in the previous Official Action dated 08/15/2024

As to claim 13, the prior art of record, taken alone or in combination, fails to disclose or render obvious a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light, in combination with the rest of the limitations of the claim. Claims 14-17 are allowable by virtue of their dependency.

The closest prior art reference of Oostman, JR. et al. (2003/0048539 A1) discloses a flow cytometer.

However, Oostman, JR. fail to disclose, teach or suggest a collimating optical element that is separate from the collecting optical element and is arranged to receive the fluorescent light collected by the collecting optical element, the collimating optical element configured to collimate the fluorescent light, as claimed and as specified in the present application specification. This argument is persuasive. Therefore, the rejections are withdrawn.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Isiaka Akanbi whose telephone number is (571) 272-8658. The examiner can normally be reached on 8:00 a.m. - 4:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tarifur R. Chowdhury can be reached on (571) 272-2287. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/ISIAKA O AKANBI/
Primary Examiner, Art Unit 2877

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Title:	FLOW CYTOMETER
Appl. No.:	17/645,727
Applicant:	Beckman Coulter, Inc.
Filed:	December 22, 2021
Group Art Unit:	2877
Examiner:	Isiaka O. Akanbi
Docket No.:	BECC.P0002US.CIP.D2C1/1001193453
Confirmation No.:	1145

CERTIFICATE OF ELECTRONIC TRANSMISSION (37 C.F.R. § 1.8)
I, Jennifer Ringer, hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office via Patent Center on October 25, 2024. Signed: /Jennifer Ringer/

INFORMATION DISCLOSURE STATEMENT

In compliance with the duty of disclosure under 37 C.F.R. § 1.56, it is respectfully requested that this Information Disclosure Statement be entered and the documents listed on attached Form PTO-1449 be considered by the Examiner and made of record.

In accordance with 37 C.F.R §§ 1.97(g), (h), this Information Disclosure Statement is not to be construed as a representation that a search has been made, and is not to be construed to be an admission that the information cited is, or is considered to be, material to patentability as defined in 37 C.F.R. § 1.56(b).

In addition, Applicant notes that in *Beckman Coulter Inc. v. Cytek Biosciences, Inc.*, No. 24-945 (D. Del.), Plaintiff Beckman Coulter Inc. asserts that claims of Patent No. 10,330,582 and Patent No. 11,703,443 are infringed by Cytek Aurora flow cytometers & Cytek Aurora CS cell sorters, which are sold by Defendant Cytek Biosciences, Inc.

Timing and Fees

☐ Under 37 C.F.R. § 1.97(b), **no fee or statement is required** for filing this Information Disclosure Statement because it is filed:

- ☐ within three months of the filing date of a national application other than a CPA under § 1.53(d); **OR**
- ☐ within three months of the actual filing date of the national phase of a PCT application; **OR**
- ☐ before the mailing of a first substantive office action (including after filing of an RCE).

☐ Under 37 C.F.R. § 1.97(c), this Information Disclosure Statement is filed after the periods specified in 37 C.F.R. § 1.97(b), but **before** the mailing date of:

- ☐ a final rejection under 37 C.F.R. § 1.113; **OR**
- ☐ termination of prosecution, e.g. Ex Parte Quayle, M.P.E.P. § 609(B)(2); **OR**
- ☐ a notice of allowance under 37 C.F.R. § 1.311;

AND is accompanied by:

- ☐ the statement as specified in 37 C.F.R. § 1.97(e) set out below; **OR**
- ☐ payment covering the fee of Choose an item. under 37 C.F.R. § 1.17(p).

☒ Under 37 C.F.R. § 1.97(d), this Information Disclosure Statement is filed **after** the mailing date of the following actions which have not been withdrawn:

- ☐ a final action under 37 C.F.R. § 1.113; **OR**
- ☐ termination of prosecution; e.g. Ex Parte Quayle, M.P.E.P. § 609(B)(2); **OR**
- ☒ a notice of allowance under 37 C.F.R. § 1.311 and is filed on or before payment of the issue fee;

AND is accompanied by:

the statement as specified in 37 C.F.R. § 1.97(e) as set forth below, **AND** payment covering the fee of $260.00 - Large Entity under 37 C.F.R. § 1.17(p).

Statements Under 37 C.F.R. § 1.97(e) (if applicable)

☒ No item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the undersigned who has made a reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 C.F.R. § 1.56(c) more than three months prior to the filing of this Information Disclosure Statement.

Copies of Cited Materials (if applicable)

☐ Copies of materials listed but not attached were cited in benefit (35 U.S.C. § 120) ancestor application Serial No. _____ on Form 892 by the Examiner and/or Form 1449 by the applicant; see 37 C.F.R. § 1.98(d).

☐ This application may be related by inventorship and/or subject matter to co-pending U.S. application Serial No. _____, filed _____.

Payment of Fees Due (if applicable)

☒ Payment is made by credit card via Patent Center for $260.00 - Large Entity covering the fee identified above.

☒ The Commissioner is hereby authorized to charge or credit any overpayment to Deposit Account 50-1212/1001193453.

Respectfully submitted,

/Michael Pohl/

Michael Pohl
Reg. No. 72,871
Attorney

NORTON ROSE FULBRIGHT US LLP
Phone: (512) 474-5201
Date: October 25, 2024

Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1/1001193453	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT (Use several sheets if necessary)	Applicant: Beckman Coulter, Inc.	
	Filing Date: December 22, 2021	Group: 2877

U.S. Patent Documents	Foreign Patent Documents	Other Art
None	*None*	*See Page 1*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language

Other Art (Including Author, Title, Date, Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C1	INTERNATIONAL SOCIETY FOR ADVANCEMENT OF CYTOMETRY, "CYTO 2012", ISAC XXVII International Congress, Leipzig, Germany, June 2012, 272 pages.

EXAMINER:	DATE CONSIDERED:

EXAMINER: INITIAL IF REFERENCE CONSIDERED, WHETHER OR NOT CITATION IS IN CONFORMANCE WITH MPEP609; DRAW LINE THROUGH CITATION IF NOT IN CONFORMANCE AND NOT CONSIDERED. INCLUDE COPY OF THIS FORM WITH NEXT COMMUNICATION TO APPLICANT.

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**10/25/2024 03:38:13 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Jennifer Ringer
PATENT CENTER #	67726125	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Michael Pohl

Documents

TOTAL DOCUMENTS: 3

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
BECC.P0002US.CIP.D2C1 SIDS3.pdf		4	-	234 KB
BECC.P0002US.CIP.D2C1 SIDS3-TRAN.LET.pdf	(1-3)	3	Transmittal Letter	168 KB
BECC.P0002US.CIP.D2C1 SIDS3-IDS.pdf	(4-4)	1	Information Disclosure Statement (IDS) Form (SB08)	204 KB
NPL_CYTO_2012.pdf		272	Non Patent Literature	6058 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
BECC.P0002US.CIP.D2C1	849B36DF23487FC318BE04C584260135B7B44883C5B573C7F1

SIDS3.pdf	0926C54451EE998C190EBA5D6F6D803D364C3E1FD64ABB0B E2CBC3C0859BB0CAEC1065057B9BE2
BECC.P0002US.CIP.D2C1 SIDS3-TRAN.LET.pdf	7468C153D3319D852AA1DFED45E826234F5A6D1D9ECC6C25 1FF8E6B007A5FC85C7B4152B87A6117203CC804B6FC334B72 A3DFC2621230E688716B7F906BAC15C
BECC.P0002US.CIP.D2C1 SIDS3-IDS.pdf	EFEEAA4BDC62F3BD2F1BC52425292B9E1B0CFAAA6BEA612 4B7B3E8EEED11D6577C0BC2853F39A88F165FC534B44F60A8 273F556D46EE23C530B47F44256D44CB
NPL_CYTO_2012.pdf	2499F72F05521D35F40307D5C191F08CCABFBC6A1A05BE583 A6A4E70FB2E2A5F4564D98034B5F58BA18C5B67B8E90FF178 4B3294D1C0C244BBB67B6941CE6E84

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**10/25/2024 03:38:13 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Jennifer Ringer
PATENT CENTER #	67726125	AUTHORIZED BY	Michael Pohl
CUSTOMER #	129381	FILING DATE	12/22/2021
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Yong Qin Chen

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 1978	**E20240OF38378506**	**Jennifer Ringer**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1806	SUBMISSION OF AN INFORMATION DISCLOSURE STATEMENT	260.00	1	260.00
			TOTAL AMOUNT:	**$260.00**

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

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371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1	1145

129381 7590 11/01/2024

NORTON ROSE FULBRIGHT US LLP - BCI
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

EXAMINER
AKANBI, ISIAKA O

ART UNIT	PAPER NUMBER
2877	

NOTIFICATION DATE	DELIVERY MODE
11/01/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

PatentDocket@Beckman.com
aoipdocket@nortonrosefulbright.com

Corrected ***Notice of Allowability***	**Application No.** 17/645,727	**Applicant(s)** Chen, Yong Qin	
	Examiner ISIAKA O AKANBI	**Art Unit** 2877	**AIA (FITF) Status** No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 10/25/2024.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☐ The allowed claim(s) is/are _____ . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 10/25/2024.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/ISIAKA O AKANBI/
Primary Examiner, Art Unit 2877

Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1/1001193453	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT (Use several sheets if necessary)	Applicant: Beckman Coulter, Inc.	
	Filing Date: December 22, 2021	Group: 2877

U.S. Patent Documents	Foreign Patent Documents	Other Art
None	*None*	*See Page 1*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language

Other Art (Including Author, Title, Date, Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C1	INTERNATIONAL SOCIETY FOR ADVANCEMENT OF CYTOMETRY, "CYTO 2012", ISAC XXVII International Congress, Leipzig, Germany, June 2012, 272 pages.

EXAMINER: /ISIAKA O AKANBI/	DATE CONSIDERED: 10/29/2024

EXAMINER: INITIAL IF REFERENCE CONSIDERED, WHETHER OR NOT CITATION IS IN CONFORMANCE WITH MPEP609; DRAW LINE THROUGH CITATION IF NOT IN CONFORMANCE AND NOT CONSIDERED. INCLUDE COPY OF THIS FORM WITH NEXT COMMUNICATION TO APPLICANT.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /I.O.A/

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PATENT AND TRADEMARK OFFICE

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Alexandria, VA 22313 - 1450
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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**11/05/2024 08:45:52 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Susan Lien
PATENT CENTER #	67855477	AUTHORIZED BY	Michael Pohl
CUSTOMER #	129381	FILING DATE	12/22/2021
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Yong Qin Chen

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 3346	**E2024A5K46409439**	**Susan Lien**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1501	UTILITY ISSUE FEE	1200.00	1	1200.00
			TOTAL AMOUNT:	**$1,200.00**

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

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PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

129381 7590 09/11/2024
NORTON ROSE FULBRIGHT US LLP - BCI
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

Michael Pohl	(Typed or printed name)
/Michael Pohl/	(Signature)
November 5, 2024	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1	1145

TITLE OF INVENTION: FLOW CYTOMETER

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	12/11/2024

EXAMINER	ART UNIT	CLASS-SUBCLASS
AKANBI, ISIAKA O	2877	356-337000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Norton Rose Fulbright US LLP
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: BECKMAN COULTER, INC.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Brea, California

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via the USPTO patent electronic filing system ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 50-1212

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

☐ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

☐ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Michael Pohl/ Date November 5, 2024

Typed or printed name Michael Pohl Registration No. 72,871

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P.O. Box 1450
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www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**11/05/2024 08:45:52 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	1145	FILED BY	Susan Lien
PATENT CENTER #	67855477	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Michael Pohl

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
BECCP0002USCIPD2C1_Issue_Fee_Transmittal.pdf	1	Issue Fee Payment (PTO-85B)	1682 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
BECCP0002USCIPD2C1_Issue_Fee_Transmittal.pdf	0DB444BCCEB7CA39199F801FECC68EBC338BB134C0FD6287F15C04FEF80676D88E3EC7DA9E2FD5CE286EB99A257CB088DDB8C7FF0CD05FABC0ADF15AF4A58C12

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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Form PTO-1449 (modified)	Atty. Docket No.: BECC.P0002US.CIP.D2C1	Serial No.: 17/645,727
List of Patents and Publications for Applicant's INFORMATION DISCLOSURE STATEMENT (Use several sheets if necessary)	Applicant: IRIS INTERNATIONAL, INC.	
	Filing Date: December 22, 2021	Group: 2877

U.S. Patent Documents	Foreign Patent Documents	Other Art
See Page 1	*None*	*See Page 1*

U.S. Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Name
	A1	6198864	3/6/01	Lemoff et al.
Change(s) applied to document, /C.L./ 9/25/2024	A2	2002/131180	~~9/9/19~~	09/2002 Goodman
	A3	2004/101247	05/27/04	Chen et al.

Foreign Patent Documents

Exam. Init.	Ref. Des.	Document Number	Date	Country	Language

Other Art (Including Author, Title, Date Pertinent Pages, Etc.)

Exam. Init.	Ref. Des.	Citation
	C1	Extended European Search Report issued by the European Patent Office in corresponding European Application No. 24151670.7 dated April 9, 2024.

EXAMINER: /ISIAKA O AKANBI/	DATE CONSIDERED: 06/11/2024

EXAMINER: INITIAL IF REFERENCE CONSIDERED, WHETHER OR NOT CITATION IS IN CONFORMANCE WITH MPEP609; DRAW LINE THROUGH CITATION IF NOT IN CONFORMANCE AND NOT CONSIDERED. INCLUDE COPY OF THIS FORM WITH NEXT COMMUNICATION TO APPLICANT.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /I.O.A/

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/645,727	12/24/2024	12174106	BECC.P0002US.CIP.D2C1	1145

129381 7590 12/04/2024

NORTON ROSE FULBRIGHT US LLP - BCI
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at https://patentcenter.uspto.gov/. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at https://certifiedcopycenter.uspto.gov/index.html. The Certified Copy Center may be reached at (800)972-6382.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 289 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Center (https://patentcenter.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

INVENTOR(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional inventors):

Yong Qin Chen, San Jose, CA;

APPLICANT(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional applicants):

Beckman Coulter, Inc., Brea, CA;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**12/11/2024 03:36:35 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	12174106
CONFIRMATION #	1145	FILED BY	Michael Pohl
PATENT CENTER #	68329998	AUTHORIZED BY	-
CUSTOMER #	129381	FILING DATE	12/22/2021
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Yong Qin Chen

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
DA / 501212	**E2024BAF36577820**	**Michael Pohl**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1814	STATUTORY DISCLAIMER, INCLUDING TERMINAL DISCLAIMER	170.00	1	170.00
			TOTAL AMOUNT:	**$170.00**

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

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371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A PRIOR PATENT

APPLICATION #	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET #
17645727	12/22/2021	Yong Chen	BECC.P0002US.CIP.D2C1

Title of Invention

FLOW CYTOMETER

- ☑ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action
- ☑ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.

Owner	Percent interest
Beckman Coulter, Inc.	100%
Total	**100%**

The owner(s) of percent interest listed above in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of any patent granted on pending reference Application Number(s)

Application #	Filing Date

as the term of any patent granted on said reference application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending reference application. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and any patent granted on the reference application are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.
In making the above disclaimer, the owner does not disclaim the terminal part of any patent granted on the instant application that would extend to the expiration date of the full statutory term of any patent granted on said reference application, "as the term of any patent granted on said reference application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending reference application," in the event that any such patent granted on the pending reference application: expires for failure to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321, has all claims canceled by a reexamination certificate, is reissued, or is in any manner terminated prior to the expiration of its full statutory term as shortened by any terminal disclaimer filed prior to its grant.

The owner(s) of percent interest listed above in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of prior patent number(s)

Patent #
10330582

as the term of said prior patent is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.
In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the prior patent, "as the term of said prior patent is presently shortened by any terminal disclaimer," in the event that said prior patent later:
- expires for failure to pay a maintenance fee;
- is held unenforceable;
- is found invalid by a court of competent jurisdiction;
- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
- has all claims canceled by a reexamination certificate;
- is reissued; or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.



Terminal disclaimer fee under 37 CFR 1.20(d) included with Electronic Terminal Disclaimer request.

Applicant claims the following entity status:
Regular Undiscounted

I hereby declare that all statements made herein of my own knowledge are true and that all statemnts made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I certify, in accordance with 37 CFR 1.4(d)(4) that I am: An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application

Signature	Name	Registration #
/Michael Pohl/	Michael Pohl	72871

* Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner). Form PTO/SB/96 may be used for making this certification. See MPEP 324.

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**12/11/2024 03:36:35 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	12174106
CONFIRMATION #	1145	FILED BY	Michael Pohl
PATENT CENTER #	68329998	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	-

Documents

TOTAL DOCUMENTS: 2

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
petition-request.pdf	3	Terminal Disclaimer-Filed (Electronic)	44 KB
grantLetter.pdf	1	Terminal Disclaimer-Electronic-Approved	18 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
petition-request.pdf	5F99B6E7835290BAC74DD8281CAD34B1638B58015DF84D3B2CFEE6E7696AA474A06B199482962E75850775860C8353CDED630E0756CD2B970EE753CFCC19B8BD
grantLetter.pdf	EEE2AA0C80300D04FCCF34439AC0068BB0BBDF9E31B4F605

1187E03F1CC83E62C8C147A2245F3098E786C320F7B38B2743
614F85831A811A83831725B4CA37E0

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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United States Patent and Trademark Office
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APPROVAL LETTER

APPLICATION #	FILING DATE	APPLICANT/PATENT UNDER REEXAMINATION
17/645,727	12/22/2021	Yong Chen

Title of Invention

FLOW CYTOMETER

Electronic terminal disclaimer filed on 12/11/2024

☑ Approved

This patent is subject to a Terminal Disclaimer

Approved / Disapproved by: Electronic Terminal Disclaimer automatically approved

UNITED STATES
PATENT AND TRADEMARK OFFICE

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**12/11/2024 03:39:31 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	12174106
CONFIRMATION #	1145	FILED BY	Michael Pohl
PATENT CENTER #	68330159	AUTHORIZED BY	-
CUSTOMER #	129381	FILING DATE	12/22/2021
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Yong Qin Chen

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
DA / 501212	**E2024BAF39527842**	**Michael Pohl**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1811	CERTIFICATE OF CORRECTION	160.00	1	160.00
			TOTAL AMOUNT:	**$160.00**

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New Applications Under 35 U.S.C. 111

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/645,727	**12/11/2024 03:39:31 PM Z ET**	**BECC.P0002US.CIP.D2C1**

Title of Invention

FLOW CYTOMETER

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	12174106
CONFIRMATION #	1145	FILED BY	Michael Pohl
PATENT CENTER #	68330159	FILING DATE	12/22/2021
CUSTOMER #	129381	FIRST NAMED INVENTOR	Yong Qin Chen
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	-

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
BECC.P0002US.CIP.D2C1 - Request for Certificate of Correction.pdf	3	Request for Certificate of Correction	361 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
BECC.P0002US.CIP.D2C1 - Request for Certificate of Correction.pdf	EA75E42E60BA28E0609E68E671FADC7F178BC3B082C212DD 9A597A75744E7D2FDDA9BB7867BACC824FFA91669B98D127 9D4F517B82D9D6788E209DC74EBEF47C

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Beckman Coulter, Inc.	Group Art Unit: 2877
Serial No.: 17/645,727	Examiner: Isiaka O. Akanbi
Filed: December 22, 2021	Atty. Dkt. No.: BECC.P0002US.CIP.D2C1
For: Flow Cytometer	Confirmation No.: 1145

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

CERTIFICATE OF ELECTRONIC TRANSMISSION
37 C.F.R. § 1.8

I hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office via Patent Center on the date below:

December 11, 2024	/Michael Pohl/
Date	Michael Pohl

REQUEST FOR CERTIFICATE OF CORRECTION

Applicant respectfully requests issuance of a Certificate of Correction pursuant to the attached form PTO/SB/44 so that "the face of the patent [is] amended to state that the patent is subject to a terminal disclaimer," which is being filed concurrently with this request. *See* MPEP § 1490.V.A ("Any eTD submitted after the date of payment of the issue fee, but prior to the patent grant date, must include a certificate of correction"). Should any fees be required for any reason relating to the filing of this paper and not otherwise be paid, Applicant authorizes the Commissioner to deduct them from Norton Rose Fulbright US LLP's Deposit Account No. 50-1212/BECC.P0002US.CIP.D2C1.

Respectfully submitted,

NORTON ROSE FULBRIGHT US LLP
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701
(512) 536-3113
(512) 536-4598 Fax

/Michael Pohl/

Michael Pohl
Reg. No. 72,871
Attorney

Date: December 11, 2024

PTO/SB/44 (09-07)
Approved for use through 03/31/2026. OMB 0651-0033
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.
(Also Form PTO-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 12174106

APPLICATION NO.: 17/645727

ISSUE DATE : December 24, 2024

INVENTOR(S) : Yong Qin Chen

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the Title Page:

In Date of Patent, Item (45), an asterisk --*-- should precede "Dec. 24, 2024."

The first or sole Notice should read --This patent is subject to a terminal disclaimer.-- following its statement that "Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 289 days."

MAILING ADDRESS OF SENDER (Please do not use Customer Number below):

Michael J. Pohl
Norton Rose Fulbright US LLP, 98 San Jacinto Blvd, Suite 1100
Austin, TX 78701

A Federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with an information collection subject to the requirements of the Paperwork Reduction Act of 1995, unless the information collection has a currently valid OMB Control Number. The OMB Control Number for this information collection is 0651-0033. Public burden for this form is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Send comments regarding this burden estimate or any other aspect of this information collection, including suggestions for reducing this burden to the Chief Administrative Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 or email InformationCollection@uspto.gov. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. If filing this completed form by mail, send to: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1	1145

129381 7590 12/23/2024

NORTON ROSE FULBRIGHT US LLP - BCI
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

EXAMINER
AKANBI, ISIAKA O

ART UNIT	PAPER NUMBER
2877	

NOTIFICATION DATE	DELIVERY MODE
12/23/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

PatentDocket@Beckman.com
aoipdocket@nortonrosefulbright.com

UNITED STATES PATENT AND TRADEMARK OFFICE

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United States Patent and Trademark Office
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Alexandria, VA 22313-1450
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Patent No.: 12174106
Issue Date: 12/24/2024
Appl. No.: 17/645,727
Filed: 12/22/2021

PART (A) RESPONSE FOR CERTIFICATES OF CORRECTION

This is a decision on the Certificate of Correction request filed 11 December 2024.

The request for issuance of Certificate of Correction for the above-identified correction(s) under the provisions of 37 CFR 1.322 and/or 1.323 is hereby:

(Check one)
☑ Approved ☐ Approved in Part ☐ Denied

Comments: ____

PART (B) PETITION UNDER 37 CFR 1.324 OR 37 CFR 1.48

☐ This is a decision on the petition filed ____ to correct inventorship under 37 CFR 1.324.

☐ This is a decision on the request under 37 CFR 1.48, petition filed ____. In view of the fact that the patent has already issued, the request under 37 CFR 1.48 has been treated as a petition to correct inventorship under 37 CFR 1.324.

The petition is hereby: ☐ Granted ☐ Dismissed

Comment: ____

The patented filed is being forwarded to Certificate of Corrections Branch for issuance of a certificate naming only the actual inventor or inventors.

/TARIFUR R CHOWDHURY/
Supervisory Patent Examiner, Art Unit 2877
Technology Center 2800
Phone: (571)272-2287

Certificates of Correction Branch email: CustomerServiceCoC@uspto.gov CoC Central Phone Number: (703) 756-1814

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1	1145

129381 7590 12/24/2024

NORTON ROSE FULBRIGHT US LLP - BCI
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

EXAMINER	
AKANBI, ISIAKA O	

ART UNIT	PAPER NUMBER
2877	

NOTIFICATION DATE	DELIVERY MODE
12/24/2024	ELECTRONIC

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PatentDocket@Beckman.com
aoipdocket@nortonrosefulbright.com

APPLICATION NO.	ISSUE DATE	PATENT NO.
17/645,727	24-Dec-2024	12174106

NORTON ROSE FULBRIGHT US LLP - BCI
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

EGRANT NOTIFICATION

Your electronic patent grant (eGrant) is now available, which can be accessed via Patent Center at https://patentcenter.uspto.gov

The electronic patent grant is the official patent grant under 35 U.S.C. 153. For more information, please visit https://www.uspto.gov/electronicgrants

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO.	: 12,174,106 B2
APPLICATION NO.	: 17/645727
DATED	: December 24, 2024
INVENTOR(S)	: Yong Qin Chen

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the Title Page

The first or sole Notice should read --This patent is subject to a terminal disclaimer.-- following its statement that "Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 289 days."

In Date of Patent, Item (45), an --*-- should precede "Dec. 24, 2024."

Signed and Sealed this
Fourth Day of March, 2025

Coke Morgan Stewart

Coke Morgan Stewart
Acting Director of the United States Patent and Trademark Office

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/645,727	12/22/2021	Yong Qin Chen	BECC.P0002US.CIP.D2C1	1145

129381 7590 03/04/2025

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98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

EXAMINER
AKANBI, ISIAKA O

ART UNIT	PAPER NUMBER
2877	

NOTIFICATION DATE	DELIVERY MODE
03/04/2025	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

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APPLICATION NO.	ISSUE DATE	PATENT NO.
17/645,727	04-Mar-2025	12174106

NORTON ROSE FULBRIGHT US LLP - BCI
98 San Jacinto Blvd., Suite 1100
Austin, TX 78701

ELECTRONIC CERTIFICATE OF CORRECTION NOTIFICATION

Your electronic certificate of correction is now available, and can be accessed via Patent Center at https://patentcenter.uspto.gov.

The electronic certificate of correction is the official certificate of correction under 35 U.S.C. 254 or 255. For more information, please visit https://www.uspto.gov/electronicgrants.