

Petition for Post-Grant Review of
U.S. Patent No. 12,174,107 B2

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CYTEK BIOSCIENCES, INC.,
Petitioner

v.

BECKMAN COULTER, INC.
Patent Owner

Case No. PGR2025-00088
U.S. Patent No. 12,174,107 B2
Issue Date: December 24, 2024

Title: FLOW CYTOMETER

**PETITION FOR POST-GRANT REVIEW
OF U.S. PATENT NO. 12,174,107 B2**

Table of Contents

	Page
I. INTRODUCTION	1
II. MANDATORY NOTICES UNDER §42.8(A)(1)	3
A. Real Party-In-Interest under §42.8(b)(1).....	3
B. Related Matters under §42.8(b)(2)	3
C. Lead and Back-Up Counsel under §42.8(b)(3).....	3
D. Service Information.....	4
III. FEE PAYMENT	5
IV. REQUIREMENTS FOR POST GRANT REVIEW	5
A. Grounds for Standing	5
B. Identification of Challenge and Statement of Precise Relief Requested	5
C. Considerations Under §§ 314(a) and 325(d).....	6
V. TECHNOLOGY BACKGROUND.....	6
A. Flow Cytometers	6
B. Wavelength Division Demultiplexers	8
C. Avalanche Photodiodes (APDs) in Flow Cytometry	10
VI. OVERVIEW OF THE '107 PATENT	12
VII. LEVEL OF ORDINARY SKILL	14
VIII. CLAIM CONSTRUCTION	14
IX. PRIORITY DATE OF THE CHALLENGED CLAIMS	15
A. Claims 14 and 18 Are First Supported by the '412 Patent's New Matter	17
B. Claims 6 and 22 Are First Supported by the PCT App.....	18
X. GROUNDS 1-7: THE CHALLENGED CLAIMS ARE INVALID UNDER 35 U.S.C. § 112.....	18
A. Ground 1: The Challenged Claims Recite a “WDM” that Lacks Written Description Support	19

Table of Contents
(continued)

	Page
1. The Omitted “Collimating Optical Element” that Projects a “Collimated Beam” is Critical to Operate the Claimed WDM.....	20
a. Technical Background on Light Beam Properties	21
b. The Omitted “collimating optical element” That Projects a “collimated beam” is Required to Operate the Claimed WDM.....	23
2. The Prosecution History Confirms a “Collimating Optical Element” that Projects a “Collimated Beam” is Critical.....	25
B. Ground 2: The Challenged Claims Lack Full Scope Enablement for a “WDM” Without a “Collimating Optical Element” That Projects a “Collimated Beam”.....	26
C. Ground 3: Claims 1-3, 5-14 Lack Written Description Support for an “optical fiber”.....	29
D. Ground 4: Claims 1-3, 5-14 Lack Full Scope Enablement for “optical fiber”	30
E. Ground 5: Claims 9, 29 Lack Written Description Support	34
F. Ground 6: Claims 9, 29 are Not Enabled	38
G. Ground 7: Claim 30 Lacks Written Description Support	40
XI. GROUNDS 8-11: THE CHALLENGED CLAIMS ARE OBVIOUS.....	41
A. Prior Art Summary	41
1. Chandler [EX1051]	41
2. Goodman [EX1016].....	42
3. Hamamatsu [EX1055, EX1056]	44
4. Oostman [EX1005]	44
5. Frazier [EX1009]	46
B. Ground 8: Chandler and Goodman Render the Challenged Claims Obvious	47

Table of Contents

(continued)

	Page
1. Motivation to Combine Chandler with Goodman and Reasonable Expectation of Success	47
2. Independent Claim 1	50
a. Claim 1[pre]: “A flow cytometer comprising:”	50
b. Claim 1[a]: “an optical fiber; and”	50
c. Claim 1[b]: “a wavelength division multiplexer (WDM) configured to receive light from the optical fiber, wherein the WDM comprises:”	52
d. Claim 1[c]: “an array of mirrors;”	54
e. Claim 1[d]: “an array of filters; and”	55
f. Claim 1[e]: “an array of avalanche photodiodes (APDs) configured to receive light that passed through one or more filters in the array of filters;”	57
(a) Claim 1[f]: “wherein each of the filters in the array of filters is configured to receive light such that: a portion of the light passes through the filter; and another portion of the light is reflected; and”	59
(b) Claim 1[g]: “wherein each of the mirrors in the array of mirrors is configured to: receive light reflected by a filter in the array of filters; and reflect light to another filter in the array of filters.”	61
3. Dependent Claim 2: “The flow cytometer of claim 1, wherein: the array of mirrors is substantially linear; the array of filters is substantially linear; and the array of APDs is substantially linear.”	63
4. Dependent Claim 3 “The flow cytometer of claim 2, wherein at least one of the mirrors in the array of mirrors is a concave mirror.”	65
5. Dependent Claim 5: “The flow cytometer of claim 3, wherein the WDM is configured such that a portion of an optical path between the array of mirrors and the array of filters forms a zig-zag pattern.”	66

Table of Contents
(continued)

	Page
6. Dependent Claim 6: “The flow cytometer of claim 5, further comprising a laser that is configured to emit blue light, yellow-green light, violet light, or ultraviolet light.”	67
7. Dependent Claim 7: “The flow cytometer of claim 6, wherein the flow cytometer is a benchtop flow cytometer.”	68
8. Dependent Claim 8: “The flow cytometer of claim 6, wherein the flow cytometer is compact.”	68
9. Dependent Claim 9: “The flow cytometer of claim 8, wherein the WDM is capable of detecting a substantially full spectrum of visible light.”	69
10. Dependent Claim 10: “The flow cytometer of claim 6, wherein: the WDM further comprises a block comprising a first surface; and each of the filters in the array of filters is coupled to the first surface of the block.”	70
11. Dependent Claim 11: “The flow cytometer of claim 10, wherein the flow cytometer is a benchtop flow cytometer.”	71
12. Dependent Claim 12: “The flow cytometer of claim 10, wherein the flow cytometer is compact.”	72
13. Dependent Claim 13: “The flow cytometer of claim 6, wherein the WDM further comprises: an array of focusing lenses, wherein each of the focusing lenses in the array of focusing lenses is configured to focus light that passed through a filter in the array of filters to a spot on an APD in the array of APDs, wherein the spot has a diameter that is smaller than a diameter of a core of the optical fiber.”	72
14. Dependent Claim 14: “The flow cytometer of claim 13, wherein for each of the focusing lenses in the array of focusing lenses, the diameter of the spot is less than 1 mm.”	74

Table of Contents
(continued)

		Page
15.	Independent Claim 16	76
a.	Claim 16[pre]: “A flow cytometer comprising:”	76
b.	Claim 16[a]: “a flow cell configured to permit liquid to flow through the flow cell;”	76
c.	Claim 16[b]: “a laser configured to project light into the flow cell;”	78
d.	Claim 16[c]: “a multimode optical fiber configured to receive light from the flow cell; and”	80
e.	Claim 16[d]: “a wavelength division multiplexer (WDM) configured to receive light from the multimode optical fiber, wherein the WDM comprises:”	80
f.	Claim 16[e]: “a plurality of mirrors,”	80
g.	Claim 16[e][i]: “wherein at least one of the mirrors is a concave mirror;”	80
h.	Claim 16[f]: “a plurality of filters; and”	80
i.	Claim 16[g]: “a plurality of avalanche photodiodes (APDs) configured to receive light that passed through one or more filters of the plurality of filters;”	81
j.	Claim 16[h]: “wherein each of the plurality of filters is configured to receive light such that: a portion of light passes through the filter; and another portion of light is reflected; and”	81
k.	Claim 16[i]: “wherein each of the plurality of mirrors is configured to: receive light reflected by a filter of the plurality of filters; and reflect light to another filter of the plurality of filters.”	81

Table of Contents
(continued)

Page

16.	Dependent Claim 17: “The flow cytometer of claim 16, wherein the WDM further comprises: a plurality of focusing lenses, wherein each of the plurality of focusing lenses is configured to focus light that passed through a filter of the plurality of filters to a spot on an APD of the plurality of APDs, wherein the spot has a diameter that is smaller than a diameter of a core of the multimode optical fiber.”	82
17.	Dependent Claim 18: ““The flow cytometer of claim 17, wherein for each of the plurality of focusing lenses, the diameter of the spot is less than 1 mm.”	82
18.	Dependent Claim 20: “The flow cytometer of claim 16, wherein the plurality of mirrors includes more than one concave mirror.”	82
19.	Dependent Claim 21: “The flow cytometer of claim 20, wherein the WDM is configured such that a portion of an optical path between the plurality of mirrors and the plurality of filters forms a zig-zag pattern.”	82
20.	Dependent Claim 22: “The flow cytometer of claim 21, wherein the laser is configured to emit blue light, yellow-green light, violet light, or ultraviolet light.”	83
21.	Dependent Claim 26: “The flow cytometer of claim 22, wherein: the WDM further comprises a block comprising a first surface; and each of the plurality of filters is coupled to the first surface of the block.”	83
22.	Dependent Claim 27: “The flow cytometer of claim 26, wherein the flow cytometer is a benchtop flow cytometer.”	83
23.	Dependent Claim 28: “The flow cytometer of claim 26, wherein the flow cytometer is compact.”	83
24.	Dependent Claim 29: “The flow cytometer of claim 28, wherein the WDM is capable of detecting a substantially full spectrum of visible light.”	83

Table of Contents
(continued)

	Page
25. Dependent Claim 30: “The flow cytometer of claim 29, wherein: the plurality of mirrors comprise five or more mirrors; and the plurality of filters comprise six or more filters.”	84
C. Ground 9: Chandler in View of Goodman and Hamamatsu Render Obvious Claims 13, 14, 17, and 18.....	84
1. Motivation to Combine Chandler and Goodman with Hamamatsu and Reasonable Expectation of Success	84
2. Dependent Claim 13	85
3. Dependent Claim 14	85
4. Dependent Claim 17	85
5. Dependent Claim 18	85
D. Ground 10: Oostman, Goodman, and Frazier Render the Challenged Claims Obvious.....	86
1. Motivation to Combine Oostman and Goodman and Reasonable Expectation of Success	86
2. Motivation to Combine Oostman and Goodman with Frazier and Reasonable Expectation of Success.....	88
3. Independent Claim 1	89
a. Claim 1[pre]: “A flow cytometer comprising:”	89
b. Claim 1[a]: “an optical fiber; and”	90
c. Claim 1[b]: “a wavelength division multiplexer (WDM) configured to receive light from the optical fiber, wherein the WDM comprises:”	91
d. Claim 1[c]: “an array of mirrors;”	92
e. Claim 1[d]: “an array of filters; and”	93
f. Claim 1[e]: “an array of avalanche photodiodes (APDs) configured to receive light that passed through one or more filters in the array of filters;”	93

Table of Contents

(continued)

	Page
g. Claim 1[f]: “wherein each of the filters in the array of filters is configured to receive light such that: a portion of the light passes through the filter; and another portion of the light is reflected; and”	93
h. Claim 1[g]: “wherein each of the mirrors in the array of mirrors is configured to: receive light reflected by a filter in the array of filters; and reflect light to another filter in the array of filters.”	94
4. Dependent Claim 2	94
5. Dependent Claim 3	95
6. Dependent Claim 5	95
7. Dependent Claim 6	95
8. Dependent Claim 7	96
9. Dependent Claim 8	97
10. Dependent Claim 9	97
11. Dependent Claim 10	98
12. Dependent Claim 11	98
13. Dependent Claim 12	98
14. Dependent Claim 13	98
15. Dependent Claim 14	99
16. Independent Claim 16	99
a. Claim 16[pre]: “A flow cytometer comprising:”	99
b. Claim 16[a]: “a flow cell configured to permit liquid to flow through the flow cell;”	99
c. Claim 16[b]: “a laser configured to project light into the flow cell;”	100
d. Claim 16[c]: “a multimode optical fiber configured to receive light from the flow cell; and”	101

Table of Contents

(continued)

	Page
e. Claim 16[d]: “a wavelength division multiplexer (WDM) configured to receive light from the multimode optical fiber, wherein the WDM comprises:”	101
f. Claim 16[e]: “a plurality of mirrors,”	102
g. Claim 16[e][i]: “wherein at least one of the mirrors is a concave mirror;”	102
h. Claim 16[f]: “a plurality of filters; and”	102
i. Claim 16[g]: “a plurality of avalanche photodiodes (APDs) configured to receive light that passed through one or more filters of the plurality of filters;”	102
j. Claim 16[h]: “wherein each of the plurality of filters is configured to receive light such that: a portion of light passes through the filter; and another portion of light is reflected; and”	102
k. Claim 16[i]: “wherein each of the plurality of mirrors is configured to: receive light reflected by a filter of the plurality of filters; and reflect light to another filter of the plurality of filters.”	103
17. Dependent Claim 17	103
18. Dependent Claim 18	103
19. Dependent Claim 20	103
20. Dependent Claim 21	103
21. Dependent Claim 22	103
22. Dependent Claim 26	104
23. Dependent Claim 27	104
24. Dependent Claim 28	104
25. Dependent Claim 29	104
26. Dependent Claim 30	104

Table of Contents
(continued)

	Page
E. Ground 11: Oostman in View of Goodman, Frazier, and Hamamatsu Render Obvious Claims 13, 14, 17 and 18	104
1. Motivation to Combine Oostman, Goodman, and Frazier with Hamamatsu and Reasonable Expectation of Success....	104
2. Dependent Claim 13	105
3. Dependent Claim 14	105
4. Dependent Claim 17	105
5. Dependent Claim 18	105
XII. CONCLUSION.....	105
CERTIFICATE OF SERVICE	108

Petition for Post-Grant Review of
U.S. Patent No. 12,174,107 B2

List of Exhibits

Exhibit No.	Description of Document
1001	U.S. Patent No. 12,174,107 B2 to Yong Qin Chen (filed September 3, 2024, issued December 24, 2024) (“ 107 patent ”)
1002	Declaration of Fedor A. Ilkov, Ph.D.
1003	Prosecution History of U.S. Patent No. 12,174,107 B2
1004	Nigel P. Carter and Michael G. Ormerod, <i>Chapter 1, Introduction to the Principles of flow cytometry</i> , Flow Cytometry, pp. 1-22 (3rd ed. 2000)
1005	U.S. Patent No. 6,683,314 B2 to Clifford A. Oostman, Jr. et al. (filed August 28, 2001; published January 27, 2004) (“ Oostman ”)
1006	U.S. Patent No. 5,317,162 to Bertram G. Pinsky et al. (filed September 9, 1992; published May 31, 1994) (“ Pinsky ”)
1007	Excerpts of Howard M. Shapiro, Practical Flow Cytometry (4th ed. 2003) (“ Shapiro ”)
1008	World Patent No. WO 2010/101623 A1 to Michael Thomas (filed March 2, 2010; published September 10, 2010) (“ Thomas ”)
1009	U.S. Patent No. 8,284,402 B2 to Erich Frazier et al. (filed February 26, 2010; published October 9, 2012) (“ Frazier ”)
1010	U.S. Patent No. 4,244,045 to Kiyoshi Nosu et al. (filed January 31, 1979; published January 6, 1981) (“ Nosu ”)
1011	U.S. Patent No. 8,537,468 B1 to Xuan Wang et al. (filed June 10, 2011; published September 17, 2013) (“ Wang ”)
1012	U.S. Patent No. 6,198,864 B1 to Brian E. Lemoff et al. (filed November 24, 1998; published March 6, 2001) (“ Lemoff ”)
1013	U.S. Patent No. 7,212,343 B1 to Chun He et al. (filed July 11, 2003; published May 1, 2007) (“ He ”)
1014	U.S. Patent No. 5,835,517 to Vijaysekhar Jayaraman et al. (filed October 4, 1996; published November 10, 1998) (“ Jayaraman ”)

List of Exhibits

Exhibit No.	Description of Document
1015	U.S. Patent No. 6,201,908 B1 to Eric B. Grann (filed July 2, 1999; published March 13, 2001) (“ Grann ”)
1016	U.S. Patent No. 6,542,306 B2 to Timothy D. Goodman (filed March 16, 2001; published April 1, 2003) (“ Goodman ”)
1017	Listing of Challenged Claims
1018	Joint Claim Construction Chart including Exhibit A Parties Agreed and Proposed Constructions filed in <i>Beckman Coulter, Inc. v. Cytek Biosciences, Inc.</i> , C.A. No. 24-945 (D. Del. May 28, 2025), D.I. 89 & 89-1
1019	Plaintiff’s Disclosure of Asserted Claims and Infringement Contentions [Redacted Version], served in <i>Beckman Coulter, Inc. v. Cytek Biosciences, Inc.</i> , C.A. No. 24-945 (D. Del. Feb. 14, 2025)
1020	Definition of Mirror from Concise Oxford English Dictionary (12th ed. 2011)
1021	Excerpts of Course 1 Fundamentals of Light and Lasers, Optics and Photonics Series, Modules 1-6, OP-TEC (3rd ed. 2018)
1022	Henry Semat and Robert Katz, <i>Chapter 38: Mirrors and Lenses</i> , Physics, Robert Katz Publications, pp. 699-722 (1958)
1023	Steve Wasserman, <i>Geometrical optics and ray tracing</i> , Course Wiki (August 27, 2019)
1024	<i>Reserved</i>
1025	Complaint filed in <i>Beckman Coulter, Inc. v. Cytek Biosciences, Inc.</i> , C.A. No. 1:24-cv-00945 (D. Del. Aug. 14, 2024), D.I. 1
1026	Summons in a Civil Action to Cytek Biosciences, Inc. c/o Cogency Global, Inc. served on August 15, 2024, filed in <i>Beckman Coulter, Inc. v. Cytek Biosciences, Inc.</i> , C.A. No. 1:24-cv-00945 (D. Del. Aug. 16, 2024), D.I. 5
1027	Stipulation and Order Amending Scheduling Order filed in <i>Beckman Coulter, Inc. v. Cytek Biosciences, Inc.</i> , C.A. No. 1:24-cv-00945 (D. Del. March 4, 2025), D.I. 55
1028	<i>Reserved</i>
1029	Excerpts of the Prosecution history of U.S. Patent No. 9,746,412

List of Exhibits

Exhibit No.	Description of Document
1030	Rochelle A. Diamond, <i>Chapter 8: Quality Control Guidelines for Research Flow Cytometry</i> , In <i>Living Color</i> , pp. 98-105 (2000)
1031	R.M.P. Doornbos et al., <i>White Blood Cell Differentiation Using a Solid State Flow Cytometer</i> , <i>Cytometry</i> 14:589-594 (1993) (“ Doornbos ”)
1032	SensL SPMMini High Gain APD (Oct. 2007)
1033	Menlo Systems APD210/310 High Sensitivity Detector Unit (Apr. 2021)
1034	Thorlabs.com – High-Sensitivity Avalanche Photodetectors website Overview, Specs and Documents & Drawings, (Aug. 31, 2011), https://web.archive.org/web/20110831115024/http://www.thorlabs.com/NewGroupPage9.cfm?ObjectGroup_ID=947
1035	World Patent No. WO 94/29695 to Oddbjørn Gjelsnes (filed June 8, 1993; published December 22, 1994) (“ Gjelsnes ”)
1036	Carleton C. Stewart et al., <i>Flow Cytometer in the Infrared: Inexpensive Modifications to a Commercial Instrument</i> , <i>Cytometry Part A</i> , 67A:104-111 (2005) (“ Stewart ”)
1037	William G. Lawrence et al., <i>A 16-channel avalanche photodiode detector array for visible and near-infrared flow cytometry</i> , <i>Imaging, Manipulation, and Analysis of Biomolecules, Cells, and Tissues IV</i> , <i>Proc. of SPIE</i> , Vol. 6088, 60880T, (2006) (“ Lawrence ”)
1038	William G. Lawrence et al., <i>A Comparison of Avalanche Photodiode and Photomultiplier Tube Detectors for Flow Cytometry</i> , <i>Imaging, Manipulation, and Analysis of Biomolecules, Cells, and Tissues VI</i> , <i>Proc. of SPIE</i> Vol. 6859, 68590M, (2008) (“ Lawrence 2008 ”)
1039	Shutao Zhao et al., <i>High gain avalanche photodiode (APD) arrays in flow cytometer optical [sic] system</i> , <i>IEEE</i> (2011) (“ Zhao ”)
1040	U.S. Patent No. 8,188,438 B2 to Dongqing Li (filed Mar. 8, 2010; published May 29, 2012) (“ Li-438 ”)
1041	Canadian Patent No. 2 771 324 to Paul Patt (filed Aug. 20, 2010; published June 21, 2016) (“ Patt-324 ”)
1042	U.S. Patent No. 7,580,120 B2 to Yuichi Hamada et al. (filed Apr. 6, 2006; published Aug. 25, 2009) (“ Hamada ”)

List of Exhibits

Exhibit No.	Description of Document
1043	World Patent No. 98/59233 to Van S. Chandler (filed June 22, 1998; published Dec. 30, 1998) (“ Chandler-233 ”)
1044	U.S. Patent No. 7,523,637 B2 to Wayne D. Roth et al. (filed Nov. 29, 2007; published Apr. 28, 2009) (“ Roth-637 ”)
1045	U.S. Patent No. 7,505,131 B2 to Wayne D. Roth (filed Mar. 6, 2008; published Mar. 17, 2009) (“ Roth-131 ”)
1046	U.S. Patent Application Publication No. 2008/0305481 A1 to Douglas F. Whitman et al. (filed Dec. 13, 2007; published Dec. 11, 2008) (“ Whitman ”)
1047	U.S. Patent Application Publication No. 2007/0269345 A1 to Adam Richard Schilffarth et al. (filed May 17, 2007; published Nov. 22, 2007) (“ Schilffarth-345 ”)
1048	U.S. Patent Application Publication No. 2007/0207513 A1 to Keld Sorensen et al. (filed Mar. 5, 2007; published Sept. 6, 2007) (“ Sorensen ”)
1049	U.S. Patent Application Publication No. 2009/0071225 A1 to Adam Richard Schilffarth (filed Sept. 17, 2008; published Mar. 19, 2009) (“ Schilffarth-225 ”)
1050	U.S. Patent Application Publication No. 2009/0237658 A1 to Edward Calvin et al. (filed Apr. 9, 2009; published Sept. 24, 2009) (“ Calvin ”)
1051	U.S. Patent No. 6,139,800 to Van S. Chandler (filed June 22, 1998; published Oct. 31, 2000) (“ Chandler ”)
1052	Luminex 100™ IS User Manual Version 2.3 (Oct. 2005)
1053	Luminex FlexMap 3D® User Manual (Jan. 2019)
1054	BD Biosciences Immunocytometry Systems Technical Specifications BD FACSAArray (Oct. 2003)
1055	Archived website page for Hamamatsu NIR High Sensitivity Type products, (June 20, 2010), https://web.archive.org/web/20100620045039/http://jp.hamamatsu.com/products/sensor-ssd/pd078/pd079/pd083/index_en.html
1056	Archived website page for Hamamatsu Short Wavelength Type products, (June 20, 2010),

List of Exhibits

Exhibit No.	Description of Document
	https://web.archive.org/web/20100620044720/http://jp.hamamatsu.com/products/sensor-ssd/pd078/pd079/pd082/index_en.html
1057	<i>Reserved</i>
1058	<i>Reserved</i>
1059	<i>Reserved</i>
1060	Hamamatsu Si APD S5343 to S5345, S9073 to S9075, Short wavelength type APD (Apr. 2004)
1061	Hamamatsu Si APD S8890 series, Long wavelength type APD (June 2010)
1062	Hamamatsu Si APD S2381 to S2385, S5139, S8611, S3884, S4315 series, Low bias operation, for 800 nm band (May 2010)
1063	Hamamatsu Products by Division, (Aug. 7, 2011), https://web.archive.org/web/20110807025645/http://sales.hamamatsu.com:80/en/products.php
1064	First Sensor APD Data Sheet Part Description AD800-11 to Order # 500970, Version 20-06-11 (June 2011)
1065	Thorlabs, Collimated Light's Non-Zero Beam Divergence, <i>Does collimated light maintain a constant beam diameter out to infinity?</i> (Apr. 20, 2021), https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=14489
1066	Edmund Optics, Considerations in Collimation, https://www.edmundoptics.com/knowledge-center/application-notes/optics/considerations-in-collimation/
1067	<i>Reserved</i>
1068	Affidavit of Mina Ching
1069	<i>Reserved</i>
1070	U.S. Patent No. 9,746,412 B2 to Yong Qin Chen (filed Nov. 26, 2014; published Aug. 29, 2017) (“ 412 ”)
1071	Prosecution History of PCT/US2013/043453 (the “ PCT App. ”)

Petition for Post-Grant Review of
U.S. Patent No. 12,174,107 B2

List of Exhibits

Exhibit No.	Description of Document
1072	<i>Reserved</i>
1073	<i>Reserved</i>
1074	<i>Reserved</i>
1075	<i>Reserved</i>
1076	<i>Reserved</i>
1077	<i>Reserved</i>
1078	U.S. Patent No. 11,255,772 B2 to Yong Qin Chen (filed June 30, 2017; published Feb. 22, 2022) (“772”)
1079	<i>Reserved</i>
1080	<i>Reserved</i>
1081	Declaration of Dr. David Schaafsma, Ph.D. in Support of Beckman Coulter’s Opening Claim Construction Brief, dated June 5, 2025, filed in <i>Beckman Coulter, Inc. v. Cytek Biosciences, Inc.</i> , C.A. No. 1:24-cv-00945 (D. Del. July 27, 2025)
1082	<i>Reserved</i>
1083	<i>Reserved</i>
1084	<i>Reserved</i>
1085	How Gas-Ion Lasers Work, Lexel Laser (May 14, 2004), https://web.archive.org/web/20040817080937/http://www.lexellaser.com/techinfo_gas-ion.htm
1086	Clive Barnes, Copper at the Cutting Edge: The Copper Vapor Laser (June 2001), https://web.archive.org/web/20090101015131/https://copper.org/publications/newsletters/innovations/2001/06/cutting_edge.html
1087	Argon Lasers, Remanufactured Air-Cooled Argon and Argon/Krypton Lasers, Midwest Laser Products LLC (Dec. 2, 2015)

List of Exhibits

Exhibit No.	Description of Document
	https://web.archive.org/web/20151202062833/https://www.midwest-laser.com/Products/argon-lasers.html
1088	U.S. Patent No. 12,174,106 B2 to Yong Qin Chen (filed December 22, 2021, issued December 24, 2024) (“ 106 patent ”)
1089	Excerpts from Newport Catalog, including Focusing and Collimating pp. 479-481 and Optics Glossary pp. 500-505 available at http://rpdata.caltech.edu/courses/aph162/2007/Protocols/Optics/e3613_Focusing-and-Collimating.pdf and http://rpdata.caltech.edu/courses/aph162/2007/Protocols/Optics/e3878_Optics-Glossary.pdf
1090	Newport Catalog, <i>Precision Laser & Optics Products</i> , available at http://rpdata.caltech.edu/courses/aph162/2007/Protocols/Optics/Newport%20Catalog.pdf
1091	U.S. Patent No. 10,330,582 B2 to Yong Qin Chen (filed June 30, 2017, issued June 25, 2019) (“ 582 patent ”)
1092	Jean-Luc Néron, Application Note Fiber Coupling Efficiency Calculation, Doric Lenses Inc., (December 5, 2005), https://www-eng.lbl.gov/~shuman/NEXT/CURRENT_DESIGN/TP/FO/fiber_coupling_efficiency_doric_lenses.pdf
1093	Thorlabs, Single Mode Fiber, https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=949
1094	Thorlabs, 0.22 NA Silica Core, Glass Clad Multimode Optical Fiber, Step Index, https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=6838
1095	Thorlabs, 0.39 NA TECS-Clad Multimode Optical Fiber, Step Index, https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=6845
1096	Beckman Coulter, Spectral Flow Cytometry: A Detailed Scientific Overview, https://www.beckman.com/resources/reading-material/application-notes/spectral-flow-cytometry-detailed-scientific-overview
1097	Thermo Fisher Scientific, Electronics of a Flow Cytometer, https://web.archive.org/web/20200919201221/https://www.thermofisher.com/us/en/home/life-science/cell-analysis/cell-analysis-learning-center/molecular-probes-school-of-fluorescence/flow-cytometry-basics/flow-cytometry-fundamentals/electronics-flow-cytometer.html

List of Exhibits

Exhibit No.	Description of Document
1098	Claudio Ortolani, <i>Chapter 22 Non-Conventional Flow Cytometry</i> , Flow Cytometry Today, pp. 497-522 (2023)
1099	Beckman Coulter Life Sciences Launches Industry-First Modular Spectral Flow Cytometry Solution (March 18, 2025), https://www.beckman.com/news/beckman-coulter-life-sciences-launches-industry-first-modular-spectral-flow-cytometry-solution
1100	Beckman Coulter, CytoFLEX mosaic Spectral Detection Module, https://www.beckman.com/flow-cytometry/research-flow-cytometers/cytoflex-mosaic
1101	U.S. Patent No. 7,280,204 B2 to Joseph Paul Robinson et al. (filed April 8, 2005, issued October 9, 2007) (“ Robinson ”)
1102	Howard M. Shapiro and Michael Hercher, <i>Flow Cytometers Using Optical Waveguides in Place of Lenses for Specimen Illumination and Light Collection</i> , Cytometry, 7:221-223 (1986)
1103	Markman Hearing Transcript from <i>Beckman Coulter, Inc. v. Cytek Biosciences, Inc.</i> , C.A. No. 24-945 (D. Del. August 21, 2025)
1104	Newport, <i>Technical Note: Fiber Optic Coupling</i> , (2017), https://web.archive.org/web/20171018084228/https://www.newport.com/n/fiber-optic-coupling
1105	Markman Hearing Transcript from <i>Beckman Coulter, Inc. v. Cytek Biosciences, Inc.</i> , C.A. No. 24-945 (D. Del. September 17, 2025)
1106	First Amended Complaint filed in <i>Beckman Coulter, Inc. v. Cytek Biosciences, Inc.</i> , C.A. No. 1:24-cv-00945 (D. Del. Jan. 9, 2025), D.I. 42
1107	U.S. Provisional Application 61/911,859 to Yong Qin Chen (filed December 4, 2013)

I. INTRODUCTION

Petitioner respectfully requests post-grant review (“PGR”) of claims 1-3, 5-14, 16-18, 20-22, 26-30 of U.S. Patent No. 12,174,107 B2 (“’107” or “’107 patent”) (collectively, the “Challenged Claims”).

The ’107 written description discloses decades-old demultiplexing technology from the analogous field of optical communications to the detection optics in a flow cytometer. This WDM—wavelength division [de]multiplexer—separates fluorescent and scattered light, collected from a flow cell and transported through an optical fiber, into distinct color bands (i.e., wavelength ranges) for photodetection through use of a series of filters, mirrors, and avalanche photodiode detectors (APDs).

The ’107 patent purports that “fundamental reasons preventing the use of small area APD in fluorescence detection instrumentation is the well-known theorem of etendue conservation[.]” (’107, 44:33-35.) This apparently is because “fluorescence [*sic*] 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.” (*Id.*, 44:35-39.) The ’107 thus targets “a technology capable of collimating a large etendue light beam over an extended distance without significantly expanding the beam diameter would be highly desirable” because it would “enable a WDM like device for fluorescence light

detection with characteristics comparable to low noise semiconductor detectors.”

(*Id.*, 44:47-53.) What follows are WDMs with collimating optical elements that project collimated beams through an unit-magnification imaging relay architecture. (’107, 2:36-45, 4:46-67, 5:8-34, 6:53-64, 8:65-9:2, 9:63-10:10, 20:31-46, 21:8-23, 21:52-60, 46:1-3, FIG. 25.)

The Challenged Claims overreach on this limited disclosure and are invalid under § 112. **First**, the independent claims omit a collimating optical element projecting a collimated beam—an essential feature of the purported invention. (See Grounds 1-2.) But the written description does not support or enable **any** WDM that only includes filters, mirrors, and APDs without a collimating optical element. **Second**, Patent Owner broadly recites an “optical fiber” in Claim 1 when the written description fails to support or enable a single mode optical fiber. (See Grounds 3-4.) **Third**, multiple claims are overbroadly trying to cover non-conventional spectral flow cytometry but the intrinsic evidence indicates that the ’107 patent only supports conventional flow cytometers that use conventional binning and compensation techniques for emission peak wavelengths of fluorochromes. (See Grounds 5-7.)

In addition, the claimed WDM configuration and use of APDs had been publicly disclosed in flow cytometry before the time of the alleged invention, including the current Patent Owner’s publications. (EX1009.) Petitioner logically combines and applies these well-known features from the prior art to demonstrate

the obviousness of the Challenged Claims in Grounds 8-11.

II. MANDATORY NOTICES UNDER §42.8(A)(1)

A. Real Party-In-Interest under §42.8(b)(1)

Cytek Biosciences, Inc. (“Petitioner”) is the real party-in-interest.

B. Related Matters under §42.8(b)(2)

The ’107 patent is asserted in pending litigation involving Petitioner and Beckman Coulter, Inc.: *Beckman Coulter, Inc. v. Cytek Biosciences, Inc.*, No. 1:24-cv-00945-CFC-EGT (D. Del.). The Complaint in this related litigation was first served on August 15, 2024 and Petitioner later amended the Complaint to add the ’107 patent on January 9, 2025. (EX1025; EX1026, EX1106.) Petitioner recently challenged several related patents:

- IPR2025-01319: U.S. Patent No. 11,703,443;
- PGR2025-00084: U.S. Patent No. 12,174,106; and
- Reexamination Request (Control No. 90/015,441): U.S. Patent No. 10,330,582.

C. Lead and Back-Up Counsel under §42.8(b)(3)

Petitioner provides the following designation of counsel.

LEAD COUNSEL	BACK-UP COUNSEL
Dustin M. Knight (Reg. No. 76,239) dknight@cooley.com COOLEY LLP	Reuben Chen (<i>Pro hac vice</i> application to be submitted) rchen@cooley.com

Petition for Post-Grant Review of
U.S. Patent No. 12,174,107 B2

LEAD COUNSEL	BACK-UP COUNSEL
ATTN: Patent Group 1299 Pennsylvania Ave. NW, Suite 700 Washington, DC 20004 Tel: (202) 776-2066 Fax: (202) 842-7899	COOLEY LLP ATTN: Patent Group 1299 Pennsylvania Avenue NW Suite 700 Washington D.C. 20004 Tel: (650) 843-5480 Fax: (650) 849-7400
	Adam Pivovar (<i>Pro hac vice</i> application to be submitted) apivovar@cooley.com COOLEY LLP ATTN: Patent Group 1299 Pennsylvania Ave. NW, Suite 700 Washington, DC 20004 Tel: (202) 842-7889 Fax: (202) 842-7899
	HanByul Chang, J.D., Ph.D. (<i>Pro hac vice</i> application to be submitted) hanbyul.chang@cooley.com COOLEY LLP ATTN: Patent Group 1299 Pennsylvania Ave. NW, Suite 700 Washington D.C. 20004 Tel: (650) 843-5405 Fax: (650) 849-7400

D. Service Information

This Petition is being served by Federal Express to the attorney of record for the '107 patent, 129381 – NORTON ROSE FULBRIGHT US LLP – BCI, 98 San Jacinto Blvd., Suite 1100, Austin, TX 78701. This Petition is also being served on litigation counsel for Patent Owner identified in the Certificate of Service.

Petition for Post-Grant Review of
U.S. Patent No. 12,174,107 B2

Please send all correspondence to the lead and backup counsel at the addresses shown above. Petitioner consents to electronic service at the email addresses provided above for lead and back-up counsel.

III. FEE PAYMENT

Petitioner requests review of 24 claims, with a \$67,015 payment.

IV. REQUIREMENTS FOR POST GRANT REVIEW

A. Grounds for Standing

Petitioner certifies that the '107 patent is available for PGR, and that Petitioner is not barred or otherwise estopped. 35 U.S.C. § 321(c); 37 C.F.R. § 42.202(a). This Petition is being filed within 9 months of the '107 patent's issuance (issued December 24, 2024), and, for the reasons stated in Section IX, the '107 is entitled to an effective filing date no earlier than its non-provisional utility application filing date, September 3, 2024.

B. Identification of Challenge and Statement of Precise Relief Requested

Petitioner respectfully requests PGR institution based on:

Ground	Claim(s)	Basis for Challenge
1	1-3, 5-14, 16-18, 20-22, 26-30	Lack of written description for “wavelength division multiplexer (WDM)”
2	1-3, 5-14, 16-18, 20-22, 26-30	Lack of full scope enablement for “wavelength division multiplexer (WDM)”
3	1-3, 5-14	Lack of written description for “optical fiber”
4	1-3, 5-14	Lack of full scope enablement for “optical fiber”

Petition for Post-Grant Review of
U.S. Patent No. 12,174,107 B2

Ground	Claim(s)	Basis for Challenge
5	9, 29	Lack of written description for “the WDM is capable of detecting a substantially full spectrum of visible light”
6	9, 29	Lack of enablement for “the WDM is capable of detecting a substantially full spectrum of visible light”
7	30	Lack of written description for “or more”
8	1-3, 5-14, 16-18, 20-22, 26-30	Unpatentable under 35 U.S.C. § 103 as obvious over Chandler and Goodman
9	13, 14, 17, 18	Unpatentable under 35 U.S.C. § 103 as obvious over Chandler, Goodman, and Hamamatsu
10	1-3, 5-14, 16-18, 20-22, 26-30	Unpatentable under 35 U.S.C. § 103 as obvious over Oostman, Goodman, and Frazier
11	13, 14, 17, 18	Unpatentable under 35 U.S.C. § 103 as obvious over Oostman, Goodman, Frazier, and Hamamatsu

Submitted with this Petition is the Declaration of Fedor A. Ilkov, Ph.D. [EX1002], a qualified technical expert. (EX1002, ¶¶1-9, App. A.)

C. Considerations Under §§ 314(a) and 325(d)

Discretionary denial is inappropriate, as Petitioner will explain in its opposition to any discretionary denial brief that Patent Owner elects to submit under the USPTO’s March 26, 2025 Interim Processes for PTAB Workload Management.

V. TECHNOLOGY BACKGROUND

A. Flow Cytometers

Flow cytometers are optical instruments capable of detecting and measuring

particles, cells, or beads flowing through a flow channel. In a flow cytometer, light sources, such as one or more lasers, illuminate the sample flowing through a flow channel at different points within the flow channel. (EX1002, ¶40.) Particles, cells, or beads are often tagged with fluorescent markers, such as fluorescent dyes, that emit light of certain wavelengths when illuminated by one or more lasers. (*Id.*) Laser light incident on the particles, cells, or beads can be either scattered or absorbed by the fluorescent markers; the absorbed light can result in a fluorescence emission from the fluorescent markers. (*Id.*) The scattered light and the fluorescent light can be collected, detected, and with detected signals digitized for further quantitative analysis of the analyzed particles, cells, or beads. (*Id.*; EX1004, pp.010, 016-017.)

Fluorescence detection-based flow cytometers, like the one described in the '107 patent, typically comprise four subsystems: (1) illumination subsystem with optics and electro-optics (e.g., a laser or arc lamp); (2) a fluidic subsystem, including the flow channel permitting samples to flow in suspension to an illumination site; (3) collection subsystem with optics, such as an objective lens, to collect and focus the scattered and/or fluorescent light; and (4) detection subsystem with optics and electro-optics that separate the collected light into multiple color bands and direct those bands into photodetectors for further analysis. (EX1002, ¶41; EX1004, pp.016-024.) A general schematic for a flow cytometer is shown below:

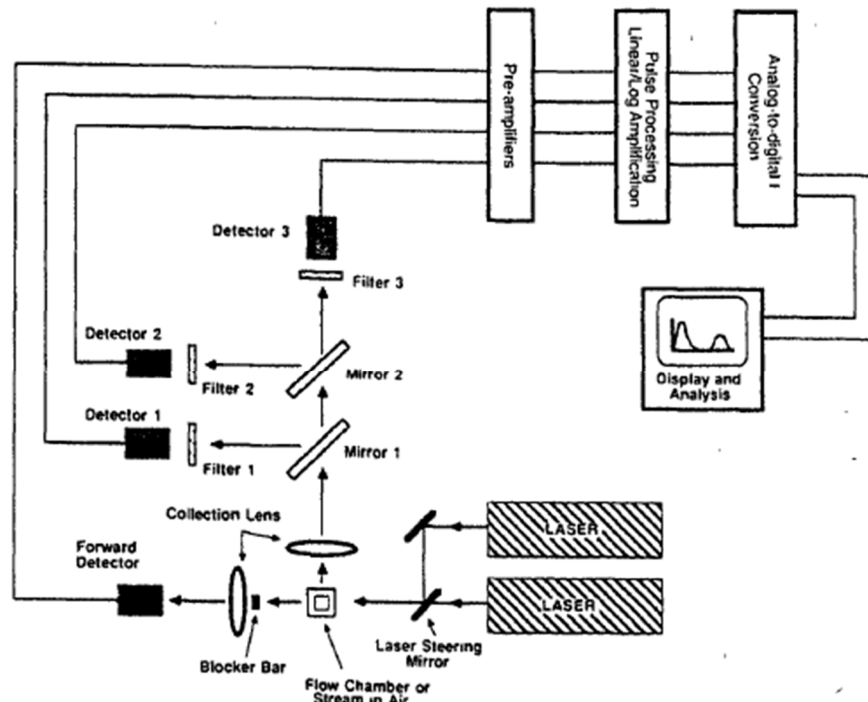


Figure 4 A generalized flow cytometer system.

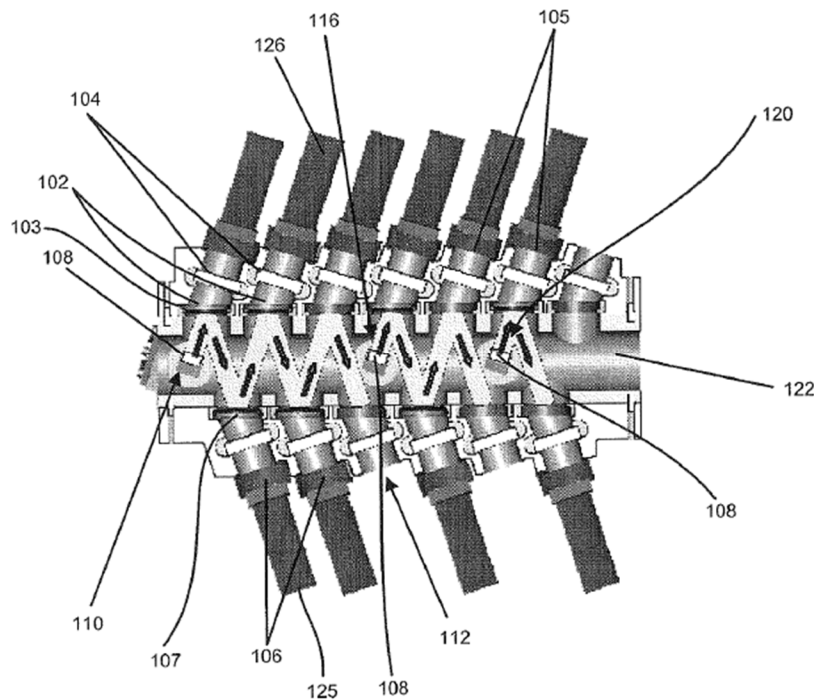
(EX1004, p.017.)

B. Wavelength Division Demultiplexers

Detection in fluorescence detection-based flow cytometers typically involves spectrally separating collected light into multiple color bands (i.e., wavelength ranges) and then directing those color bands into separate photodetectors. A POSA would have known that a “wavelength division [de]multiplexer” or “WDM” refers to the optical components that demultiplex light into those color bands. (EX1002, ¶42.) WDMs accomplish spectral separation through the use of filters, mirrors, and lenses to separate light into color bands and focus those color bands into photodetectors. (EX1002, ¶43.)

Multiple WDM configurations existed in the art by 2011. (EX1002, ¶¶43-44.) Multiple prior art references disclosed a well-known linear branch configuration of WDMs. (EX1006, FIG. 1; EX1007, p.082 (Fig. 1-21); EX1008, FIG. 1, [0017].) The '107 also describes a WDM “star configuration” disclosed by Oostman [EX1005] (*see* '107, 5:23-30).

The '107's zig-zag WDM was also a well-known demultiplexing configuration in flow cytometry. For example, Patent Owner's own disclosures in Frazier [EX1009] show optical fibers that transport light collected from a flow cell, where the light is collimated by a lens and then spectrally separated for detection by zig-zagging between arrays of filters and mirrors.



(Frazier, FIG. 1; *see also id.*, 4:14-5:17, 7:3-17, 7:34-61; EX1002, ¶45.)

This zig-zag configuration was commonly used for both single mode and multimode optical fiber waveguides in the optical communication industry, which a POSA would have considered an analogous field to flow cytometry. (EX1002, ¶46.) The '107 patent admits that “WDM techniques well-established in the optical communication industry can be readily adapted for fluorescence light detection[,]” indicating that the optical communication industry is an analogous field of art. ('107, 4:62-5:5; EX1002, ¶47.) A POSA would have expected such, particularly because the WDMs in both fields are “almost identical in function and architecture,” addressing the same set of problems in light demultiplexing and detection. ('107, 44:25-33.)

Numerous examples from the optical communication industry disclose a zig-zag WDM configuration. (EX1002, ¶¶47-49 (citing EX1011-EX1015).) Goodman [EX1016], described below, is an example of this zig-zag WDM configuration that was already well-established in the art by 2011. (EX1002, ¶49.)

C. Avalanche Photodiodes (APDs) in Flow Cytometry

The '107 patent acknowledges that flow cytometers can use avalanche photodiodes (APDs), known semiconductor detectors. ('107, 43:50-61; EX1002, ¶50.) APDs had been used in fluorescence light detection for flow cytometers for almost twenty years before the date of the alleged invention; their benefits were well-known; and technical hurdles to their implementation had long been overcome.

(EX1002, ¶¶52-53 (citing EX1031, 1032, 1033, 1007).)

As early as 1994, numerous sources disclosed use of APDs for fluorescence detection in flow cytometers. (EX1002, ¶¶54-58 (citing EX1035-1042).) These references recognized the multiple advantages and benefits of using APDs over photomultiplier tubes (PMTs) or other types of detectors. (EX1002, ¶¶54-58.) Specifically, by 2011, the APD was well-known as an “excellent photo-counting device, whose features include the following: excellent photon detection efficiency; high gain 10^5 - 10^6 ; room temperature operation; insensitive to magnetic fields; excellent time resolution, that are important for the laboratory-built optical system.” (EX1039, p.002; *see also* EX1032, p.001; EX1035, 6:10-13 (superior in weak fluorescent light environment); EX1036, pp.003, 006; EX1037, p.009 (high quantum efficiency in IR region); EX1038, p.010 (better signal-to-noise ratio as PMTs in red and near IR spectral regions); EX1002, ¶¶55-57.)

With advances in APD technology and their known benefits, use of APD photodetectors in flow cytometers arose with more frequency in commercial systems and the patent literature, including for Patent Owner. (EX1002, ¶¶58-59.) Frazier [EX1009], discussed with respect to Grounds 10 and 11, recognizes that its zig-zag WDM could be adapted to use APDs. (Frazier, 4:19-21.) Other pre-2011 flow cytometry patents similarly discuss use of APDs for fluorescence detection in flow cytometers. (*See, e.g.*, EX1040, 13:5-19; EX1041, [0020]; EX1042, Abstract.)

Researchers began swapping out PMTs for APDs in commercial flow cytometers without difficulty. (EX1036 (Becton Dickinson); EX1037, p.001; EX1002, ¶¶55-56.)

Commercial flow cytometers with APDs were also available by 2011. (EX1002, ¶59.) Partec, Optoflow, and Becton Dickinson sold flow cytometers using APDs as early as 2003. (EX1007, p.155; EX1054, p.002.) Luminex Corporation also sold several flow cytometer systems (e.g., Luminex 100, Luminex 200, and Luminex Flexmap 3D System) that implemented APD detector arrays, obtaining patent rights to the technology as early as the late 1990s. (See EX1002, ¶59 (citing EX1043-EX1050).) Chandler [EX1051], discussed with respect to Grounds 8 and 9, is a Luminex patent that implements APDs within a flow cytometer.

VI. OVERVIEW OF THE '107 PATENT

The '107 patent recites WDM configurations that pass light through a collimating optical element that projects a collimated beam into a cascaded relay architecture of filters and mirrors while maintaining the beam's size throughout. (See, e.g., '107, 2:36-45, 4:46-67, 5:8-34, 6:53-64, 8:65-9:2, 9:63-10:10, 20:31-46, 21:8-23, 21:52-60,.) FIG. 25 represents an optical ray trace of the collimated beam for an exemplary six-port WDM using a zig-zag configuration.

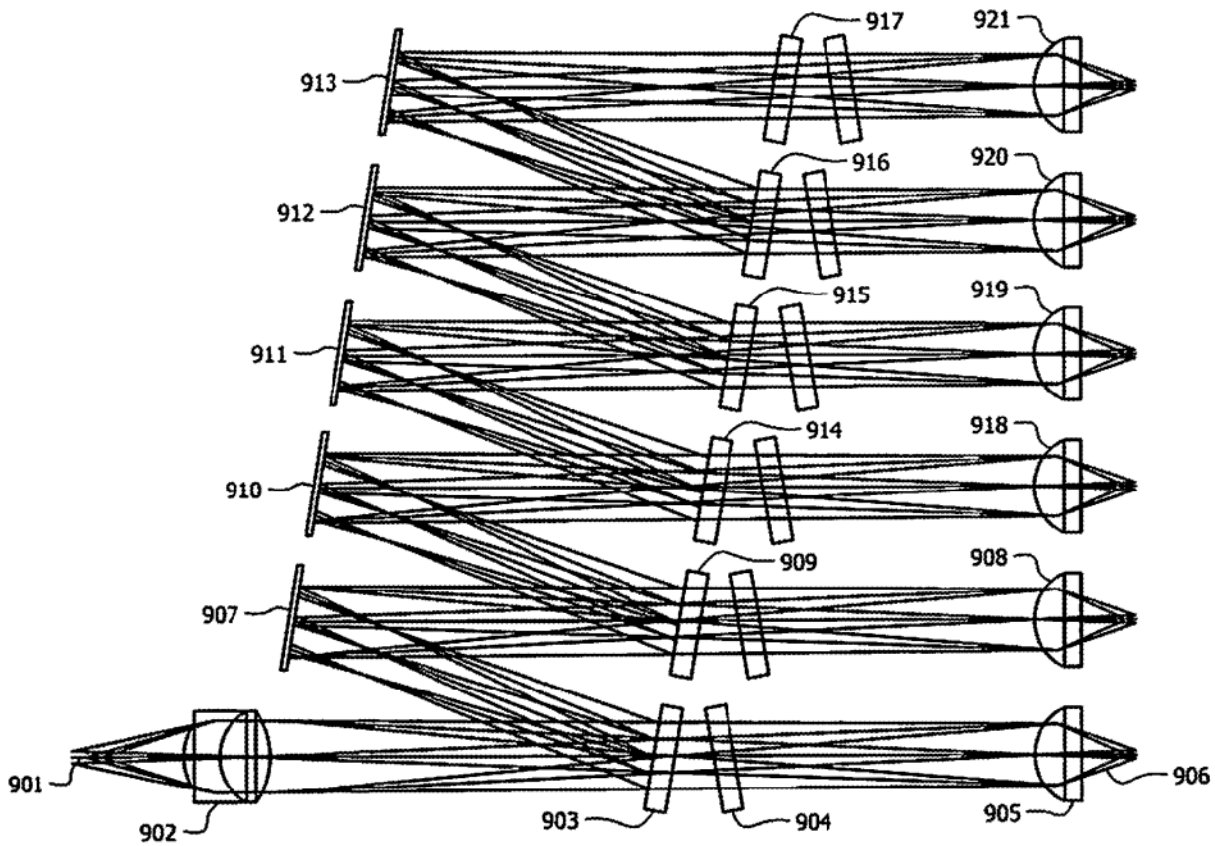


FIG. 25

(*Id.*, FIG. 25.) Dichroic filters **903**, **909**, **914**, **915**, **916**, **917** separate the collimated beam passing through collimating optical element **902** into multiple color bands (i.e., wavelength ranges), “pass[ing] the color band of interest” to a focusing lens **905** to focus light into a photodetector. (*Id.*, 45:23-32, FIG. 25.) The remaining color bands in the collimated light incident on dichroic filter **903** are reflected toward and impinge on a next relay element, e.g., a concave mirror **907**. (*Id.*, 45:35-36.) The process continues to separate and process additional color bands in the collimated beam as the beam zig-zags between mirrors **907**, **910**, **911**, **912**, **913** and the dichroic filters **903**, **909**, **914**, **915**, **916**, **917**. (*Id.*, 45:63-46:1.)

VII. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art (“POSA”) as of September 2024 would have had at least a B.S. in physics, mechanical engineering, electrical engineering, or optical engineering (or equivalent degree) and at least two years of experience in designing optical and electro-optical systems, including for flow cytometer applications. A person could also have qualified as a POSA with a combination of (1) more formal education (such as a doctoral degree) and less technical experience, or (2) less formal education and more technical or professional experience. (EX1002, ¶14.)

VIII. CLAIM CONSTRUCTION

Petitioner and Patent Owner have exchanged proposed constructions in the underlying district court litigation. (EX1027.) The district court has construed certain terms, (*see* EX1103, pp.71-75, 133-135, 182-183, 192-193) including the term “focusing lens” in Claim 13, which is accorded its plain meaning (i.e., “lenses that capture and converge light”), and the term “portion” in Claims 1 and 16, meaning a “subset of the spectrum of wavelengths of light.” (EX1105, p.033:23-p.034:19, p.092:21-24.) For the remaining disputes, the claims are invalid whether the Board adopts the constructions proposed by Patent Owner or Petitioner, where a party proposes a construction instead of alleging a term is indefinite. (EX1002, ¶¶68, 71.)

IX. PRIORITY DATE OF THE CHALLENGED CLAIMS

The '107 patent is PGR eligible because the Challenged Claims are entitled to a priority date no earlier than September 3, 2024. The '107 patent is a “transitional” application because it was filed after the March 16, 2013 effective date of the AIA but claims priority to an application filed before that date. The '107 patent is a continuation of U.S. Patent No. 12,174,106 (“’106 patent”) [EX1088], which is a continuation of 11,255,772 (“’772 patent”) [EX1078], which is a divisional of U.S. Patent No. 9,746,412 (“’412 patent”) [EX1070], which is a continuation-in-part (“CIP”) of international patent application No. PCT/US2013/043453 (“PCT App.”) [EX1071].¹

¹ The '107 patent also purports to claim priority to multiple provisional patent applications, including four pre-AIA provisional applications. These provisional applications do not provide written description support for “WDM,” “optical fiber,” or the limitations recited in Claims 9, 29, and 30 for the same reasons that the '106 patent, '772 patent, '412 patent, and PCT App. lack written description support for the full scope of these claim elements, as described below.

Petition for Post-Grant Review of
U.S. Patent No. 12,174,107 B2



Grounds 1, 3, 5, and 7, incorporated here, explain how at least one claim of the '107 patent lacks written description support; the provisional applications fail to supply written description support for the same reasons. Patent Owner is only entitled to

Petition for Post-Grant Review of
U.S. Patent No. 12,174,107 B2

claim priority to these claims as of the '107's filing date, September 3, 2024.

LizardTech, Inc. v. Earth Res. Mapping Inc., 424 F.3d 1336, 1345 (Fed. Cir. 2005);

Purdue Pharma L.P. v. Faulding Inc., 230 F.3d 1320, 1323 (Fed. Cir. 2000).

Independent of the reasons in Grounds 1, 3, 5, and 7, the '107 patent is PGR eligible because (1) recited limitations of claims 14 and 18 are supported only by new matter added to the specification with the '412 patent (filed on November 26, 2014); and (2) recited limitations of claims 6 and 22 are first supported in the PCT App filed on May 30, 2013. (EX1002, ¶¶78-80.)

A. Claims 14 and 18 Are First Supported by the '412 Patent's New Matter

Claims 14 and 18 of the '107 patent are not entitled to a priority date earlier than November 26, 2014 because the earliest written description support for the limitation “the diameter of the spot is less than 1 mm” originates from new matter added to the '412 patent, a CIP of the post-AIA PCT App. (*See* '412, 9:46-60, 12:35-38, 12:39-44, 20:12-27, 20:34-37, 20:38-43, 20:56-21:4, 21:11-14, 21:15-20, 57:23-26, 58:11-13.) “Claims containing any matter introduced in the CIP are accorded the filing date of the CIP application.” *Waldemar Link, GmbH & Co. v. Osteonics Corp.*, 32 F.3d 556, 558 (Fed. Cir. 1994); *see also Nat. Alts. Int'l, Inc. v. Iancu*, 904 F.3d 1375, 1383 (Fed. Cir. 2018). These disclosures are absent from the PCT App. or any pre-AIA provisional application, and nothing in any of those applications would have indicated that the inventor had possession of the subject matter of Claims

14 and 18 prior to the November 26, 2014 filing date of the '412 patent. (EX1002, ¶79.)

B. Claims 6 and 22 Are First Supported by the PCT App.

Claims 6 and 22 recite a “laser [that] is configured to emit blue light, yellow-green light, violet light, or ultraviolet light” that finds written description support for the first time in the PCT App. filed on May 30, 2013. (*See* EX1071, p.009 (2:13-26).) This support is absent from any pre-AIA provisional application to which the '107 patent claims priority, and nothing in any of those pre-AIA provisional applications would have indicated that the inventor had possession of the subject matter of Claims 6 and 22 prior to the May 30, 2013 filing date of the PCT App. (EX1002, ¶80.) A U.S. provisional application No. 61/911,859 with support was filed on December 4, 2013, after the March 16, 2013 effective date of Section 3 of the AIA (First-Inventor to File) and after the filing date of the PCT App. (*Id.*, n.2; *see also* EX1107.)

X. GROUNDS 1-7: THE CHALLENGED CLAIMS ARE INVALID UNDER 35 U.S.C. § 112

To be valid, a patent claim must have adequate written description and be enabled by the patent's specification.

To satisfy the written description standard, a patent's written description must sufficiently convey “to a person of skill in the art that the patentee had possession of

the claimed invention at the time of the application, i.e., that the patentee invented what is claimed.” *LizardTech*, 424 F.3d at 1345; *Purdue Pharma*, 230 F.3d at 1323.

To satisfy the enablement standard, the specification may not require more than a “reasonable amount of experimentation” to practice “the full scope” of the “invention as defined by its claims.” *Amgen Inc. v. Sanofi*, 598 U.S. 594, 610, 612 (2023). “A patentee who chooses broad claim language must make sure the broad claims are fully enabled[,]” including as to each claimed embodiment. *Sitrick v. Dreamworks, LLC*, 516 F.3d 993, 999 (Fed. Cir. 2008) (finding claim invalid where a claimed embodiment was not enabled); *see also, e.g., Trs. of Bos. Univ. v. Everlight Elecs. Co.*, 896 F.3d 1357, 1363–64 (Fed. Cir. 2018) (same); *Liebel-Flarsheim Co. v. Medrad, Inc.*, 481 F.3d 1371, 1378–79 (Fed. Cir. 2007) (same); *Auto. Techs. Int’l, Inc. v. BMW of N. Am., Inc.*, 501 F.3d 1274, 1281–85 (Fed. Cir. 2007) (same); *AK Steel Corp. v. Sollac & Ugine*, 344 F.3d 1234, 1243–44 (Fed. Cir. 2003) (same).

For the reasons detailed below, the Challenged Claims are invalid for insufficient written description and/or lack of enablement.

A. Ground 1: The Challenged Claims Recite a “WDM” that Lacks Written Description Support

The Challenged Claims are invalid under § 112 because the recited “wavelength division (de)multiplexer” (“WDM”) lacks adequate written description support absent a “collimating optical element” that projects a collimated beam. The Federal Circuit has held claims are invalid for lack of written description where they

omit an element that is essential to the invention as described in the specification. *Gentry Gallery, Inc. v. Berkline Corp.*, 134 F.3d 1473, 1479-80 (Fed. Cir. 1998) (invalidating claims directed to a sofa that did not limit the location of controls to a console despite the specification only describing console-located controls).

Here, while written description support exists for a WDM that uses a “collimating optical element” to project a collimated beam through a cascaded unit-magnification relay architecture, no written description exists for the broader genus of WDM comprising filters, mirrors, and APDs recited in the ’107 claims. A “collimating optical element” is necessary to project a collimated beam through the claimed WDM configuration and render it operable. (EX1002, ¶82.)

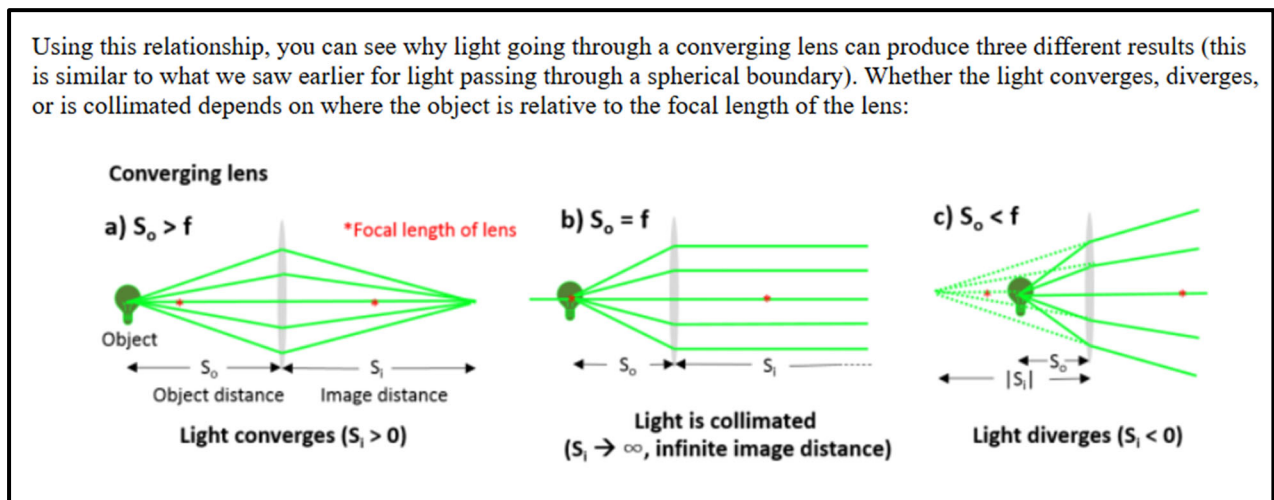
1. The Omitted “Collimating Optical Element” that Projects a “Collimated Beam” is Critical to Operate the Claimed WDM

The ’107 specification teaches the claimed WDM separates fluorescent light into color bands using a specific configuration that *requires* use of a “collimating optical element” that projects a “collimated beam” throughout a cascaded unit-magnification image relay architecture. (EX1002, ¶93.) The written description makes repeated reference to using a “collimating optical element” and it is featured in every WDM embodiment. (*Id.*, ¶¶93-95.) This architecture is necessary in part because the claimed WDM uses APDs, which have high noise sensitivity. (*See* ’107, 44:33-53; *see also* EX1002, ¶96.) A POSA at the time of the invention would have understood this configuration to require the use of a “collimating optical element”

to project a “collimated beam” through a series of mirrors and filters to enable using noise-sensitive APDs. (EX1002, ¶93.)

a. Technical Background on Light Beam Properties

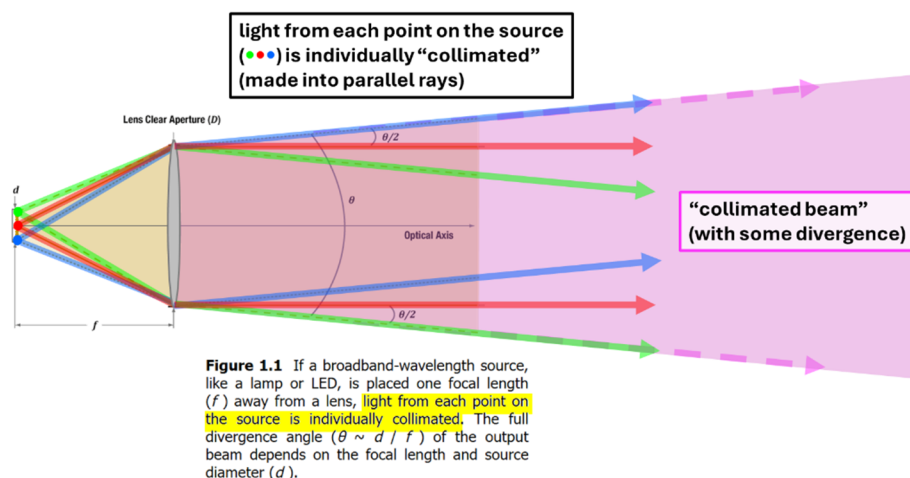
Light beam rays either (1) converge (i.e., the proximity of the rays increases over distance); (2) are collimated (i.e., the proximity of the rays remains constant over distance); or (3) diverge (i.e., the proximity of the rays decreases over distance). (EX1007, p.110; *see also* EX1023, pp.009-010; EX1002, ¶¶84-85.) To produce each of these types of light beams, a POSA would have known to manipulate the distance between a light source relative to the focal length of a lens as shown below (where f is the lens’s focal length, and S_o is the object’s distance from the lens):



(EX1023, pp.009-010.) Placing an object at a distance from the lens greater than the focal length results in converging light rays; placing the object at a distance equal to the focal length results in collimated/parallel rays; and placing the object at a

distance less than the focal length results in diverging rays. (EX1007, p.110; EX1090, at p.006; EX1066, p.001; EX1002, ¶¶86-89.)

Notably, a collimated beam from a real light source necessarily results in *some* divergence. This is because a real light source does not comprise a single point that can be placed at exactly the focal length of a lens. Rather, a real light source is defined by a specific diameter (d), which when centered on the optical axis at the focal length (f) of a lens (D), will necessarily position portions of the area within the diameter of the light source beyond the exact focal length of the lens along the optical axis. (EX1065, p.003; see also EX1066, pp.001-002; EX1002, ¶¶90-92.) Thus, real light sources “resemble groupings of multiple point sources[,]” (EX1065, p.003), such that a collimated beam comprises “light from each point on the source [that] is individually collimated[,]” (EX1065 (Fig. 1.1. caption)), as shown in the following annotated image where each point on the source (●●●) is “individually collimated”:

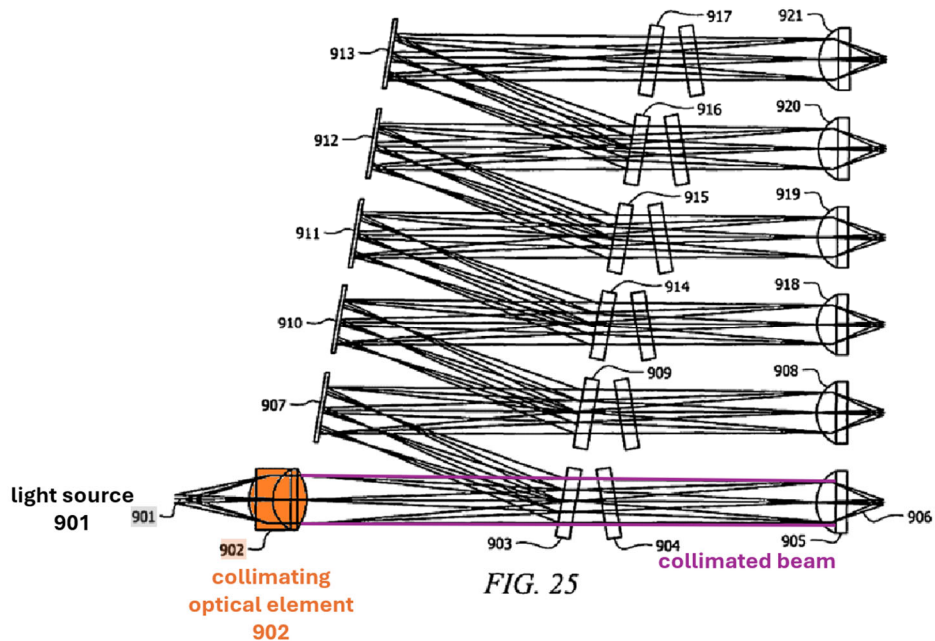


(EX1065, p.003 (annotations added); see also EX1066, p.001; EX1002, ¶¶90-92.)

b. The Omitted “collimating optical element” That Projects a “collimated beam” is Required to Operate the Claimed WDM

The '107 recognizes that while “efficient color separation can only be accomplished economically with [a] collimated light beam,” technical hurdles exist to using a collimated beam with small area APDs. ('107, 44:33-47.) The '107 targets a “highly desirable” technology to “collimat[e] a large etendue light beam over an extended distance without significantly expanding the beam diameter” because it would “enable a WDM like device for fluorescence light detection with characteristics comparable to low noise semiconductor detectors.” (*Id.*, 44:47-53.)

The '107 written description repeatedly describes using a “collimating optical element” to project a collimated light beam through a unit-magnification relay architecture. (*See* '107, 9:63-10:10, 20:31-46, 21:8-23, 20:52-60, 45:10-26, 46:34-41, FIGs. 25, 27, 28; EX1002, ¶95.) The “collimating optical element” appears in every disclosed embodiment, as shown in FIG. 25 below.



(*Id.*, FIG. 25 (annotated).) A POSA would thus have understood that the '107's goal to solve "collimating a large etendue light beam over an extended distance" requires use of a "collimating optical element" to collimate fluorescent light received into a WDM to begin with. (*Id.*, 44:47-53; *see also* EX1002, ¶96.)

And a POSA at the time of the '107 invention would not have understood the inventor to be in possession of any WDM other than one comprising a "collimating optical element" to project a collimated beam through the unit-magnification image relay architecture. (EX1002, ¶¶96, 106.) The '107 written description only discloses WDM embodiments using a "collimating optical element" to project a collimated

light beam.² (*Id.*) Unsurprisingly, the '107 teaches *against* a WDM configuration using a non-collimated beam, let alone one without a collimating optical element, explaining that “efficient color separation can only be accomplished economically with [a] collimated light beam” and addressing a problem with collimating fluorescent light from an extended light source. ('107, 44:33-53; EX1002, ¶¶96, 107.)

2. The Prosecution History Confirms a “Collimating Optical Element” that Projects a “Collimated Beam” is Critical

The prosecution history for the '107 patent's family confirms that a “collimating optical element” that projects a collimated beam is critical to the claimed WDM. The claims of every application that preceded the '107 patent in its priority chain that recite a WDM includes the limitation of a “collimating optical element” that projects a collimated beam. (PCT App., pp.059, 083; EX1070, cl. 1; EX1029, pp.029-034; EX1091, cl. 1; EX1078; EX1088, cl. 1, 13, 18; *see also* EX1002, ¶¶97-103.)

² The specification relabels “collimating optical element” in added disclosures to an “imaging optical arrangement” in FIG. 25, but the functional description of that “imaging optical arrangement” is the same as for a “collimating optical element” – i.e., projecting a collimated beam through the unit-magnification relay architecture. (*See, e.g.*, '107, 57:12-21.)

However, the Challenged Claims broadly claim a WDM comprising an “[array / plurality] of mirrors,” an “[array / plurality] of filters,” and an “[array / plurality] of avalanche photodiodes (APDs)” without reciting a “collimating optical element.” (*See* ’107, cls. 1, 16.) Thus, a POSA would have understood the Challenged Claims to recite a WDM that would operably relay a light beam without a “collimating optical element,” meaning that it could relay diverging, converging, and collimated light beams. (EX1002, ¶105.) Thus, the Challenged Claims are invalid for lack of written description as to the claimed WDM, which broadly recites a WDM that lacks a “collimating optical element” and is configured for use with non-collimated light beams. (EX1002, ¶¶105-108.)

B. Ground 2: The Challenged Claims Lack Full Scope Enablement for a “WDM” Without a “Collimating Optical Element” That Projects a “Collimated Beam”

The Challenged Claims are not fully enabled because they broadly recite any WDM with arrays of filters, mirrors, and APDs, including WDMs that project and relay *any* type of light beam in *any* filter/mirror configuration. But the specification only teaches a WDM that uses a collimating optical element to relay a collimated beam through a unit-magnification image relay architecture, the purported “only” way to achieve economical and efficient color separation of fluorescent light.

(EX1002, ¶109.) Applying the *Wands* factors demonstrates that the claimed WDM is not fully enabled. *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988).

Wands Factor No. 1 – Breadth of the Claims. The independent claims (and of what must be enabled) broadly recite WDMs that include configurations without a collimating optical element and that do not project a non-collimated light beam. (EX1002, ¶111.) The breadth of the claims would extend to, and thus require enablement for, WDM embodiments, in any conceivable configuration, that propagate an initially collimated beam, a non-focused (diverging) beam, or a focused (converging) beam through the relay architecture. The '107 specification's teachings are directed toward a cascaded unit-magnification relay architecture using a collimated beam, yet the claims omit any collimating optical element, an essential feature in the purported invention. (*Id.*)

Wands Factors Nos. 2 and 4 – Field or Nature of the Invention and Level of Ordinary Skill. The field of the invention is flow cytometry, fiber optics, and wavelength demultiplexing and detection. (*See* '107, 1:42-45, 2:7-10, 2:40-45.) The '107 refers to various subassemblies in the claimed flow cytometer, including a WDM that comprises a collimating optical element and propagates a collimated beam through a unit-magnification image relay architecture. (*See, e.g., id.*, 4:46-65.) Applying the POSA definitions provided by either of the parties (*see* Section VII; EX1081) would not alter this *Wands* factor given the overall lack of teaching

Petition for Post-Grant Review of
U.S. Patent No. 12,174,107 B2

by the specification and excessive experimentation required to practice these overbroad claims. (EX1002, ¶112.)

Wands Factors Nos. 6 and 7 – Guidance from the Specification and Working Examples. The '107 specification offers no teaching or working examples of a WDM that does not include a collimating optical element or that does not propagate a collimated light beam. Instead, the specification instructs that “efficient color separation can only be accomplished economically with [a] collimated light beam[.]” ('107, 44:33-53; *see also* EX1002, ¶113.)

Wands Factors Nos. 3, 5, and 8 – State of the Art, Predictability, and Amount of Experimentation. Given the absence of any teaching or working example from the '107 specification for a WDM that lacks a collimating optical element or that propagates a non-collimated beam, a POSA would have had to engage in excessive experimentation to practice the full scope of the claimed WDM. For example, a POSA would have had to understand how to design a WDM where filters in the array of filters receive light directly from the optical fiber for demultiplexing and processing of sufficient signal strength to overcome known technical signal-to-noise issues with APDs. (EX1002, ¶114.) As of 2012, diffraction was necessary to separate wavelengths and enable fluorescence detection systems that used diverging light with APDs. This comprised a fundamentally

different technology based on different optical principles than what the '107 discloses. (*Id.*)

C. Ground 3: Claims 1-3, 5-14 Lack Written Description Support for an “optical fiber”

Claims 1-3, 5-14 lack adequate written description because they broadly recite an “optical fiber.” A POSA would have understood that Claim 1’s “optical fiber” includes both single-mode and multi-mode optical fibers. (*Compare* '107, cl. 1 (“optical fiber”), *with id.*, cl. 16 (“multimode optical fiber”); *see also* EX1002, ¶115.)

The '107 written description provides no disclosures for how its WDM would operate with a single-mode optical fiber but instead *distinguishes* the purported invention from technology that relays light from a single-mode optical fiber.³ (*See* '107, 44:56-45:3; EX1002, ¶117.) The “problem” that the '107 purports to solve is collimating a large etendue light beam from an extended light source (e.g., a multimode optical fiber) without significantly expanding the beam diameter.⁴

³ The written description explains that APDs have only “found wide acceptance ... in optical communication” where only “single mode optical fiber[s]” are supposedly used. ('107, 44:20-25.)

⁴ A single-mode optical fiber has a diameter measured in micrometers and light from such a fiber would likely not have large etendue.

(Compare '107, 44:33-39 , with *id.*, 44:47-50; see also *id.*, 44:56-45:3; EX1002, ¶116.) All embodiments refer to a WDM that demultiplexes and detects fluorescent light from an extended light source like a multimode optical fiber. (See '107, 44:56-61; *id.*, 46:29-30, 46:41-43, 48:39-42.) A POSA would therefore have understood all references to “optical fibers” in the specification to comprise a multimode optical fiber and as teaching away from using a single-mode optical fiber with the claimed WDM.⁵ (EX1002, ¶117.) The repeated disclosures in the '107 written description and related file history show that a POSA would not have recognized the inventor to be in possession of the full scope of a WDM that broadly uses either single or multimode optical fibers, as contemplated by Claim 1. (EX1002, ¶¶118-121.)

D. Ground 4: Claims 1-3, 5-14 Lack Full Scope Enablement for “optical fiber”

Claims 1-3, 5-14 are not enabled as to “optical fiber” because they broadly encompass both single and multimode optical fibers for use with the claimed WDM.

⁵ Notably, the inventor did not consider single mode optical fibers as “extended light sources”—during prosecution for the parent '412 patent, the applicant affirmed that a single mode optical fiber was a “point light source” and claimed that its use in U.S. Publication No. 2004/0165828 to Capewell taught against combining with Oostman, which used a multimode optical fiber. (EX1029, p.084.)

The specification lacks disclosures for using the claimed WDM with a single-mode optical fiber, and a POSA would have had to engage in undue experimentation to implement such a design. (EX1002, ¶122.)

Wands Factor 1 – Breadth of the Claims. Claims 1-3, 5-14 broadly recite “optical fiber,” which a POSA would have understood to include single and multimode optical fibers for use with the claimed WDM. (EX1002, ¶123.) That Claims 1-3 and 5-14 intend to encompass both single and multimode optical fibers is evident from Claim 1’s broad recitation of “optical fiber” compared to Claim 16’s narrower recitation of “multimode optical fiber.”

Wands Factor No. 2 – Field or Nature of the Invention. For the same reasons discussed in *Wands Factor No. 2* in Ground 2, Claims 1-3, 5-14 are not fully enabled. (EX1002, ¶123.)

Wands Factors Nos. 3 and 4 – State of the Prior Art at the Time of the Invention and Level of a POSA. A POSA at the time of the invention would have known to use multimode optical fibers to transport light in a flow cytometer from collection optics to the WDM; however, a POSA would not have known to use a single-mode optical fiber for the same. (EX1002, ¶124.) Because single-mode optical fibers do not meet the requirements of low sensitivity to mechanical manipulation/positioning, high light collection efficiency, and cost efficiency, a

POSA would consider them inferior vis-à-vis multimode optical fibers for use with the claimed WDM. (EX1002, ¶124.)

Wands Factors Nos. 5-8 – Predictability, Guidance from the Specification, Working Examples, and Amount of Experimentation. As described in Ground 3, the '107 specification offers no guidance or working examples to enable a POSA to use the claimed WDM with a single-mode optical fiber—the specification teaches away from such use. (*Supra* n.4; EX1002, ¶125; *see also* Ground 3.)

Absent any teaching or working examples of single-mode optical fiber implementation, a POSA would have had to engage in excessive experimentation to practice the claimed WDM (with APDs) using a single-mode optical fiber due to the technical obstacles of such implementation. The '107 specification explains that the optical fiber transports light in a flow cytometer gathered from the composite microscope objective to the WDM for processing. (*E.g.*, '107, 28:19-27, FIG. 1 (item **852**).) To do this, the composite microscope objective gathers and focuses light scattered and fluoresced by particles to images on an image plane, where the diameter of these images “may be less than 35 microns.” (*See id.*, FIGs. 9A, 9B1, 9B2, 9B3, 34:44-67, 35:20-25.) A POSA would have understood that the optical fiber must have a core diameter at least sufficiently large as these images to avoid signal loss when implemented under these conditions. (EX1002, ¶127.) As discussed in Section V.C, while APDs have highly sensitive detection capabilities

and fast response times, they also have greater signal-to-noise sensitivity. A POSA would have recognized the need for high signal collection and delivery to the claimed WDM. (EX1002, ¶131.)

This need for delivering a stronger signal to the WDM would be impeded by using single-mode optical fibers. A POSA would have understood that an optical fiber having a greater core diameter and a higher numerical aperture would be needed to obtain the collection efficiency necessary to operate the claimed APD-based WDM. (EX1092, p.003-004; EX1002, ¶¶128-131.) But as the '107 specification explains, single-mode optical fibers, which are “measured in micrometers,” comprise substantially smaller core diameters than multimode optical fiber, which are measured “in millimeters.” ('107, 44:63-66; *compare* EX1093, *with* EX1094, EX1095; *see also* EX1002, ¶¶126-127, 132.) Accordingly, a weak resultant signal transported to the WDM by a single-mode optical fiber would provide a lower signal to noise ratio and be inadequate to allow APDs, with their inherently high dark current, to be used. (EX1002, ¶133.)

* * *

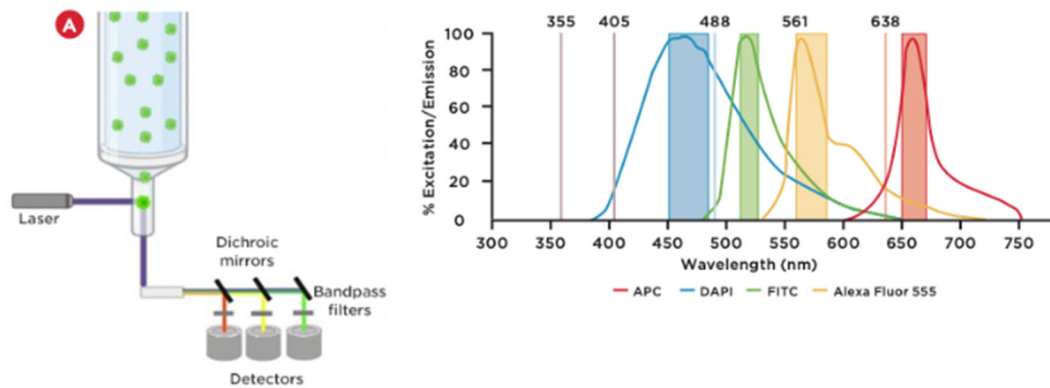
Given the absence of any teaching or working examples of single-mode optical fiber implementation, and the technical obstacles to such implementation, a POSA would have had to engage in undue experimentation to practice the claimed APD-based WDM using a single-mode optical fiber—even today, there are no

commercially available flow cytometers that use a single-mode optical fiber with APD fluorescence detectors. (EX1002, ¶¶133-134.)

E. Ground 5: Claims 9, 29 Lack Written Description Support

Claims 9 and 29 lack of adequate written description support because each recite a “WDM ... capable of detecting a substantially full spectrum of visible light.” A POSA would have understood these claims to cover non-conventional spectral flow cytometry (“SFC”) within the WDM. But the ’107 written description lacks any SFC disclosure, and only references detecting fluorochrome emission peaks as done in conventional flow cytometry. (EX1002, ¶135.)

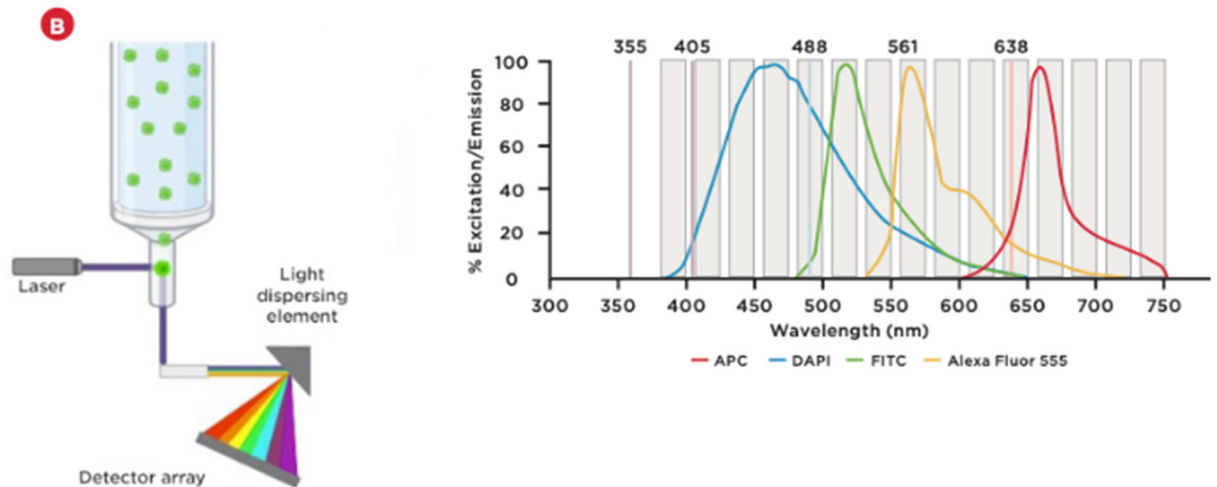
Conventional flow cytometers and spectral flow cytometers comprise substantially different means for detecting fluorescent light to generate different fluorescent signals, as well as substantially different methods of processing the different fluorescent signals. (EX1002, ¶¶136-139.) **Conventional flow cytometers** rely on a combination of bandpass filters and dichroic mirrors to detect fluorescent light within a few distinct color bands associated with emission peaks of the fluorochromes used to mark the different particles or cells within a sample. (EX1096; EX1097; EX1002, ¶¶136-137.)



(EX1096, FIG. 1A.) When photons within each color band enter the photodetector, the photodetector converts the photons into electrons and multiplies the electrons into an analog current signal (photocurrent). The analog current signal can be converted into an analog voltage signal. Over the time period of an event, when a laser interacts with each fluorochrome attached to a cell or particle to cause it to emit fluorescent light, the analog voltage signal forms a voltage pulse (also called a signal pulse). (EX1097.) The voltage pulse data then goes through a process called “binning,” where the voltage pulse data (height, full pulse width, area) for each unit (e.g., cell) of the target material is assigned a bin, depending on its value. Compensation is then applied to the voltage pulse data to separate out spectra overlap between adjacent fluorochromes. (*Id.*; see also EX1002, ¶137.)

In contrast, for each event, **spectral flow cytometers** capture the entire emission of fluorescent light substantially over the full visible light spectrum, with the number of detectors exceeding the number of fluorochromes used to mark

particles or cells in a sample to maximize the portion of the full spectrum that is captured. (EX1096; EX1098, p.019; EX1002, ¶138.)



(EX1096, FIG. 1B.) The different wavelength bands over which fluorescent light is dispersed and detected by the detector array are shown by grey rectangles in the righthand figure. Notably, the illustrated configuration uses a light dispersing element (e.g., grating or prism instead of WDM) to disperse the fluorescent light into different wavelength bands, which is absent in the '107 claims and written description's WDM disclosures. (See also EX1002, ¶¶ 138, 140-141.)

A “major difference” between conventional and spectral flow cytometry “lies in the way the contribution of each fluorochrome is separated from similar signals[.]” (EX1096, p.009; see also EX1002, ¶139.) Conventional flow cytometers use compensation to correct for overlapping spectra from adjacent fluorochromes to isolate and measure individual contributions. (EX1098, p.019; see also EX1002,

¶¶137-139.) In contrast, spectral flow cytometers deconvolute to “unmix” the fluorochrome signals that overlap across the spectrum using sophisticated computer algorithms that isolate fluorochromes based on distinctions in their corresponding emission profiles substantially extending across the visible light spectrum. (EX1098, p.019; *see also* EX1002, ¶¶138-139; *see also* EX1096, p.009.)

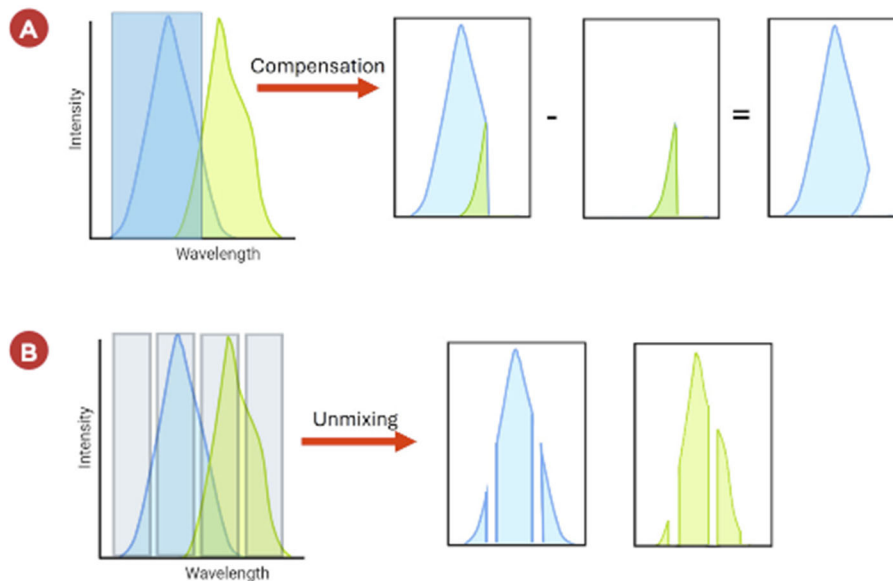


Figure 7. Graphical representation of differences between compensation used in traditional flow cytometry and unmixing used in spectral flow cytometry. **(A)**Graph on the left side shows overlapping spectra of 2 fluorescent signals (for example, from different fluorophores). After compensation, the overlapping signal, as seen for the blue detector, is adjusted by reducing the interference from spillover. **(B)**Graph on the left side shows data being captured by a spectral flow cytometer where unmixing process uses more detectors than fluorophores to deconvolute signals, showing individual isolated spectra for each fluorophore.

Nowhere in the '107 written description does the inventor describe how the claimed WDM (and its detectors) would enable SFC. The written description only describes a WDM configured for emission peak wavelength analysis performed as

part of conventional flow cytometry. (*See* '107, 27:45-49; *see also* EX1002, ¶140.)

This is confirmed by the '107's disclosures on a "replaceable dichroic filter assembly," which would be unnecessary in a SFC. ('107, 47:54-56, 48:39-42, 48:53-56, FIG. 30A; EX1002, ¶141.) In a SFC, filters are initially positioned before detectors and there would be no need to replace them for different applications, as the system collects the entire emission spectrum for fluorochromes and then unmixes their respective spectral signatures with computer algorithms. (EX1002, ¶141.)

The recent state of the art further supports the conclusion that Claims 9 and 29 lack written description support. (EX1002, ¶142.) As of 2023, Sony, Thermo Fisher Scientific, and Petitioner offered commercialized SFCs, and Becton Dickinson marketed a "module for spectrally enhanced cytometric analysis" with the FACSymphony A5 SE instrument. (EX1098, p.019.) Yet Patent Owner did not offer a commercialized SFC add-on or module until 2025 (over ten years after the inventor's submission of the PCT App.), when it launched a SFC module for its CytoFLEX flow cytometer. (EX1099; EX1100.)

F. Ground 6: Claims 9, 29 are Not Enabled

Because no written description exists for Claims 9 and 29 as to a "WDM [that] is capable of detecting a substantially full spectrum of visible light," the specification also fails to enable a POSA to practice these claims without undue experimentation.

Wands Factor No. 1 – Breadth of the Claims. Claims 9 and 29 broadly recite a “WDM [that] is capable of detecting a substantially full spectrum of light,” and POSA would have understood these claims to encompass techniques in SFC despite the specification’s lack of enabling disclosure. (EX1002, ¶143.)

Wands Factors Nos. 6-7 – Guidance from the Specification and Working Examples. The ’107 specification does not provide any teachings or working examples to enable a POSA to practice the claimed WDM with SFC capabilities but instead contain multiple passages that confirm that the claimed WDM is implemented in a conventional flow cytometer that measures fluorochrome emission peak wavelength signals and performs compensation. (See ’107, 27:45-49, 47:54-56, 48:39-42, 48:46-50, 48:53-56, FIG. 30A; see also Ground 5; EX1002, ¶143.)

Wands Factors Nos. 3 & 8 – Field or Nature of the Invention, State of the Art, Level of a POSA, Predictability, and Amount of Experimentation. A POSA would need to engage in excessive experimentation to practice Claims 9 and 29. (EX1002, ¶143.) As explained above in Ground 5, as late as 2023, SFCs had only been commercialized by a limited number of companies (and not by Patent Owner). (EX1098, p.019.) Despite the original PCT App. having been filed in May 2013, it took more than ten years for Patent Owner to develop a SFC add-on module for its commercialized CytoFLEX flow cytometer product, further demonstrating that the ’107 specification would not have enabled a POSA to practice a “WDM [that] is

capable of detecting a substantially full spectrum of visible light” at the time of the invention. (EX1099; EX1100.)

G. Ground 7: Claim 30 Lacks Written Description Support

Claim 30 is invalid and lacks adequate written description support because it recites “the plurality of mirrors comprise five *or more* mirrors; and the plurality of filters comprise six *or more* filters.” (’107, cl. 30 (emphasis added); EX1002, ¶144.)

Indeed, a POSA at the time of the invention would not have recognized the inventor to possess an operable version of the claimed WDM with hundreds or thousands of mirrors and filters. (EX1002, ¶¶144-145.) While the ’107 written description supports the “five” mirrors and “six” filters recited by Claim 30, (*e.g.*, FIG. 25 illustrates an embodiment of the WDM with five mirrors and six dichroic filters,) it fails to support the boundless “or more” number of mirrors and filters. A POSA would not have understood any portion of the written description to suggest that the inventor was in possession of a WDM with a boundless number of filters and mirrors. (EX1002, ¶145.)

In fact, the lack of written description for “or more” is further confirmed by the properties of the light beam propagated within the WDM. As the ’107 written description explains, the light beam in the WDM “can only be kept collimated for a very limited distance[.]” (’107, 45:5-9.) As explained in Ground 1 above, even a collimated beam will nevertheless experience some divergence, and therefore

photon loss will increase over distance. The written description is silent as to how a POSA would account for this photon loss over tens or hundreds of mirrors and filters.

(EX1002, ¶146.)

XI. GROUNDS 8-11: THE CHALLENGED CLAIMS ARE OBVIOUS

A. Prior Art Summary

1. Chandler [EX1051]

Chandler [EX1051] is a patent issued on October 31, 2000, entitled “Interlaced Lasers for Multiple Fluorescence Measurement.” Chandler qualifies as prior art under AIA §102(a)(1). Chandler discloses an improved fluorescence-detection based flow cytometer that uses multiple lasers to irradiate fluorescence-tagged materials in a flow cell (“viewing chamber”). The light is gathered by multiple collecting optical units (“optical detectors”), routed through multimode optical fibers into filtering, amplification, and digital conversion units (“FADC units”) for demultiplexing, detection, digital conversion, and signal processing. (Chandler, 4:62-5:4, 5:23-33, 7:24-45; *see also id.*, FIG. 4.) Each FADC unit consists of a set of standard bandpass filters, a set of standard photodetectors, and a set of standard analog to digital converters. (Chandler, 3:66-4:15, 7:46-49.) The photodetectors may be avalanche photo-diode detectors (“APDs”). (*Id.*, 4:6-8, 5:30-32, 8:32-34.)

2. Goodman [EX1016]

Goodman [EX1016] is a patent issued on April 1, 2003, entitled “Compact Multiple Channel Multiplexer/Demultiplexer Devices.” Goodman qualifies as prior art under pre-AIA §102(b).

Goodman explains that in a typical wavelength division (de)multiplexing (“WDM”) system, optical signals, generated by some light sources, are transmitted over a waveguide, such as an optical fiber and then demultiplexed into individual color bands to be routed to an optical detector, corresponding to each channel wavelength range. (Goodman, 1:46-52.) Goodman also identifies, and provides a solution for, conventional, bulky WDMs with optical attenuation issues. (*Id.*, 3:37-44.)

Goodman depicts an exemplary WDM device **10** in FIG. 1 below:

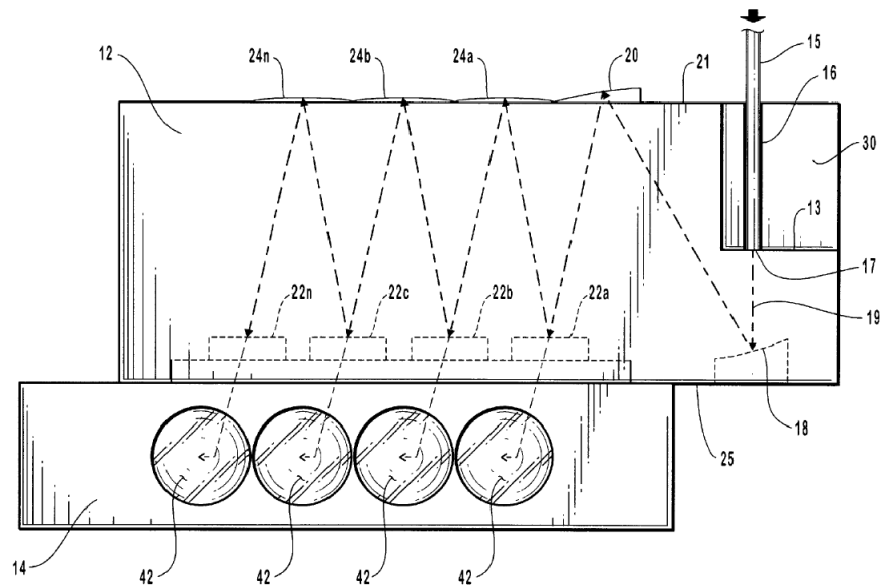


FIG. 1

(Goodman, FIG. 1.)

WDM device **10** includes an optical block **12**, configured to receive an optical beam **19** through an optical fiber **15**. (Goodman, 7:1-3, 7:17-21.) The optical beam **19** first impinges on imaging optical element **18** that reflects the beam onto imaging optical element **20**. (*Id.*, 7:17-30.) Imaging optical element **20** then reflects optical beam **19** onto a first of a set of wavelength selective elements **22a-22n**. (*Id.*, 8:21-23.)

Wavelength selective elements **22a-22n** are “each capable of transmitting a selected range of wavelengths within beam **19** and reflecting other wavelengths.” (Goodman, 8:23-26.) These wavelength selective elements can be dichroic filters, among other types, and separate each wavelength channel to demultiplex the entire multiwavelength beam. (*Id.*, 9:16-49.) A set of reflectors **24a-24n** are positioned on the top surface of the optical block **12**, opposite from the wavelength selective elements **22a-22n**, such that “each of the reflectors directs beam **19** from one wavelength selective element to an adjacent wavelength selective element.” (*Id.*, 9:58-67.) For each reflector, Goodman explains “[t]he reflective surface can comprise at least one collimating reflector or at least one non-collimating reflector,” for example, “converging lenses or mirrors, collimating lenses or mirrors, or simple reflecting surfaces.” (*Id.*, 10:17-21.)

Selected ranges of wavelengths transmitted through wavelength selective

elements **22a-22n** travel into a beam-directing member **14** that is configured to “redirect and focus the optical energy transmitted through wavelength selective elements **22a-22n**.” (Goodman, 10:45-51.) Beam-directing member **14** includes a set of focusing lenses **42** within each optical channel that focuses a selected wavelength beam into a corresponding optical receiver, such as a detector. (*Id.*, 11:30-41.)

3. Hamamatsu [EX1055, EX1056]

Hamamatsu refers to two archived website pages, depicting commercial sale of small area APDs used in low light measurement applications, including with flow cytometers. EX1055 discloses Hamamatsu’s offer for sale of certain small area APDs with active areas of 1 mm or less in diameter and spectral response ranges from 440 – 1100 nm (visible to near IR). EX1056 discloses Hamamatsu’s offer for sale of certain small area APDs with active areas of 1mm or less in diameter and spectral response ranges from 200/320 nm to 1000 nm. Hamamatsu qualifies as prior art under pre-AIA §102(b) and AIA §102(a)(1). (*See* EX1068, pp.001-002.)

4. Oostman [EX1005]

Oostman [EX1005] is a patent issued on January 27, 2004, entitled “Fluorescence Detection Instrument with Reflective Transfer Legs for Color Decimation,” that discloses “an improved system for detecting fluorescent light having multiple colors emitted from a target[.]” (Oostman, 2:60-63.) The preferred

embodiment of the invention features a flow cytometer that uses multiple WDMs for fluorescent and scattered light color band separation and detection. (*Id.*, 5:33-37.) Oostman qualifies as prior art under pre-AIA §102(b) and AIA §102(a)(1).

Oostman discloses an optical instrument (flow cytometer) that includes multiple laser light sources, a flow cell, collection lens, optical fibers, and a plurality of detector array clusters as depicted in FIG. 4 below:

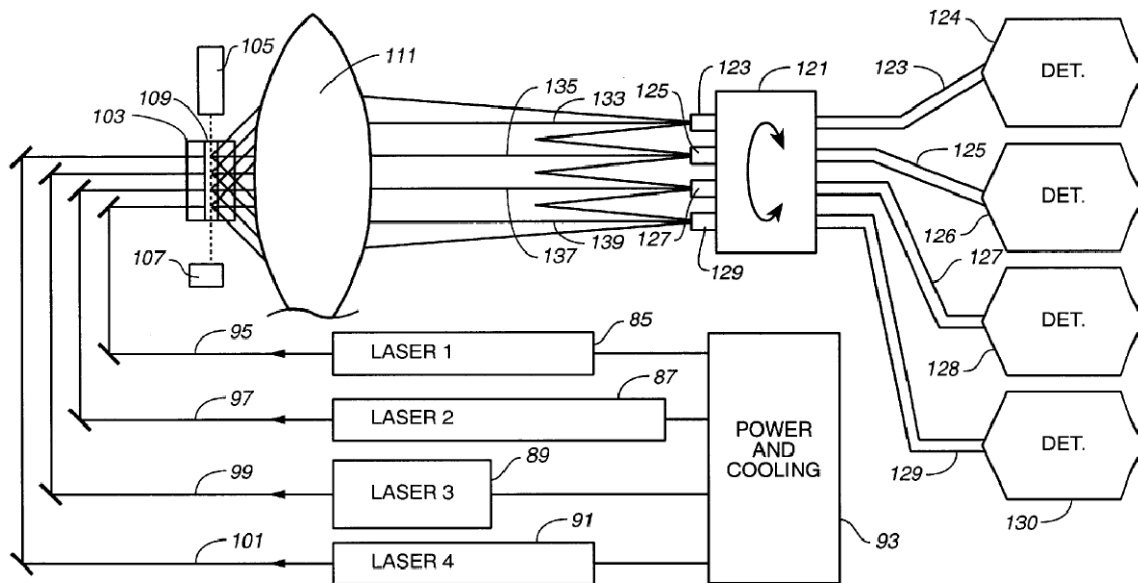


FIG. 4

(Oostman, FIG. 4.)

Each of lasers **85, 87, 89, 91** produces a beam of light with a unique wavelength that is directed toward a flow stream **103** in fluid system **105** that contains fluorescent dye marked particles within a liquid sample. (Oostman, 5:27-33, 5:41-44.) Laser beams interact with the fluorescent dye marked particles,

“causing scattering and fluorescence that is spatially separated along a line parallel to the flow channel **109**.” (*Id.*, 5:58-62.) This impinging of the laser beams upon the fluorescent dye marked particles of the liquid sample of flow stream **103** in flow channel **109** creates an “illuminated zone.” (*Id.*, 5:44-46.)

Scattered and fluorescent light is then “imaged by a lens light collector **111** to four respective optical fibers **123**, **125**, **127**, and **129**,” each of which is a multi-mode optical fiber. (Oostman, 5:63-6:7.) Light collected and focused into each optical fiber is then transmitted to a respective detector cluster **124**, **126**, **128**, **130**, which comprises an array of detectors. (*Id.*, 6:26-28.) “Each array of detectors differentially separates bands of light by filtering, using coatings on beam splitters and lenses, in a known manner.” (*Id.*, 6:34-36.)

5. Frazier [EX1009]

Frazier [EX1009] is a patent filed on February 26, 2010, entitled “Fluorescence Detection Instrument with Orthogonal Laser Entry.” Frazier qualifies as prior art under pre-AIA § 102(b) and AIA §102(a)(1). Frazier discloses a “detector assembly for analysis of light emitted form [sic] a fluorescent material, an optical alignment assembly for introducing an output beam into a detector array or demultiplexer, and methods of demultiplexing a beam of light into wavelength bands.” (Frazier, Abstract.) Frazier also indicates that its detectors can be “various ... types of photodetectors, for example, photo avalanche detectors[.]” (*Id.*, 4:19-

20.)

B. Ground 8: Chandler and Goodman Render the Challenged Claims Obvious

1. Motivation to Combine Chandler with Goodman and Reasonable Expectation of Success

A POSA would have found it obvious to combine Chandler's flow cytometers with Goodman's teachings regarding its wavelength division demultiplexer devices. Chandler, as modified by Goodman, would have predictably resulted in the substitution of the branched configuration of Chandler's bandpass filters within its FADC units with Goodman's more modular, efficient, cost-effective WDM. (EX1002, ¶165.)

Chandler's FADC units have an associated footprint that would have to be managed and/or miniaturized if additional light sources are used to irradiate fluorescence-tagged material. (EX1002, ¶167.) At the same time, Chandler intended to make conventional flow cytometers "small and inexpensive." (Chandler, 3:51-55.) But a POSA would have recognized that Chandler's branched configuration in the FADC units was suboptimal for achieving Chandler's stated goals, particularly where more color separation per light source was desired. (EX1002, ¶167.)

A POSA seeking to reduce the footprint of Chandler's FADC units without sacrificing detection capabilities would naturally have consulted alternate WDM

Petition for Post-Grant Review of
U.S. Patent No. 12,174,107 B2

arrangements, including Goodman. (EX1002, ¶168.) Goodman and Chandler are analogous references in the same field of the alleged invention related to fiber optics, aimed at compact modular optical instruments for color separation and detection. (Chandler, 1:11-15, 3:32-35; Goodman, 1:8-12, 3:48-67, 6:19-35.) Chandler and Goodman are directed to the same problems faced by the inventor of efficiently demultiplexing and detecting light, and the '107 patent specifically identifies WDMs in the optical communication industry as analogous to WDMs in flow cytometry. ('107, 4:62-5:5, 44:25-33.)

A POSA would have been motivated to combine Chandler with Goodman because Goodman teaches improvements aligned to Chandler's design goals. (EX1002, ¶169.) Goodman explains that its invention is intended to provide a demultiplexer device:

- “in which each optical surface therein can be produced within current standard molding tolerances;”
- “in which all surfaces are simple geometric forms and are easily accessible for measurement;”
- “that is easy to mold and fabricate accurately;”
- “that is easy to handle and assemble due to simple component geometries;”
- “that is easy to incorporate into other optical systems;” and

- “is easily scalable or modified.”

(Goodman, 3:48-67.) These motivations are confirmed by multiple prior art references. (*See, e.g.*, Oostman, 2:60-64, 3:36-42, 4:14-24, 4:39-45; Frazier, 2:39-46; Wang [EX1011], 1:65-2:2; Lemoff [EX1012], 2:19-24; He [EX1013], 2:36-38; Grann [EX1015], 2:51-56; Nosu [EX1010], 3:31-52.)

It would have been obvious to try Goodman’s demultiplexer device in Chandler’s flow cytometer system. Goodman provides a zig-zag pattern in an optical block that was widely accepted in optical communications and had long found adoption within flow cytometry applications. (*See* Section V.B.) Goodman’s WDM configuration was a known alternative to Chandler’s branched configuration, and one of several options available to a POSA at the time of the invention. (EX1002, ¶¶170-171; *see* Section V.B.)

A POSA would have had a reasonable expectation that the combination would have been successful. (EX1002, ¶172.) Goodman designed its invention to specifically provide a “demultiplexer device that is easy to incorporate into other optical systems.” (Goodman, 3:65-67.) Its demultiplexing devices satisfy this objective by advantageously being “formed with geometrically simple shapes and without complex off-axis surfaces” that “allows for ease of fabrication, ease of metrology, and relatively simple incorporation into more complex optical systems.” (*Id.*, 6:19-24.) Chandler also describes that its FADC unit configuration is flexible.

(Chandler, 8:25-30, 11:39-67, 12:42-51.) The '107 specification confirms that a WDM from the optical communication industry can be “readily adapted for fluorescence light detection,” as such a WDM is “almost identical in function and architecture” to WDMs used in flow cytometry. ('107, 4:62-5:5, 44:25-33.)

2. Independent Claim 1

a. Claim 1[pre]: “A flow cytometer comprising:”

The parties agree that the preamble is limiting. Chandler discloses Claim 1[pre]. (EX1002, ¶173.) Chandler directs its invention to “flow cytometric systems and/or methods of fluorescence measurement, including, multiple fluorescence measurement.” (Chandler, 1:11-15.) FIG. 4 depicts an “improved flow cytometer.” (*Id.*, 7:1-4.)

b. Claim 1[a]: “an optical fiber; and”

Goodman and Chandler each discloses Claim 1[a]. Chandler’s optical detectors **20, 22, 24, 26** are connected to corresponding FADC units **30, 32, 34, 36** via multi-mode fiber optic cables **40, 42, 44, 46**, respectively. (Chandler, 7:35-49, 9:35-41, 9:52-61, 11:39-67.)

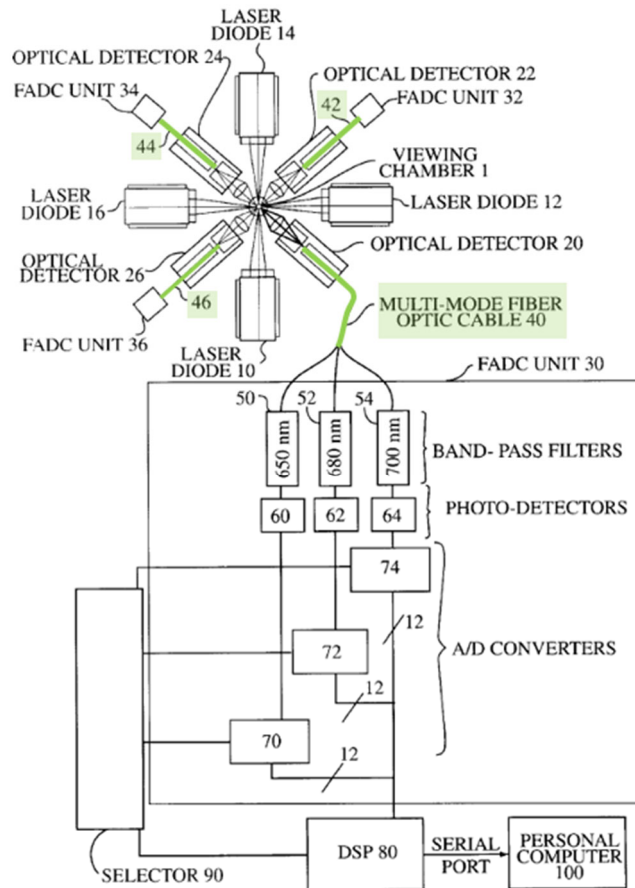


FIG. 4

(*Id.*, FIG. 4 (annotated); *see also id.*, 7:35-38, 7:66-8:3; EX1002, ¶174.)

Goodman also discloses an “**optical fiber.**” “As illustrated in FIG. 1, optical block **12** has a generally rectangular shape and is configured to receive an optical signal through a waveguide such as an optical fiber 15.” (Goodman, 7:1-3 (underlining added); *see also id.*, 7:10-12, 14:15-17.) Light emits from a facet of the optical fiber and travels through the WDM. (*Id.*, 10:22-24.)

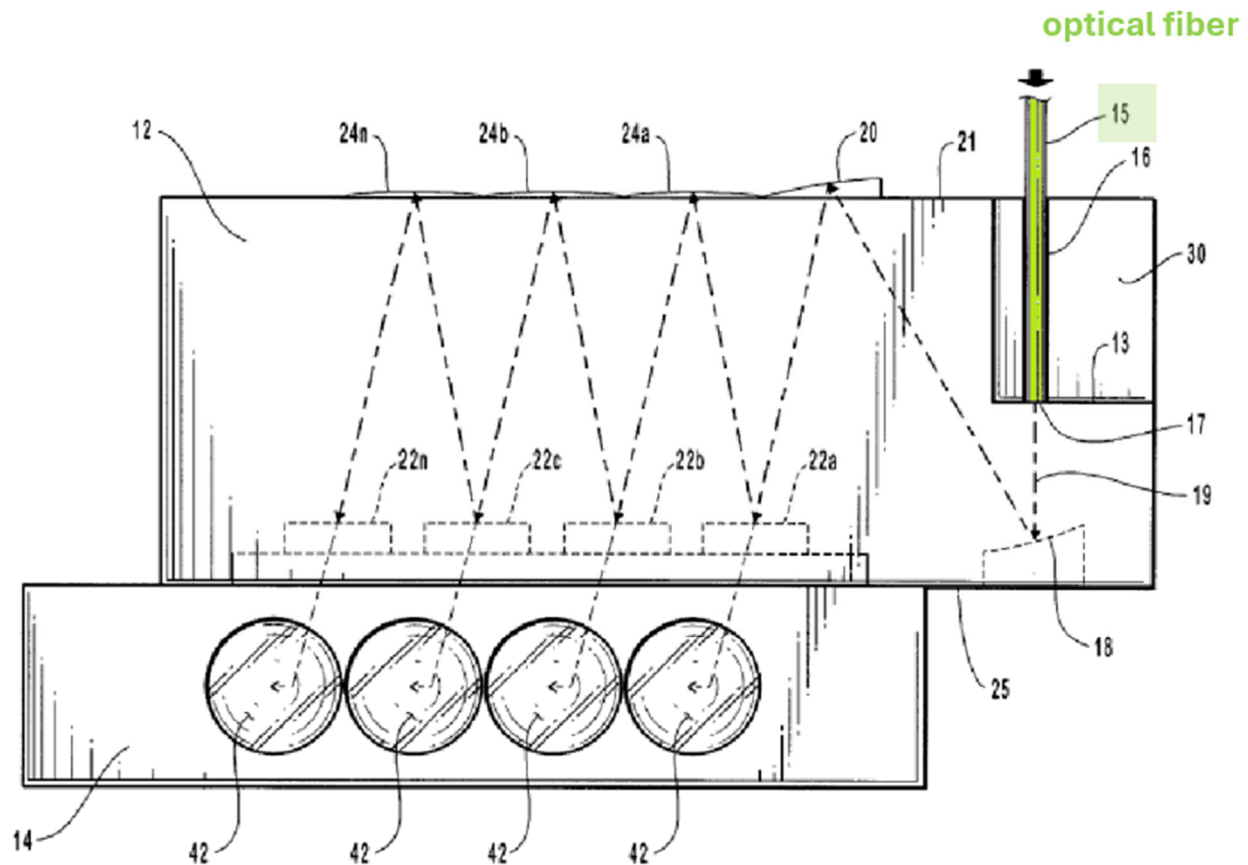


FIG. 1

(*Id.*, FIG. 1 (annotated); *see also* EX1002, ¶175.)

- c. **Claim 1[b]: “a wavelength division multiplexer (WDM) configured to receive light from the optical fiber, wherein the WDM comprises:”**

The combination of Goodman and Chandler discloses Claim 1[b]. Chandler’s optical detectors **20, 22, 24, 26** are each connected via a multimode fiber optic cable to a “filtering, amplification, and digital conversion (FADC) unit” that includes sets of bandpass filters and photodetectors for color separation and detection. (Chandler, 7:35-49, 9:35-41, 9:52-61, 11:39-67.)

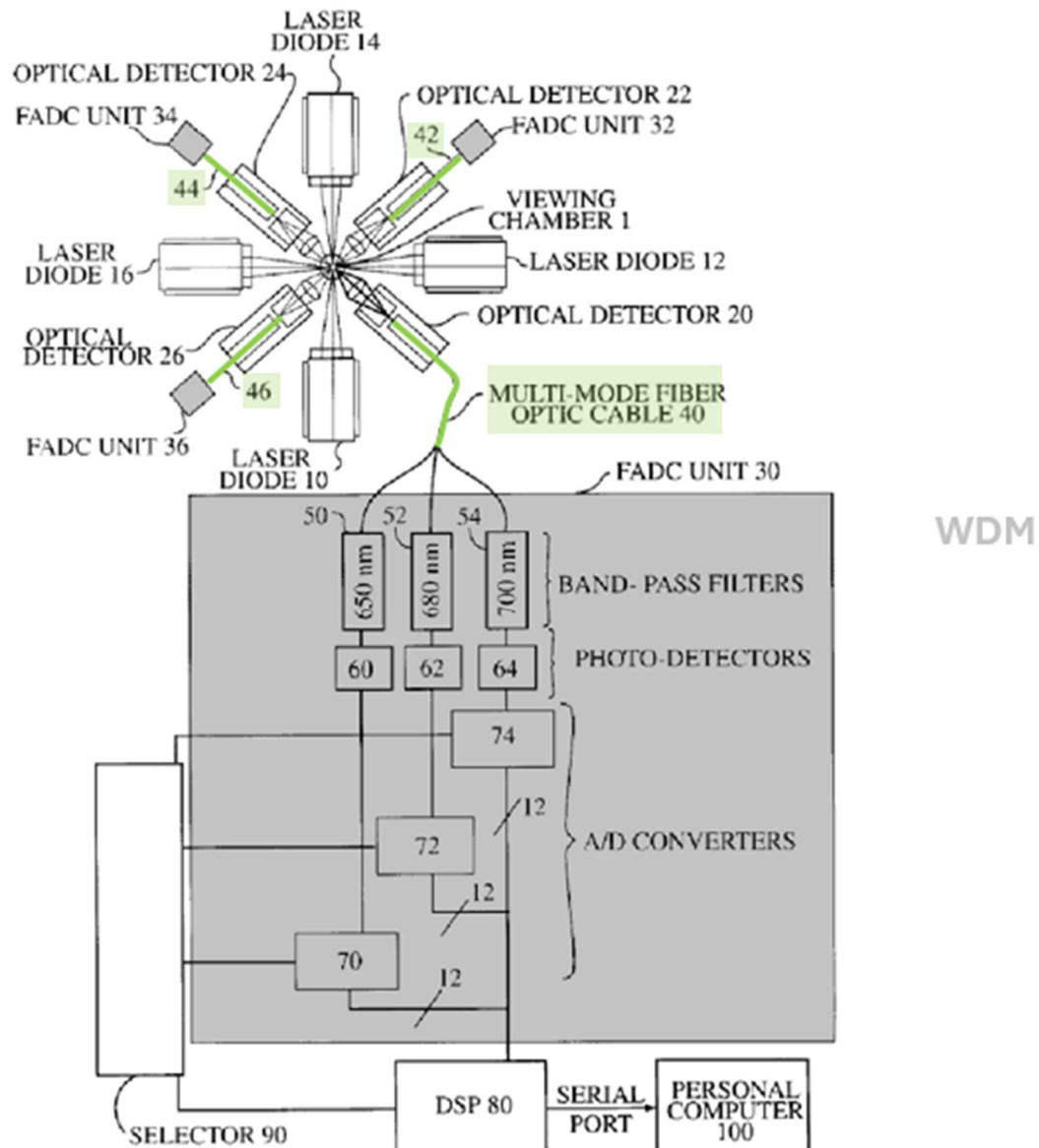


FIG. 4

(*Id.*, FIG. 4 (annotated); *see also id.*, 7:35-38, 7:66-8:3.) These FADC units are “configured to receive light from the optical fiber,” as each optical detector “gathers photons and can couple or transmit them to a respective multi-mode fiber optic cable” that “conveys the photons” to a corresponding FADC unit. (*Id.*, 9:52-56; *see also* EX1002, ¶176.)

The combination of Chandler and Goodman replaces Chandler's branched FADC unit(s) with Goodman's alternate, known zig-zag demultiplexing configuration. (EX1002, ¶177.)

d. Claim 1[c]: “an array of mirrors;”

Goodman discloses Claim 1[c]. Goodman's “demultiplexer device ... generally includes an optically transparent optical block seated atop an optically transparent beam-directing member,” where the “optical block includes ... a plurality of relay reflectors[.]” (Goodman, 5:63-6:1; *see also id.*, 4:35-40.) A POSA would have understood reflectors to include “**mirrors**,” as a mirror is defined by its ability to reflect incident light. (*See* EX1020, p.003; *see also* Goodman, 10:19-23; EX1002, ¶178.)

Goodman also discloses an “**array of mirrors**” (reflectors **24a-24n-1**) in its FIG. 1 embodiment that includes “a plurality of discrete reflectors **24a-24n**.” (Goodman, 9:58-61.) FIG. 1 depicts these reflectors **24a-24n-1** (highlighted green but for the last reflector) and ray tracing that demonstrates that the optical beam reflects from each reflector.

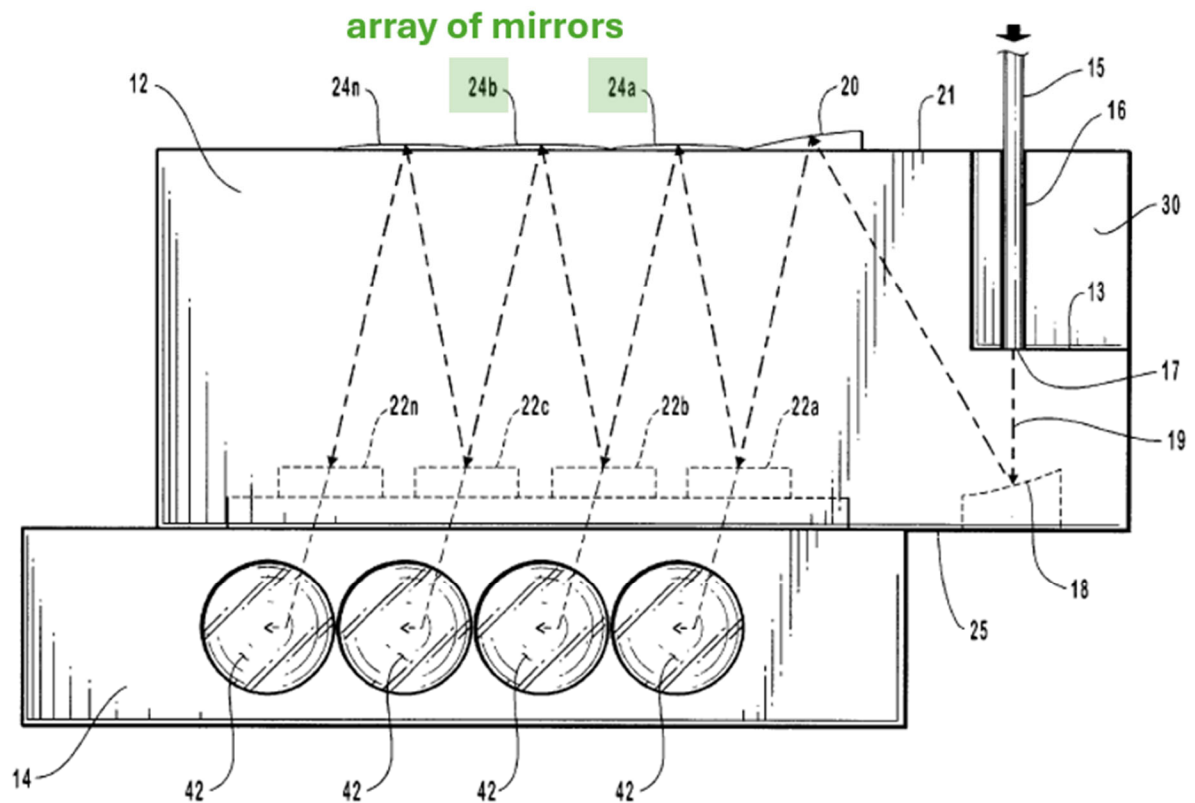


FIG. 1

(Goodman, FIG. 1 (annotated); EX1002, ¶179.)

e. Claim 1[d]: “an array of filters; and”

Goodman discloses Claim 1[d]. (EX1002, ¶180.) Goodman’s “optical block includes a plurality of wavelength selective elements such as optical interference filters[.]” (Goodman, 5:63-67; *see also id.*, 4:35-40.) Goodman’s wavelength selective elements are “**filters**” because they “separate selected wavelengths” from an incident optical beam, permitting select separated wavelengths to pass through a wavelength selective element to be focused onto the corresponding optical detector while reflecting the remaining wavelengths to a reflector positioned opposite of the

wavelength selective element in the optical block. (Goodman, 4:48-50, 4:53-65.)

Goodman teaches an “**array of filters**” in its wavelength selective elements **22a-22n-1** “configured in optical block **12** to receive beam **19** propagating along an optical path.” (Goodman, 8:21-23.) “Each wavelength selective element is preselected to pass a designated wavelength range and reflect both higher and lower wavelengths. The wavelength selective elements pass the separated wavelength bands into the beam-directing member[.]” (*Id.*, 6:12-16; *see also id.*, 8:21-26; *see also* EX1002, ¶181.)

FIG. 1 depicts the “**array**” of filters including wavelength selective elements **22a-22n-1** (in brown), showing a portion of optical beam **19** passing through wavelength selective elements **22a-22n-1** and separate portions reflecting back to reflectors **24a-24n-1**, demonstrating how the wavelength selective elements are filters. (EX1002, ¶182.) Similar to the “array of mirrors” as discussed in Claim 1[c], a POSA would have understood that the use of “n” notation signals that a POSA could use any number of filters (i.e., “**array of filters**”). (EX1002, ¶182.)

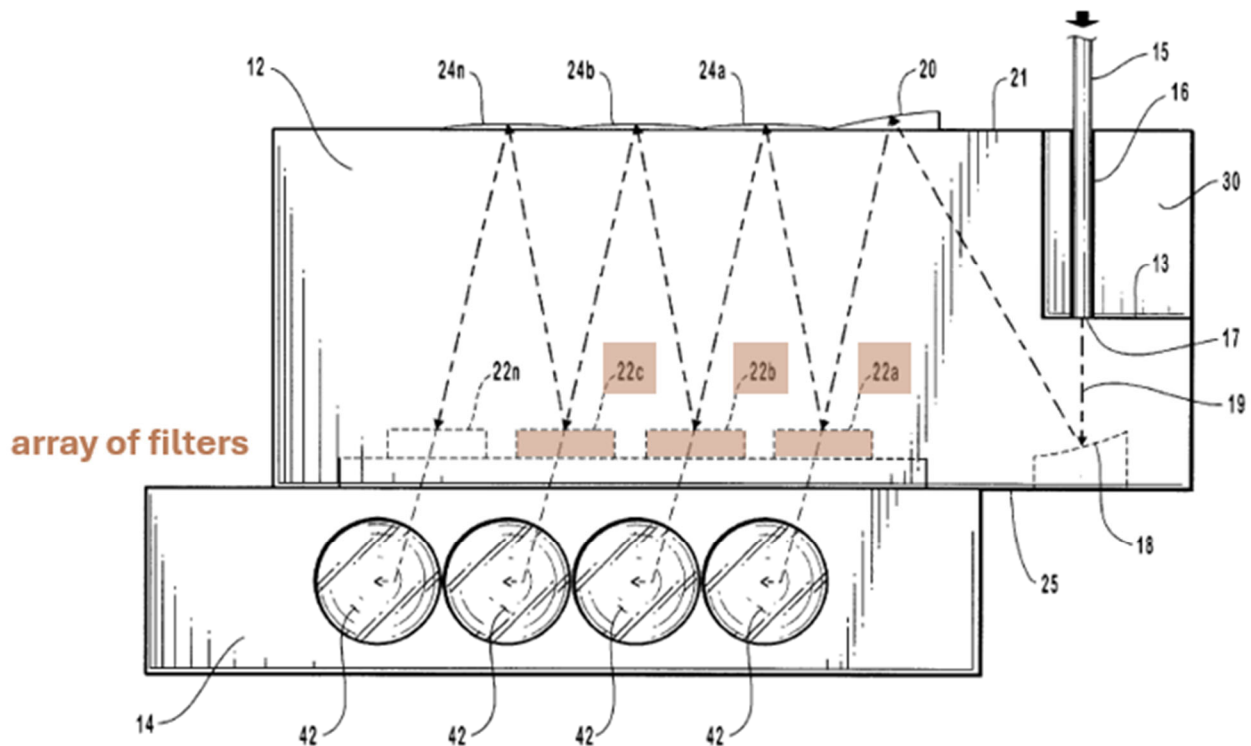


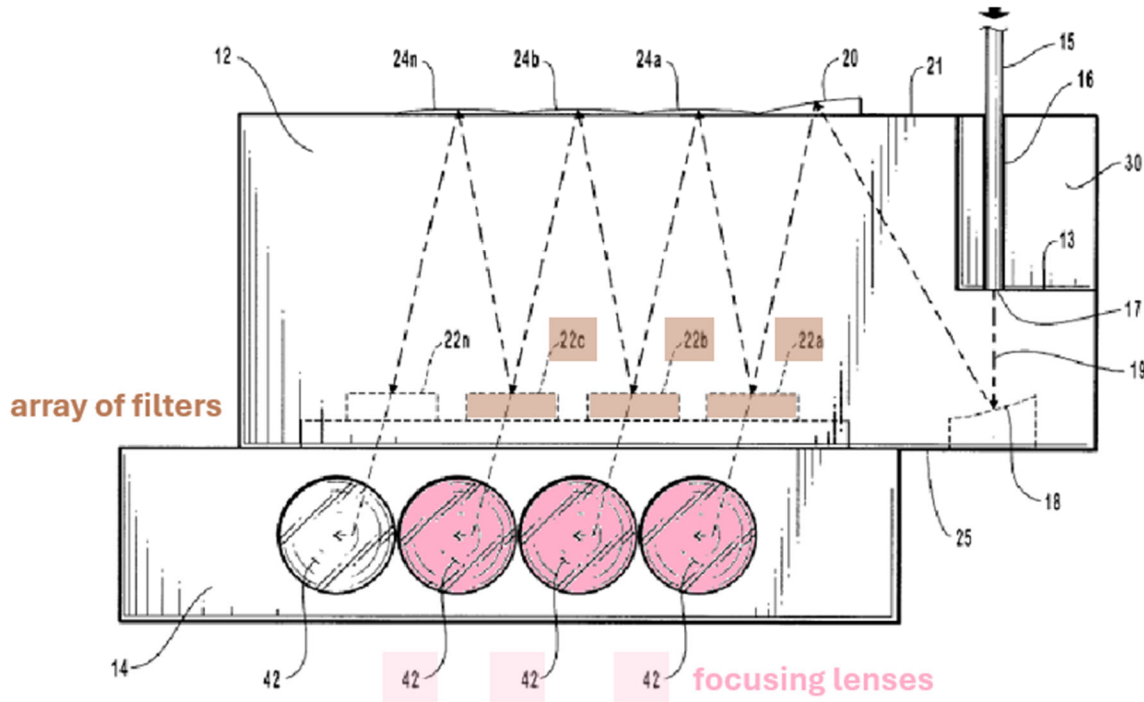
FIG. 1

(Goodman, FIG. 1 (annotated); *see also id.*, 12:1-18.)

- f. **Claim 1[e]: “an array of avalanche photodiodes (APDs) configured to receive light that passed through one or more filters in the array of filters;”**

The combination of Chandler and Goodman discloses Claim 1[e]. Goodman’s beam-directing member includes a set of focusing lenses **42**. Goodman teaches that “emitted wavelength beams” propagating from wavelength selective elements **22a-22n** may be “transmitted to the focusing lenses” **42** and then “[e]ach of the lenses **42** can focus a selected wavelength beam onto a corresponding optical receiver such as an optical detector[.]” (Goodman, 11:24-30, 11:40-42 (underlining added).) FIG. 1 below shows light transmitted through the array of filters is incident

on focusing lenses **42** (pink) arranged in a linear array such that a POSA would have understood that the corresponding optical detectors would also be arranged in a linear array. (EX1002, ¶183.)



(Goodman, FIG. 1 (annotated); *id.*, 4:59-63.)

While Goodman does not disclose whether its optical detector is an “**APD**,” Chandler teaches that its photodetector may be “an avalanche photo-diode.” (Chandler, 4:6-4:8, 5:30-32, 8:31-34.) The “**array of avalanche photodiodes (APDs)**” in the combined Chandler-Goodman system are Chandler’s APDs, “optical detectors” each associated with each of Goodman’s focusing lenses **42**. (EX1002, ¶184.)

- (a) **Claim 1[f]: “wherein each of the filters in the array of filters is configured to receive light such that: a portion of the light passes through the filter; and another portion of the light is reflected; and”**

Goodman discloses Claim 1[f]. Each filter in the array of filters is **“configured to receive light.”** (Goodman, 8:21-23.) FIG. 1 shows each of wavelength selective elements **22a-22n-1** receiving a portion of light (red arrows) from optical beam **19**. (EX1002, ¶185.)

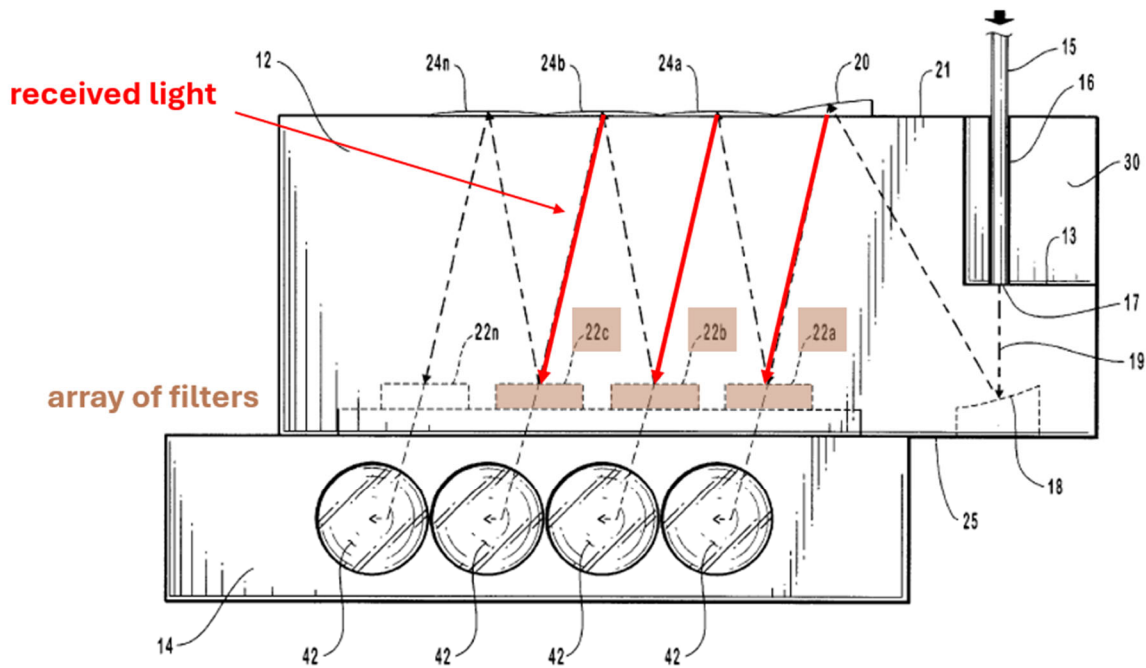


FIG. 1

(Goodman, FIG. 1 (annotated).)

Goodman also discloses that **“a portion of the light passes through”** each wavelength selective element that comports with the district court’s construction for **“portion.”** **“Each wavelength selective element is preselected to pass a designated**

wavelength range and reflect both higher and lower wavelengths. The wavelength selective elements pass the separated wavelength bands into the beam-directing member[.]” (Goodman, 6:12-16 (underlining added); *see also id.*, 8:21-26.) Ray tracing in FIG. 1 depicts a portion of optical beam **19** passing through wavelength selective elements **22a-22n-1**. (EX1002, ¶186.)

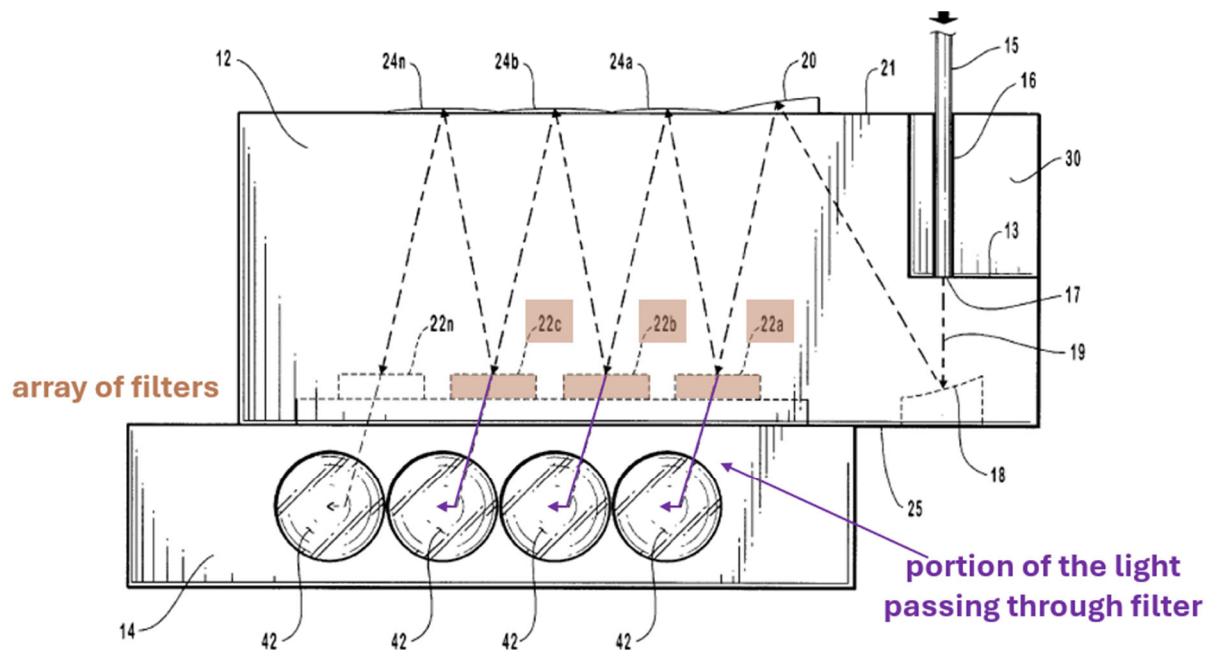


FIG. 1

(Goodman, FIG. 1 (annotated).)

Finally, Goodman teaches that “**another portion of the light is reflected**” by wavelength selective elements **22a-22n-1** under the district court’s construction for “portion.” “The wavelength selective elements **22a-22n** are each capable of ... reflecting other wavelengths.” (Goodman, 8:23-26; *see also id.*, 12:1-11.) FIG. 1 shows each wavelength selective element **22a-22n-1** reflecting a portion of the light.

(EX1002, ¶187.)

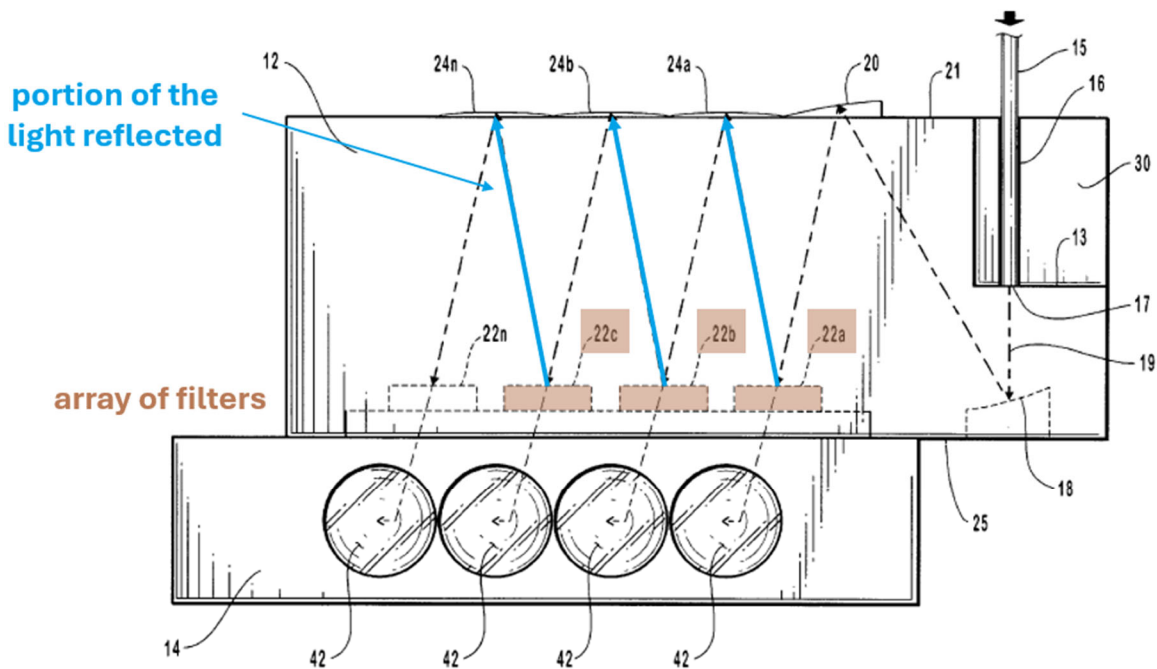


FIG. 1

(Goodman, FIG. 1 (annotated).)

- (b) **Claim 1[g]: “wherein each of the mirrors in the array of mirrors is configured to: receive light reflected by a filter in the array of filters; and reflect light to another filter in the array of filters.”**

Goodman discloses Claim 1[g]. Goodman’s “reflectors are positioned opposite from the wavelength selective elements such that each of the reflectors, as part of an imaging relay system, directs the beam of optical energy from one wavelength selective filter to an adjacent wavelength selective filter.” (Goodman, 4:53-58 (underlining added); *see also id.*, 4:60-62.) A POSA would have understood that, to direct a beam of light within an imaging relay system, a reflector must both

“receive light reflected by a filter in the array of filters” from a filter and then **“reflect light to another filter in the array of filters”** to the next filter. (EX1002, ¶188.)

Goodman’s “reflectors **24a-24n** are positioned opposite from wavelength selective elements **22a-22n** such that each of the reflectors directs beam **19** from one wavelength selective element to an adjacent wavelength selective element.” (Goodman, 9:61-65 (underlining added).) As depicted in FIG. 1, a POSA would have understood from these disclosures that each reflector in reflectors **24a-24n-1** will **“receive”** portions of light (in blue) from a wavelength selective element within wavelength selective elements **22a-22n-1** and **“reflect”** those portions of light back (in red) to the next sequential wavelength selective element within the set of wavelength selective elements **22a-22n-1**. (EX1002, ¶¶189-190.)

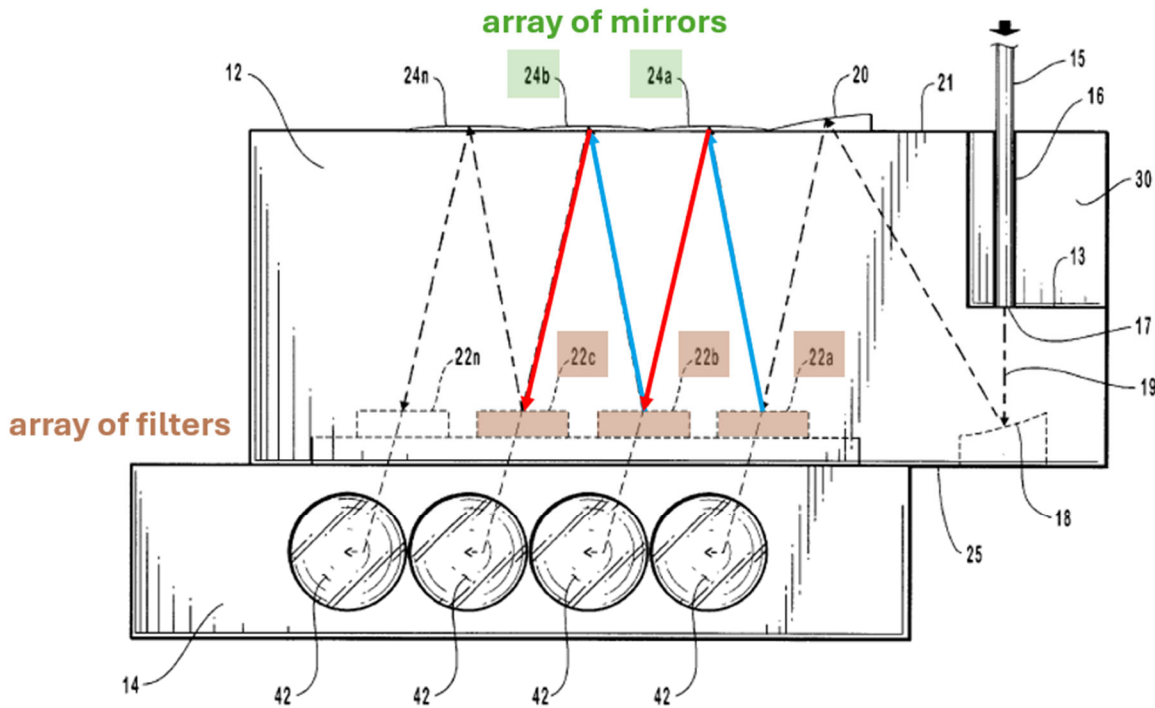


FIG. 1

(Goodman, FIG. 1 (annotated).)

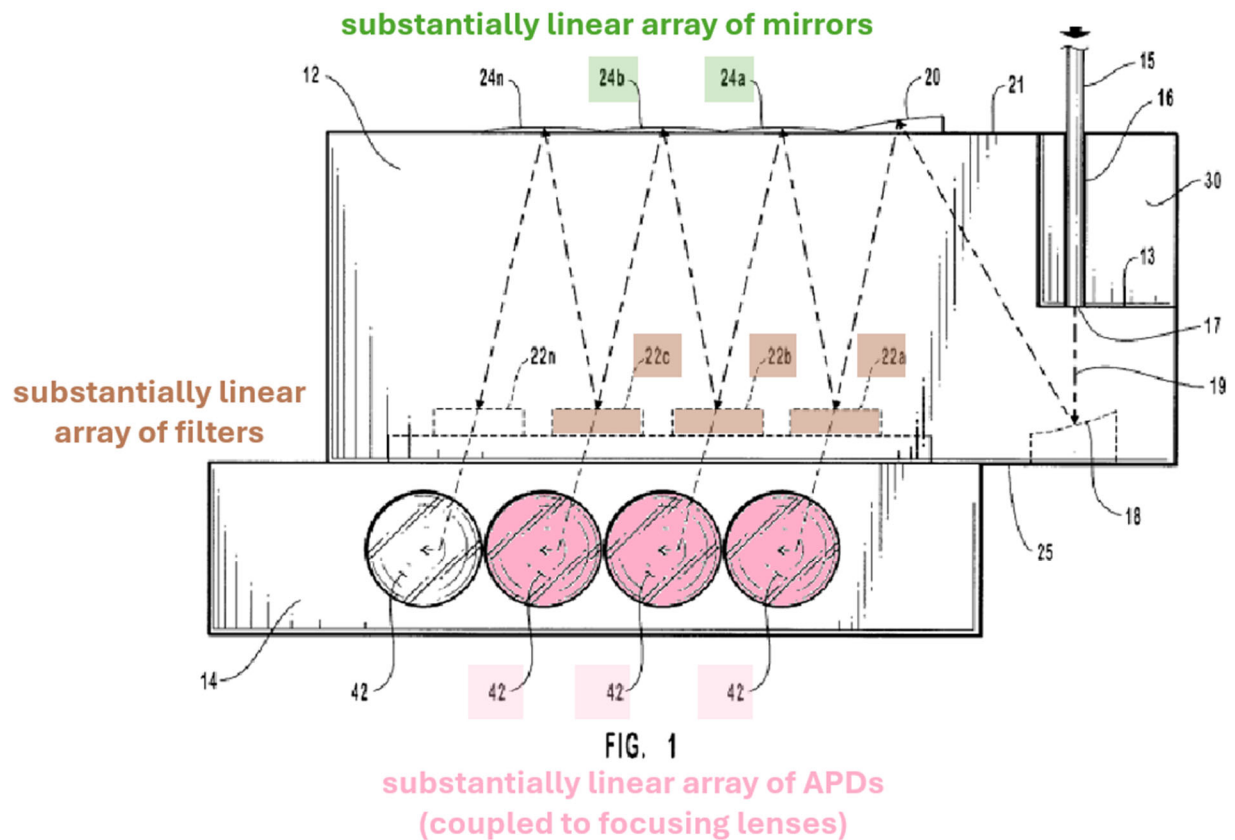
Goodman expressly discloses the dual function of each of its reflectors within the linear arrangement shown in FIG. 1. (Goodman, 12:1-6.) The subsequent reflectors within Goodman’s set of reflectors **24a-24n-1** perform the same “**receive light reflected by a filter in the array of filters**” and “**reflect light to another filter in the array of filters**” operations relative to the set of wavelength selective elements **22a-22n-1**. (See *id.*, 12:5-15; see also EX1002, ¶191.)

3. **Dependent Claim 2: “The flow cytometer of claim 1, wherein: the array of mirrors is substantially linear; the array of filters is substantially linear; and the array of APDs is substantially linear.”**

The combination of Chandler and Goodman discloses Claim 2. Goodman’s

“plurality of discrete reflectors **24a-24n** that are positioned on top surface **21** of optical block **12** in a linear arrangement.” (Goodman, 9:58-61 (underlining added).)

Wavelength selective elements are positioned opposite of the linearly arranged reflectors **24a-24n** and are similarly linear. (*See id.*, 9:61-65.) A POSA would also have understood that the array of APDs, optically coupled to the linearly arranged focusing lenses, would also be linearly arranged. (*Id.*, 11:37-42, 6:14-19; *see also id.*, FIG. 1; *see also* EX1002, ¶192.)



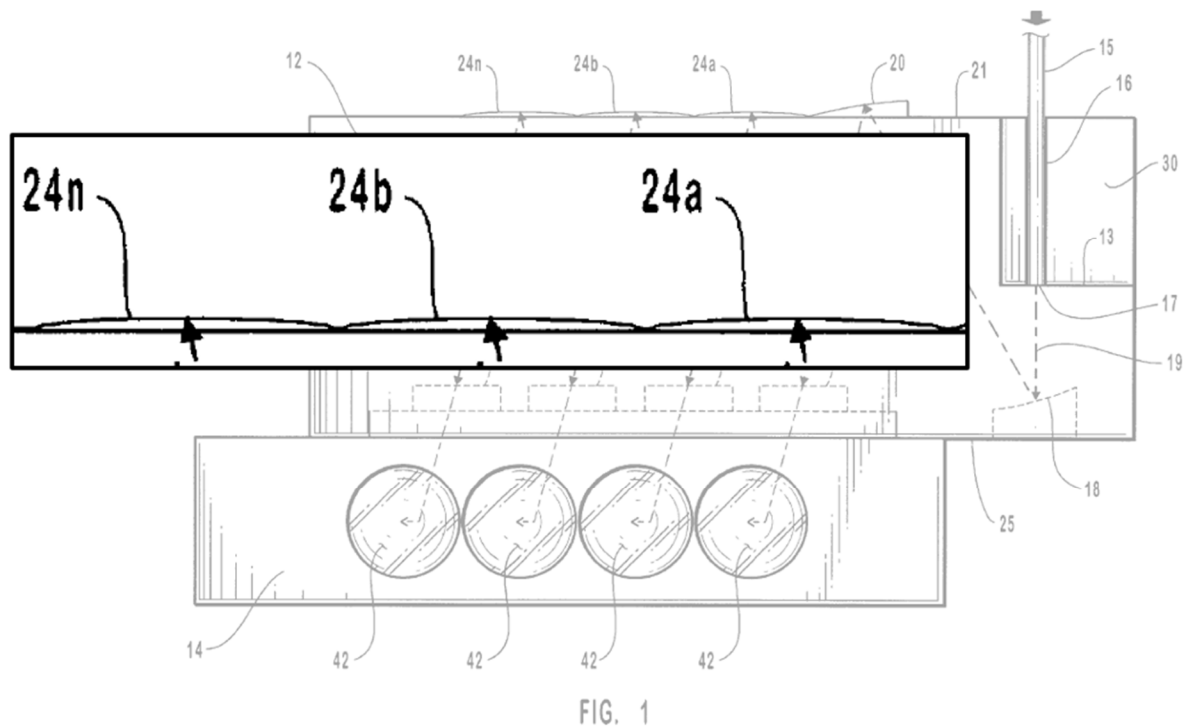
(Goodman, FIG. 1 (annotated).)

4. Dependent Claim 3 “The flow cytometer of claim 2, wherein at least one of the mirrors in the array of mirrors is a concave mirror.”

Goodman discloses Claim 3. The surface of a “concave” mirror curves inward and has a positive radius of curvature. Concave mirrors typically act to converge incident light, or at minimum, reduce divergence in a defocused light beam. (EX1021, Module 1-4, p.032; *see also* EX1022, p.002; EX1002, ¶194.)

Goodman’s reflectors are “shaped to produce the desired spatial and angular characteristics of a beam that propagates in a zigzag fashion” between reflectors and wavelength selective elements and “can be converging lenses or mirrors[.]” (Goodman, 10:3-7, 10:19-21.) A POSA would have understood that a “converging mirror” includes a “concave mirror” because Goodman’s reflector is “designed so that the demultiplexer device can be operated with a non-collimated light beam, with the reflectors controlling the tendency of such a beam to diverge.” (*Id.*, 10:25-28; *see also* EX1002, ¶195.) A reflector that controls divergence in a non-collimated beam is likely (although not required) concave.

Reflectors **24a**, **24b**, ... **24n-1** show concave surfaces—with a small, positive radius of curvature and curving inward—that reflect incident light from optical beam **19**. (EX1002, ¶196.)

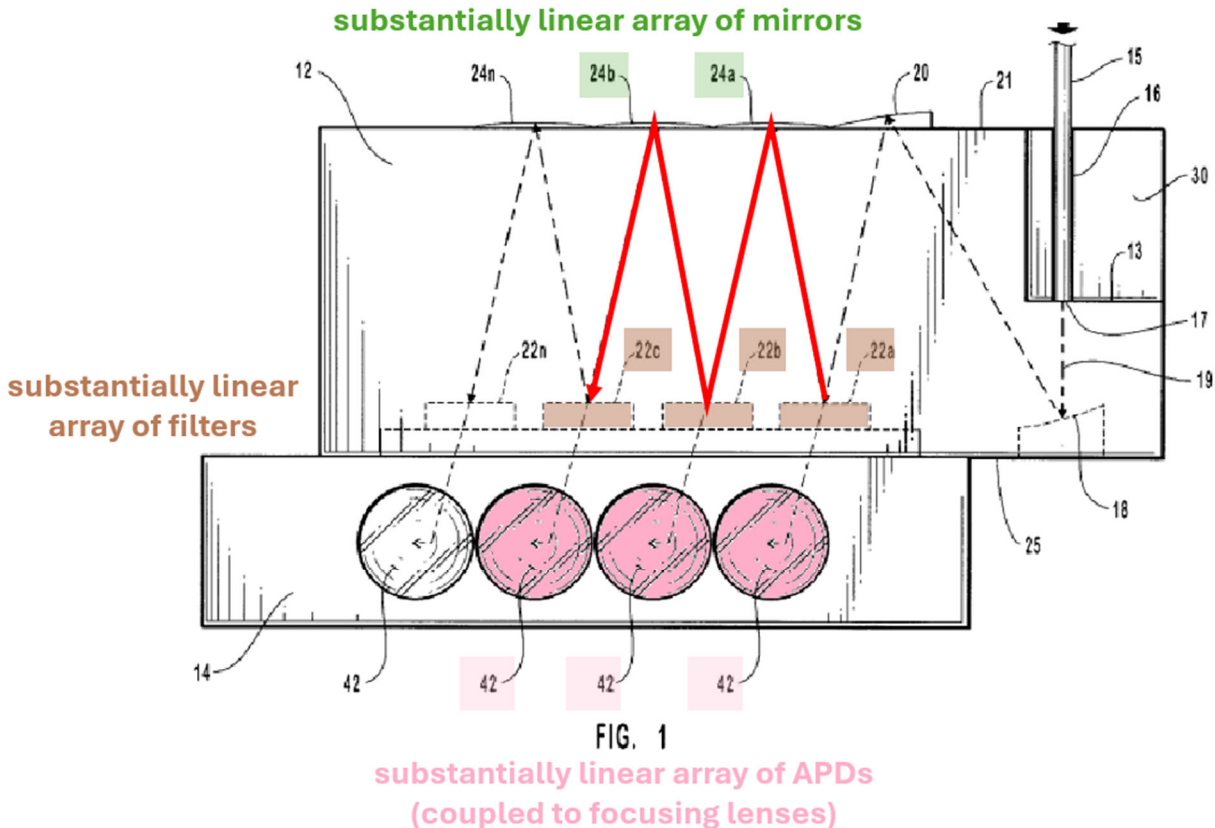


(Goodman, FIG. 1 (annotated with a magnified view of reflectors **24a-24n**).)

5. **Dependent Claim 5: “The flow cytometer of claim 3, wherein the WDM is configured such that a portion of an optical path between the array of mirrors and the array of filters forms a zig-zag pattern.”**

Goodman discloses Claim 5, under the plain meaning understanding of “portion of an optical path,” consistent with the ’107 specification. (EX1002, ¶¶197-198.)

Goodman expressly describes an optical configuration between its array of wavelength selective elements and reflectors as a “**zig-zag pattern.**” (Goodman, 6:5-19, FIG. 1.)



(Goodman, FIG. 1 (annotated).) The specification confirms that “[t]he reflectors are located and shaped to produce the desired spatial and angular characteristics of a beam that propagates in a zigzag fashion between the wavelength selective elements and the reflectors.” (*Id.*, 10:3-7 (underlining added); *see also* EX1002, ¶¶199-200.)

6. Dependent Claim 6: “The flow cytometer of claim 5, further comprising a laser that is configured to emit blue light, yellow-green light, violet light, or ultraviolet light.”

Chandler discloses Claim 6. “[L]aser diodes having respective excitation frequencies of 414 nm, 710 nm, and 780 nm are available and are suitable for use as light sources in the instant invention.” (Chandler, 10:51-54; *see also id.*, 10:59-62.)

The wavelength range for “**blue light, yellow-green light, violet light, or**

ultraviolet light” is less than approximately 570-590 nm (for yellow light), and POSA would have understood that lasers with excitation frequencies of 357 nm, 414 nm, and 488 nm fall within the blue-to-UV light range. (EX1002, ¶201.)

7. Dependent Claim 7: “The flow cytometer of claim 6, wherein the flow cytometer is a benchtop flow cytometer.”

Chandler discloses Claim 7. While the term “**benchtop flow cytometer**” is absent from the specification, a POSA would have understood Chandler-Goodman system to disclose a benchtop flow cytometer. “[A] feature and an advantage of [Goodman’s] invention [is] to provide a means of measuring multiple fluorescence wavelengths that is small and inexpensive relative to conventional flow cytometers,” (Chandler, 3:52-55), and Goodman’s WDM is (advantageously) compact, (Goodman, Title, 1:1-2, 1:8-12, 4:65-67, 5:42-45). The Chandler-Goodman system would have predictably resulted in a “**benchtop flow cytometer.**” (EX1002, ¶202.)

8. Dependent Claim 8: “The flow cytometer of claim 6, wherein the flow cytometer is compact.”

Chandler-Goodman system discloses Claim 8 for the same reasons provided for Claim 7, fully incorporated here. A POSA would have pursued Chandler’s design goals by incorporating Goodman’s compact WDM to make Chandler’s already “small” flow cytometer even more “**compact.**” *See also* Section XI.B.1 incorporated here. (EX1002, ¶203.)

9. Dependent Claim 9: “The flow cytometer of claim 8, wherein the WDM is capable of detecting a substantially full spectrum of visible light.”

As explained in Grounds 5 and 6, Claim 9 lacks written description support and is not enabled. (*See supra* Grounds 5 and 6; EX1002, ¶204.)

To the extent Patent Owner contends that Claim 9 captures a WDM capable of processing light where excitation wavelengths from light sources may span the visible light spectrum, Chandler discloses Claim 9. (EX1002, ¶205.) The visible light spectrum range is from approximately 380 to 750 nm, and the '107 specification recites that its WDM is compatible with light sources with excitation wavelengths at 375 nm, 405 nm, 440 nm, 488 nm, 502 nm, 534 nm, 561 nm, 591 nm, and 637 nm. ('107, 49:20-25.) Chandler expressly discloses a wider range of excitation wavelengths for light sources than is in the '107 patent. (Chandler, 7:10-12, 10:51-62.) Additionally, in Chandler's device, “[a]ny light source suitable for flow analysis is acceptable” and “He-Ne, Ar-ion, Ar/Kr, and UV lasers, can optionally be used.” (*Id.*, 10:50-51, 10:57-58.) As explained in Claim 6 in Ground 10 below (and incorporated here), these additional laser types have excitation wavelengths that span substantially the full visible light spectrum, and would have been able to accommodate the commercially available fluorescent dyes across the visible light spectrum at the time of invention. (EX1002, ¶205.)

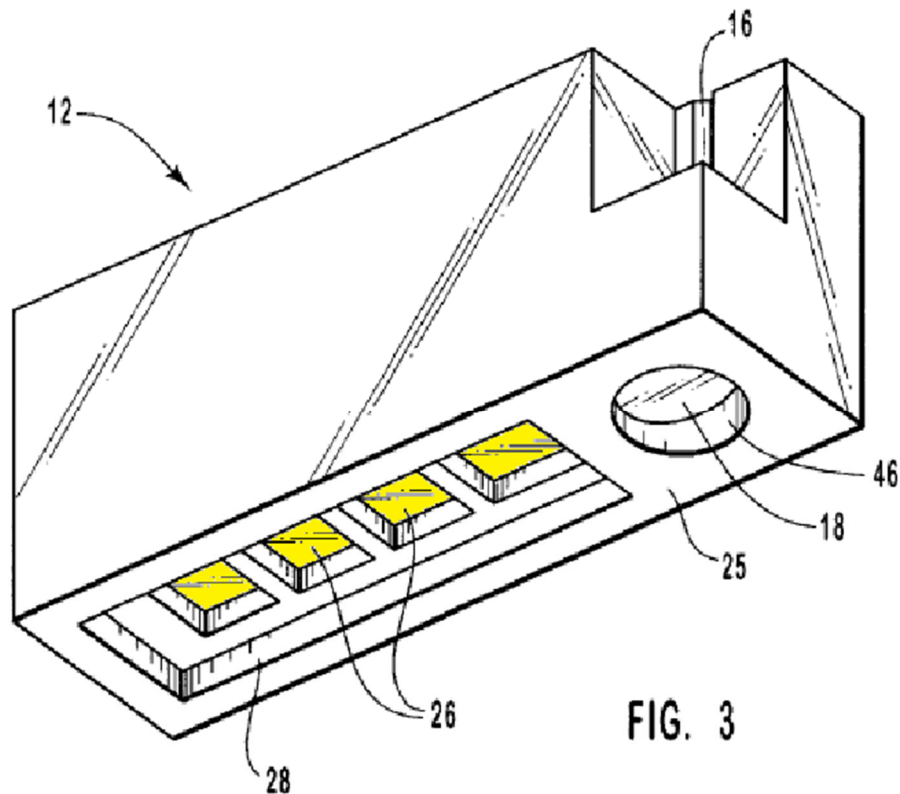
In addition, scattered and/or fluorescent light that results from illuminating

fluorescent-tagged target material with a lower-wavelength laser (e.g., 357 nm) may result in demultiplexed light with wavelength separation across the full visible light spectrum depending on the number of available detection channels. (EX1002, ¶206.) To the extent Patent Owner argues that Claim 9 contemplates a WDM that can separate low-wavelength light into color bands that substantially cover the full visible light spectrum, the combination of Chandler and Goodman discloses Claim 9. (*Id.*) The combined Chandler-Goodman system includes sufficient scalability to accommodate an array of demultiplexing channels and corresponding APDs that can demultiplex light across substantially the full visible light spectrum. (Goodman, 12:40-44; *see also id.*, 8:28-33; EX1002, ¶206.)

10. Dependent Claim 10: “The flow cytometer of claim 6, wherein: the WDM further comprises a block comprising a first surface; and each of the filters in the array of filters is coupled to the first surface of the block.”

Goodman discloses Claim 10. Goodman discloses “**a block**,” noting that its demultiplexer device “includes a transparent optical block having an upper surface defining a plane, and a lower surface” where an imaging optical element is “positioned on the upper surface of the optical block and is configured to direct a multiwavelength beam of optical energy along a predetermined optical path.” (Goodman, 4:42-48 (underlining added); *see also id.*, 6:44-47.) Optical block **12** includes a “**first surface**” in bottom surface **25** shown in FIG. 3, with the surface where Goodman’s wavelength selective elements are coupled being highlighted in

yellow (receiving indentation **26**).



(*Id.*, FIG. 3 (annotated); *see also* EX1002, ¶208.)

Goodman explains that “**each of the filters in the array of filters is coupled to the first surface of the block**” at receiving indentations 26. (EX1002, ¶209.)

Receiving indentations **26** are “molded into bottom surface **25** of optical block **12**.”

(Goodman, 8:37-38; *see also id.*, 8:44-47.)

11. Dependent Claim 11: “The flow cytometer of claim 10, wherein the flow cytometer is a benchtop flow cytometer.”

The combination of Chandler and Goodman discloses Claim 11 for the reasons provided for Claim 7, incorporated here. (EX1002, ¶210.)

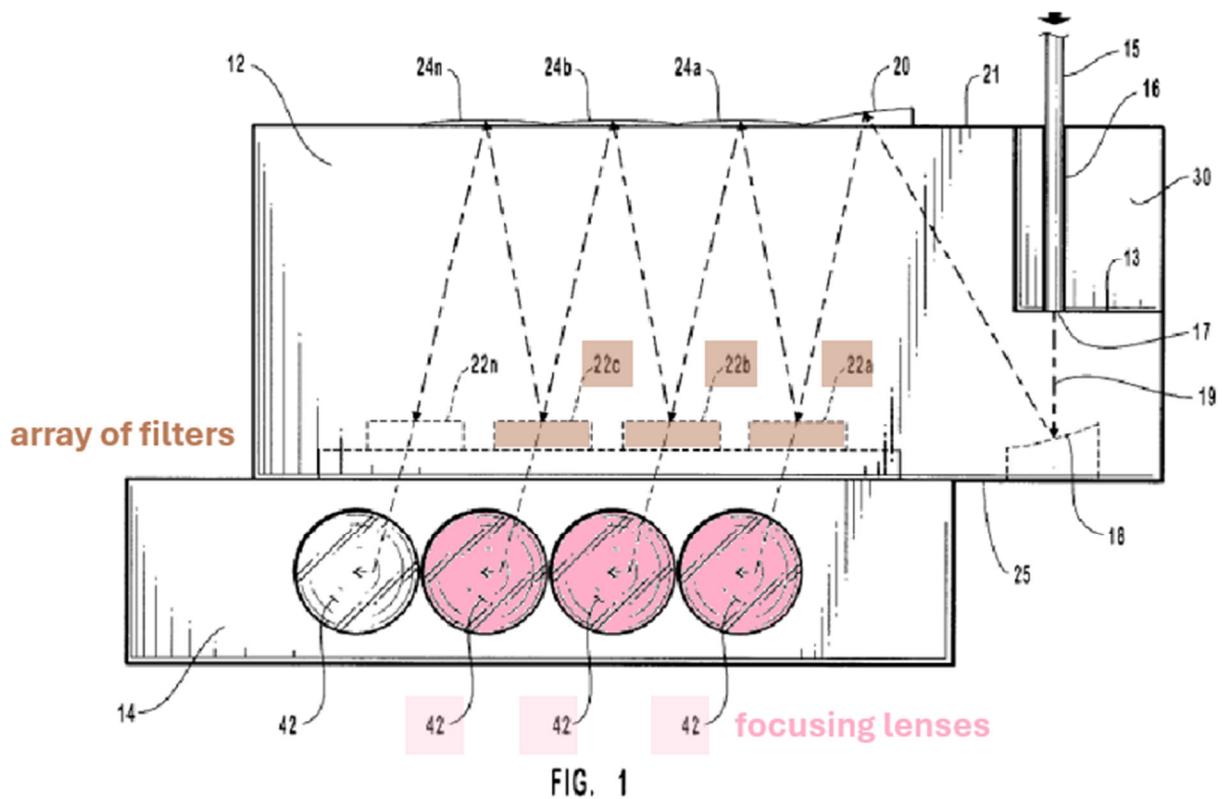
12. Dependent Claim 12: “The flow cytometer of claim 10, wherein the flow cytometer is compact.”

The combination of Chandler and Goodman discloses Claim 12 for the reasons provided for Claim 8, incorporated here. (EX1002, ¶211.)

13. Dependent Claim 13: “The flow cytometer of claim 6, wherein the WDM further comprises: an array of focusing lenses, wherein each of the focusing lenses in the array of focusing lenses is configured to focus light that passed through a filter in the array of filters to a spot on an APD in the array of APDs, wherein the spot has a diameter that is smaller than a diameter of a core of the optical fiber.”

Goodman discloses “**focusing lenses**” under the district court’s construction because Goodman describes focusing lenses that a POSA would have understood to collect and converge light. (EX1002, ¶¶212-213.) Goodman’s focusing lenses “can focus a selected wavelength beam onto a corresponding optical receiver such as an optical detector[.]” (Goodman, 11:40-42 (underlining added).)

Goodman also discloses an “**array of focusing lenses**.” Goodman’s “selected wavelength beams that pass through wavelength selective elements **22a-22n** enter beam-directing member **14**[.]” (Goodman, 12:24-26.) Beam-directing member includes an array of focusing lenses **42**. (*Id.*, 11:8-30, 12:24-32.) FIG. 1 depicts an array of focusing lenses **42** that are downstream along the optical path into wavelength selection elements **22a-22n-1**. (EX1002, ¶214.)



(Goodman, FIG. 1 (annotated).)

The focusing lenses are each “**configured to focus light that passed through a filter in the array of filters to a spot on an APD in the array of APDs.**”

Goodman’s focusing lens **42** is positioned between a wavelength selective element in the optical block and its corresponding optical detector, an APD in the Chandler-Goodman combination as explained in Claim 1[e]. (See Goodman, 11:40-42, 12:23-32; EX1002, ¶215.)

These focusing lenses also focus light down to a spot size “**wherein the spot has a diameter that is smaller than a diameter of a core of the optical fiber.**”

The diameter for a core of a multimode optical fiber is measured in millimeters.

(*See, e.g.*, '107, 44:61-65.) As discussed for Claim 14 below, a POSA would have known that using commercially available small area APDs, as Chandler contemplates, would have required design or selection of Goodman's focusing lens 42 that focused light to a spot size approximately at the APD's effective active area to maximize signal-to-noise ratio and minimize photon loss. These small area APDs had diameters less than 1 mm, and a POSA implementing the small-area APDs in the Goodman-Chandler WDM would naturally have focused the light down to a spot size less than the diameter of a core of the multimode optical fiber (which is typically greater than 1 mm). (EX1002, ¶216.)

14. Dependent Claim 14: “The flow cytometer of claim 13, wherein for each of the focusing lenses in the array of focusing lenses, the diameter of the spot is less than 1 mm.”

A POSA would have understood that Goodman's focusing lenses should be able to focus the beam to a size smaller than or equal to the effective detection area of the APD. (EX1002, ¶217; *see* Goodman, 11:48-50.) Commercially available small-area APDs from multiple vendors had active areas less than 1 millimeter in diameter, and a POSA would have understood that use of these APDs in the Goodman-Chandler optical subsystems would have required that Goodman's focusing lenses focus incident light down such that **“the diameter of the spot is less than 1 mm.”** (EX1002, ¶217.)

The '107 specification does not describe a unique APD, and a POSA would

have understood that the '107's WDM would have used off-the-shelf APDs. Chandler generally discloses use of APDs without specifying the size or model, but a POSA would have understood that major semiconductor manufacturers, like Hamamatsu and SensL cited in the '107 (*see* '107, 44:14-18), sold small-area APDs with effective active area sizes less than 1 mm in diameter. (EX1002, ¶¶218-219.) Hamamatsu's APDs, available publicly before December 2011, had effective active areas from 0.03 – 0.78 mm².

■ General ratings / Absolute maximum ratings

Type No.	Dimensional outline/ Window material *1	Package	Effective active area size (mm)	Effective active area (mm ²)	Absolute maximum ratings	
					Operating temperature Topr (°C)	Storage temperature Tstg (°C)
S9073	①/U	TO-18	φ0.2	0.03	-20 to +60	-55 to +100
S9074			φ0.5	0.19		
S5343			φ1.0	0.78		
S9075	②/U	TO-5	φ1.5	1.77		
S5344			φ3.0	7.0		
S5345	③/U	TO-8	φ5.0	19.6		

(EX1060, p.001; *see also* EX1061, p.001; EX1062, p.001; EX1055-EX1056; EX1034.) By 2007, SensL also offered several APD modules with active areas of 1 x 1 mm and specifically identified that these APDs can be used in flow cytometers. (EX1032, p.002; *id.*, p.001 (specifically identifying APDs for flow cytometer applications).) Other manufacturers, such as Menlo Systems and First Sensor, had similar small-area APD offerings by 2011 with active area sizes optimized to capture a beam with less than 1 mm diameter while maximizing signal-to-noise ratio. (EX1033, pp.001-002; EX1063; EX1064, p.001; EX1002, ¶¶218-220.)

A POSA would have generally known of these small area APDs' use in flow

cytometry applications, would have used them in the Chandler-Goodman optical subsystem, and would have selected and/or designed focusing lenses to focus the incident light down to the effective active area size for these APDs. A POSA would have found implementation of small area size APDs to be highly desirable because (1) smaller size APDs improve the WDM's compactness, enabling additional channels to be built into the device within a form factor; and (2) these types of APDs further address the known issue in APDs of having high dark current by improving the signal-to-noise ratio with a smaller active detection area. (EX1002, ¶221; *see also* Section V.C.) Based on the commercially available small-area APDs and the implementation of 1 mm APDs in SensL, a POSA would have also known that the focusing lenses would have to focus light down such that **“the diameter of the spot is less than 1 mm.”** (EX1002, ¶221.)

15. Independent Claim 16

a. Claim 16[pre]: “A flow cytometer comprising:”

The combination of Chandler and Goodman discloses Claim 16[pre] for the reasons provided for Claim 1[pre], incorporated here. (EX1002, ¶222.)

b. Claim 16[a]: “a flow cell configured to permit liquid to flow through the flow cell;”

Chandler discloses Claim 16[a]. Chandler's “sample delivery viewing chamber 1,” also referred to as “cuvette 1,” can be “a standard quartz cuvette used in standard flow cytometers[.]” (Chandler, 6:61-64, 7:1-4.) This cuvette 1 is a **“flow**

cell” as shown in FIG. 5. (EX1002, ¶223.)

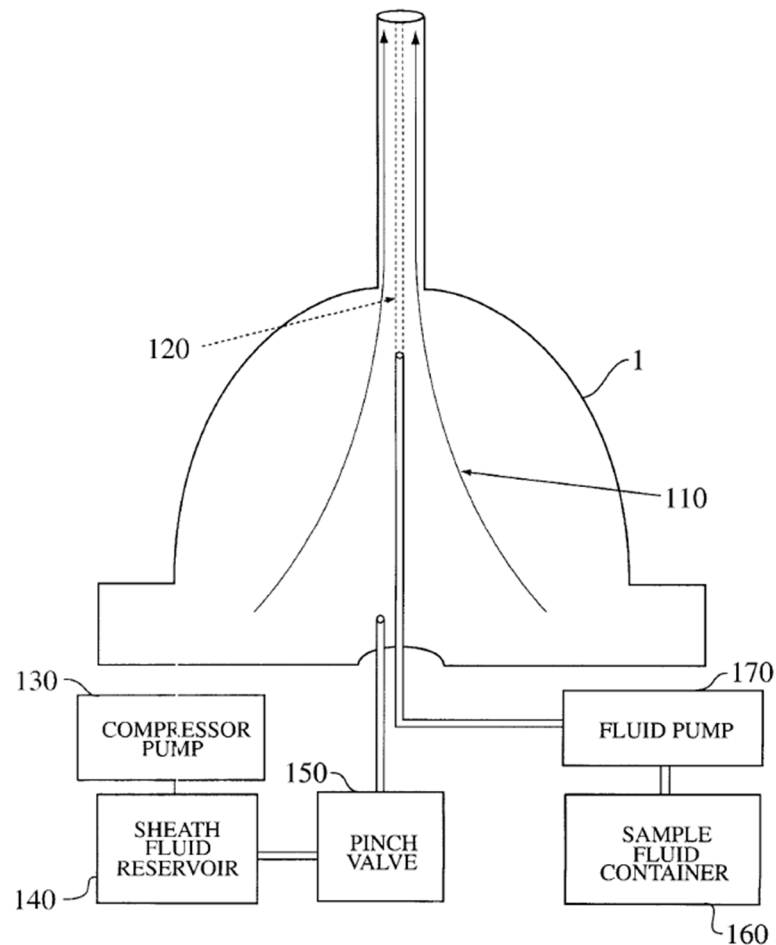


FIG. 5

(Chandler, FIG. 5.)

A flow cell is a small channel where cells are suspended in a fluid and aligned / focused into a single file as they pass through a spot illuminated by an illumination source (e.g., an arc lamp, laser). (EX1007, p.081; *see also* '107, 27:6-9; *see, e.g., id.*, 5:35-38, 30:50-53, 53:47-50; *see also* EX1002, ¶224.)

Cuvette 1 is “**configured to permit liquid to flow through the flow cell.**”

(EX1002, ¶225.) Chandler’s “conventional fluid pump **170**, for example, draws sample fluid **120** containing the cells and fluorescent microspheres out of a sample fluid container **160** and presents a drop of the sample fluid **120** into the flow of the sheath fluid **110** at approximately the neck down region of the cuvette **1**.” (Chandler, 9:5-10, 9:13-16.) When the sheath fluid reaches the neck down region of cuvette **1**, the reduced cross-section of this region causes the sheath fluid **110** to accelerate, elongating the sample fluid **120** within the sheath fluid **110** and causing particles to “form a substantially single file” before reaching the illumination region in cuvette **1**. (*Id.*, 9:16-25.)

c. Claim 16[b]: “a laser configured to project light into the flow cell;”

Chandler discloses Claim 16[b]. (EX1002, ¶226.) Chandler’s flow cytometer includes “four standard laser diodes, or light emitting sources, **10, 12, 14, 16** ... [that] surround the periphery of the viewing chamber **1**.” (Chandler, 7:1-4, FIG. 4.)

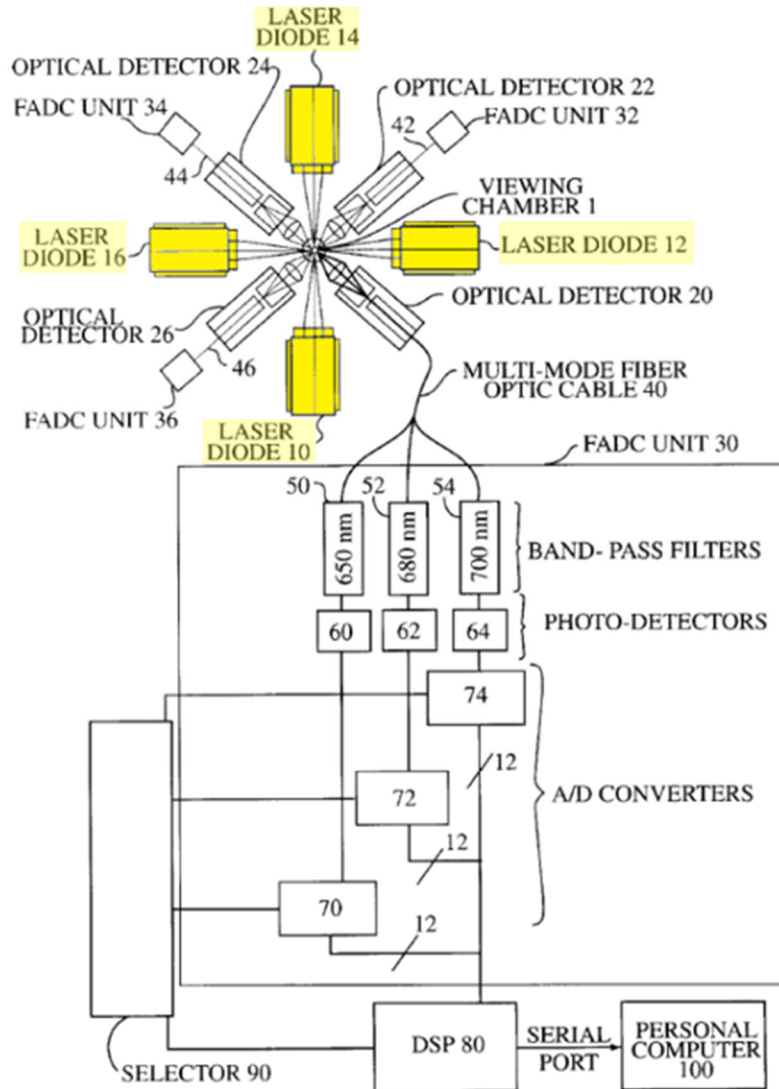


FIG. 4

(*Id.*, FIG. 4 (annotated).)

The laser diodes are “**configured to project light into the flow cell.**” (EX1002, ¶227.) Chandler’s “sample fluid **120**” in cuvette **1** is “illuminated by one of the light sources for a period of time,” and specifically, “as a particle enters the focal region, it is illuminated by one of the four laser diodes **10, 12, 14, 16** for example, laser diode **10**, for about one microsecond, by way of illustration.”

d. Claim 16[c]: “a multimode optical fiber configured to receive light from the flow cell; and”

The combination of Chandler and Goodman discloses Claim 16[c] for the reasons provided for Claim 1[a], incorporated here. (EX1002, ¶228.) Both Chandler and Goodman identify that their respective optical fibers are “**multimode optical fibers.**” (Chandler, 7:35-37, 9:52-54, FIG. 4; Goodman, 14:15-17.)

e. Claim 16[d]: “a wavelength division multiplexer (WDM) configured to receive light from the multimode optical fiber, wherein the WDM comprises:”

The combination of Chandler and Goodman discloses Claim 16[d] for the reasons provided for Claim 1[b], incorporated here. (EX1002, ¶229.)

f. Claim 16[e]: “a plurality of mirrors,”

The combination of Chandler and Goodman discloses Claim 16[e] for the reasons provided for Claim 1[c], incorporated here. A POSA would have understood that an “array of mirrors” as in Claim 1[c] constitutes a “plurality,” which means more than one. (*See also* Goodman, 4:50-53; EX1002, ¶230.)

g. Claim 16[e][i]: “wherein at least one of the mirrors is a concave mirror;”

The combination of Chandler and Goodman discloses Claim 16[e][i] for the reasons provided for Claim 3, incorporated here. (EX1002, ¶231.)

h. Claim 16[f]: “a plurality of filters; and”

The combination of Chandler and Goodman discloses Claim 16[f] for the

reasons provided for Claim 1[d], incorporated here, as a POSA would have understood that an “array of filters” in Claim 1[d] constitutes a plurality. (*See also* Goodman, 4:48-50; EX1002, ¶232.)

- i. **Claim 16[g]: “a plurality of avalanche photodiodes (APDs) configured to receive light that passed through one or more filters of the plurality of filters;”**

The combination of Chandler and Goodman discloses Claim 16[g] for the same reasons provided for Claim 1[e], incorporated here, as a POSA would have understood that an “array of avalanche photodiodes (APDs)” in Claim 1[e] constitutes a plurality. (EX1002, ¶233.)

- j. **Claim 16[h]: “wherein each of the plurality of filters is configured to receive light such that: a portion of light passes through the filter; and another portion of light is reflected; and”**

Goodman discloses Claim 16[h] for the reasons provided for Claim 1[f], incorporated here. (EX1002, ¶234.)

- k. **Claim 16[i]: “wherein each of the plurality of mirrors is configured to: receive light reflected by a filter of the plurality of filters; and reflect light to another filter of the plurality of filters.”**

Goodman discloses Claim 16[i] for the reasons provided for Claim 1[g], incorporated here. (EX1002, ¶235.)

- 16. Dependent Claim 17: “The flow cytometer of claim 16, wherein the WDM further comprises: a plurality of focusing lenses, wherein each of the plurality of focusing lenses is configured to focus light that passed through a filter of the plurality of filters to a spot on an APD of the plurality of APDs, wherein the spot has a diameter that is smaller than a diameter of a core of the multimode optical fiber.”**

The combination of Chandler and Goodman discloses Claim 17 for the same reasons provided for Claim 13, incorporated here. (EX1002, ¶236.)

- 17. Dependent Claim 18: “The flow cytometer of claim 17, wherein for each of the plurality of focusing lenses, the diameter of the spot is less than 1 mm.”**

The combination of Chandler and Goodman discloses Claim 18 for the same reasons provided for Claim 14, incorporated here. (EX1002, ¶237.)

- 18. Dependent Claim 20: “The flow cytometer of claim 16, wherein the plurality of mirrors includes more than one concave mirror.”**

Goodman discloses Claim 20 for the same reasons provided for Claim 3, incorporated here. (EX1002, ¶238.)

- 19. Dependent Claim 21: “The flow cytometer of claim 20, wherein the WDM is configured such that a portion of an optical path between the plurality of mirrors and the plurality of filters forms a zig-zag pattern.”**

The combination of Chandler and Goodman discloses Claim 21 for the same reasons provided for Claim 5, incorporated here. (EX1002, ¶239.)

- 20. Dependent Claim 22: “The flow cytometer of claim 21, wherein the laser is configured to emit blue light, yellow-green light, violet light, or ultraviolet light.”**

The combination of Chandler and Goodman discloses Claim 22 for the same reasons provided for Claim 6, incorporated here. (EX1002, ¶240.)

- 21. Dependent Claim 26: “The flow cytometer of claim 22, wherein: the WDM further comprises a block comprising a first surface; and each of the plurality of filters is coupled to the first surface of the block.”**

The combination of Chandler and Goodman discloses Claim 26 for the same reasons provided for Claim 10, incorporated here. (EX1002, ¶241.)

- 22. Dependent Claim 27: “The flow cytometer of claim 26, wherein the flow cytometer is a benchtop flow cytometer.”**

The combination of Chandler and Goodman discloses Claim 27 for the same reasons provided for Claim 7, incorporated here. (EX1002, ¶242.)

- 23. Dependent Claim 28: “The flow cytometer of claim 26, wherein the flow cytometer is compact.”**

The combination of Chandler and Goodman discloses Claim 28 for the same reasons provided for Claim 8, incorporated here. (EX1002, ¶243.)

- 24. Dependent Claim 29: “The flow cytometer of claim 28, wherein the WDM is capable of detecting a substantially full spectrum of visible light.”**

The combination of Chandler and Goodman discloses Claim 29 for the same reasons provided for Claim 9, incorporated here. (EX1002, ¶244.)

25. Dependent Claim 30: “The flow cytometer of claim 29, wherein: the plurality of mirrors comprise five or more mirrors; and the plurality of filters comprise six or more filters.”

Goodman renders obvious Claim 30. Goodman explains that “one skilled the art will recognize ... that a greater or lesser number of filters may be used, for example two, eight or sixteen, depending on the number of channels to be demultiplexed.” (Goodman, 8:29-33.) Given that the reflectors are positioned opposite the wavelength selective elements, a POSA would also have understood that an expansion to use “eight or sixteen” filters would have also required a similar addition of corresponding reflectors. (*Id.*, 9:61-65; *see also id.*, 12:40-44; EX1002, ¶245.)

C. Ground 9: Chandler in View of Goodman and Hamamatsu Render Obvious Claims 13, 14, 17, and 18

1. Motivation to Combine Chandler and Goodman with Hamamatsu and Reasonable Expectation of Success

A POSA would have been motivated to use APDs and combine the Chandler-Goodman optical subsystem with Hamamatsu to further reduce footprint and improve signal-to-noise ratio by using an APD with a small active area size. (EX1002, ¶247.) Given the well-known benefits of APDs in flow cytometers and the existing commercially available flow cytometers using APDs by 2011, a POSA would have had reasonable expectation of success that APDs could be used in the Chandler-Goodman optical subsystem. (EX1002, ¶¶248-249; *see also* Chandler,

5:29-31.)

2. Dependent Claim 13

The combination of Chandler and Goodman discloses Claim 13 for the same reasons provided for Claim 13 in Ground 8. Hamamatsu expressly discloses what a POSA would have generally known at the time of invention—commercially available APDs that detect over the full visible light spectrum with active area diameters at or smaller than 1 mm. (See EX1055, p.001; EX1056, p.001; EX1060; EX1061; EX1002, ¶¶250-251.)

3. Dependent Claim 14

The combination of Chandler, Goodman, and Hamamatsu discloses Claim 14 for the same reasons provided for Claim 14 in Ground 8 and for Claim 13 in this Ground related to Hamamatsu's disclosures. (EX1002, ¶252.)

4. Dependent Claim 17

The combination of Chandler, Goodman, and Hamamatsu discloses Claim 17 for the same reasons provided for Claim 17 in Ground 8 and for Claim 13 in this Ground related to Hamamatsu's disclosures. (EX1002, ¶253.)

5. Dependent Claim 18

The combination of Chandler, Goodman, and Hamamatsu discloses Claim 17 for the same reasons provided for Claim 18 in Ground 8 and for Claim 13 in this Ground related to Hamamatsu's disclosures. (EX1002, ¶254.)

D. Ground 10: Oostman, Goodman, and Frazier Render the Challenged Claims Obvious

1. Motivation to Combine Oostman and Goodman and Reasonable Expectation of Success

A POSA would have found it obvious to combine Oostman's flow cytometers with Goodman's teachings regarding its wavelength division (de)multiplexer devices. (EX1002, ¶255.) Oostman, as modified by Goodman, would have predictably resulted in the substitution of Oostman's detector array cluster arrangements with Goodman's more modular, compact, and efficient optical block demultiplexers that included Oostman's collimating lens.

A POSA would have been motivated to combine Oostman's flow cytometers with Goodman's teachings regarding its modular, efficient, cost-effective optical block demultiplexers. (EX1002, ¶255-256.) Oostman and Goodman both identified and proposed a solution for the same problem, which is to develop a WDM device that is compact and cost-effective, and at the same time, capable of separating colors and detecting light over a wide range of wavelengths. (Oostman, 2:60-64, 3:39-41, 3:53-55, 4:14-16; Goodman, 1:8-12; EX1002, ¶¶256-258.) Further, a POSA would have been motivated to combine Oostman's teachings with the teachings of Goodman regarding an optical block. Optical alignment is critical to WDM operation, particularly in Oostman's non-integrated designs where light propagates through air and optical components are oriented/fixated through holders. (Oostman,

8:48-59, FIGs. 9-11.) Optical alignment and calibration were known technical challenges that practitioners actively attempted to solve in flow cytometer applications. (*See, e.g.*, EX1030, pp.013-014; EX1007, p.089; EX1002, ¶257.)

Oostman and Goodman are analogous references in the same fields of the alleged invention related to optical fibers and, more particularly, modular optical instruments for color separation and detection. (Oostman, 1:8-12, 5:34-40; Goodman, 1:8-12, 3:48-67, 6:19-35; *see also, e.g.*, '107, 2:45; *see* EX1002, ¶258.) Other prior art references discussed in the motivation to combine analysis for Ground 8 confirm this motivation to develop such a device. (EX1002, ¶259.) The combined Oostman-Goodman device would have resulted in a flow cytometer with the zig-zag WDM configuration by substituting Oostman's polygonal WDMs with Goodman's more modular, efficient, cost-effective zig-zag WDM. (EX1002, ¶¶260-262.)

Lastly, a POSA would have had a reasonable expectation that the combination would have been successful given that both Goodman and Oostman disclosed that their configurations are adaptable. (Oostman, 3:39-41, 4:44-45; Goodman, 3:65-67, 6:19-24; *see also, e.g.*, '107, 4:62-5:5, 44:25-33; EX1002, ¶263.) The '107 specification confirms that a WDM from the optical communication industry can be “readily adapted for fluorescence light detection,” as such a WDM is “almost identical in function and architecture” to WDMs used in flow cytometry. ('107,

4:62-5:5, 44:25-33.)

2. Motivation to Combine Oostman and Goodman with Frazier and Reasonable Expectation of Success

A POSA would have been motivated to combine the Oostman-Goodman optical subsystem with Frazier's teachings on the use of APDs within its WDM to further reduce footprint of a flow cytometer while expanding color separation and increasing detection sensitivity capabilities. (EX1002, ¶264.)

Oostman, Goodman, and Frazier are analogous references in the same field as the alleged invention related to wavelength division demultiplexing, fluorescence detection, and/or flow cytometry. (*See, e.g.*, Oostman, 1:8-12, 5:34-40; Goodman, 1:8-12, 3:48-67, 6:19-35; Frazier, Abstract, 1:15-20, 4:5-13.) Frazier discloses a zig-zag WDM configuration similar to Goodman's albeit with a central boulevard design. (*Compare, e.g.*, Frazier, FIG. 1, *with* Goodman, FIG. 1.) (EX1002, ¶265.)

A POSA would have understood the benefits of using APDs (*see* Section V.C) in developing a more compact flow cytometer with expanded color separation and more sensitive detection capabilities. (EX1002, ¶266.) A POSA would have further found these technical features of APDs to be highly desirable over PMTs, including because APDs are significantly smaller than larger PMTs with bulkier housings. (EX1035, 6:10-13; EX1037, p.009; EX1036, pp.003, 006; EX1038, p.010; EX1039, p.002; EX1032, p.001; *see also* EX1060, EX1061, EX1062; EX1002, ¶266.)

Given the well-known benefits of APDs in flow cytometers and the existing commercially available flow cytometers using APDs by 2011, a POSA would have had a reasonable expectation of success that APDs could be used in the Oostman-Goodman optical subsystem. (EX1002, ¶267; *see also* Chandler, 5:29-31.) With relative ease, researchers in the field had already demonstrated that PMTs can be successfully substituted with APDs in a commercial system (LSR-II) that embodied Oostman's polygonal arrangement. (EX1036, p.006; EX1002, ¶267.)

A POSA would not have anticipated any additional technical hurdles from implementing APDs, as opposed to using bulkier PMTs with Goodman's zig-zag WDM configuration in the Oostman flow cytometer system. Frazier's zig-zag WDM configuration is substantively similar to Goodman's zig-zag WDM configuration and discloses use of APDs. And, as discussed in Section V.C, skilled artisans had already long since resolved the technical issues that early APD adopters had encountered when using APDs in flow cytometry applications (e.g., temperature dependence, high dark current). (EX1002, ¶267.)

3. Independent Claim 1

a. Claim 1[pre]: "A flow cytometer comprising:"

Oostman discloses a "**flow cytometer.**" Oostman's "preferred embodiment features a flow cytometer" that is "illustrative of instruments which employ fluorescence detection and color separation." (Oostman, 5:34-37.) Oostman's FIG.

4 depicts a flow cytometer setup. (EX1002, ¶269.)

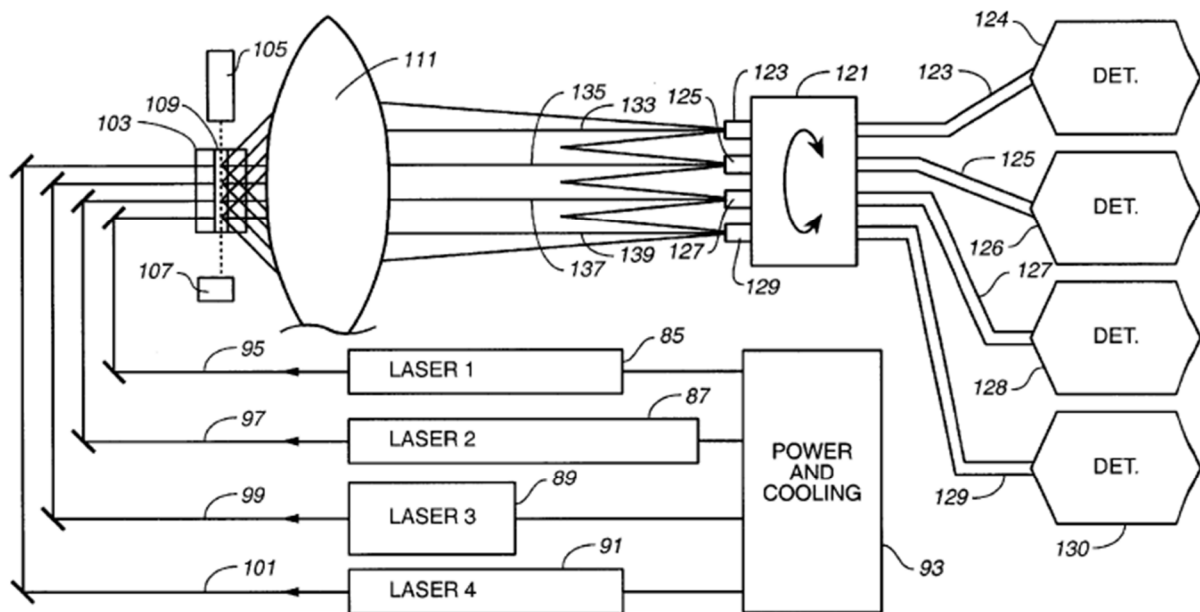


FIG. 4

(Oostman, FIG. 4.)

b. Claim 1[a]: “an optical fiber; and”

Goodman and Oostman disclose Claim 1[a]. Oostman discloses an “**optical fiber.**” After light from multiple lasers intersects the flow stream and interacts with fluorescent-marked particles in a fluid sample to cause scattering and fluorescence, a light collector “gathers fluorescent light from the fluorescent target material” and focuses the light into several optical fibers **123, 125, 127, 129**. (Oostman, 5:58-66, 6:12-13.)

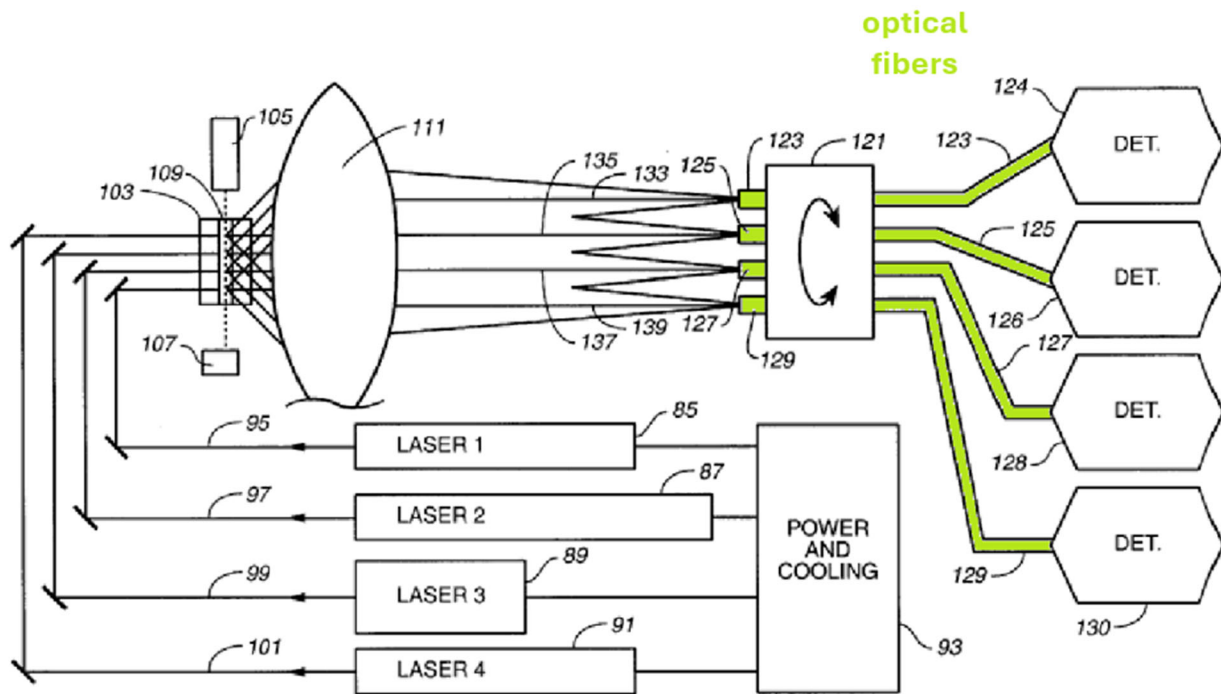


FIG. 4

(*Id.*, FIG. 4 (annotated).)

Goodman also discloses an **“optical fiber”** for the same reasons provided for Claim 1[a] in Ground 8 with respect to Goodman, incorporated here. (EX1002, ¶271.)

- c. **Claim 1[b]: “a wavelength division multiplexer (WDM) configured to receive light from the optical fiber, wherein the WDM comprises:”**

The combination of Goodman and Oostman discloses Claim 1[b]. “[L]ight in each of the fibers **123, 125, 127 and 129** is transmitted to a respective detector cluster **124, 126, 128 and 130** which houses an array of detectors.” (Goodman, 6:26-28.) A POSA would have understood Oostman’s “array of detectors” to be wavelength

division [de]multiplexers, as Oostman describes how the “array processes fluorescent light” and “[e]ach array of detectors differentially separates bands of light by filtering, using coatings on beam splitters and lenses, in a known manner.” (*Id.*, 6:28-36; *see also* EX1002, ¶272.)

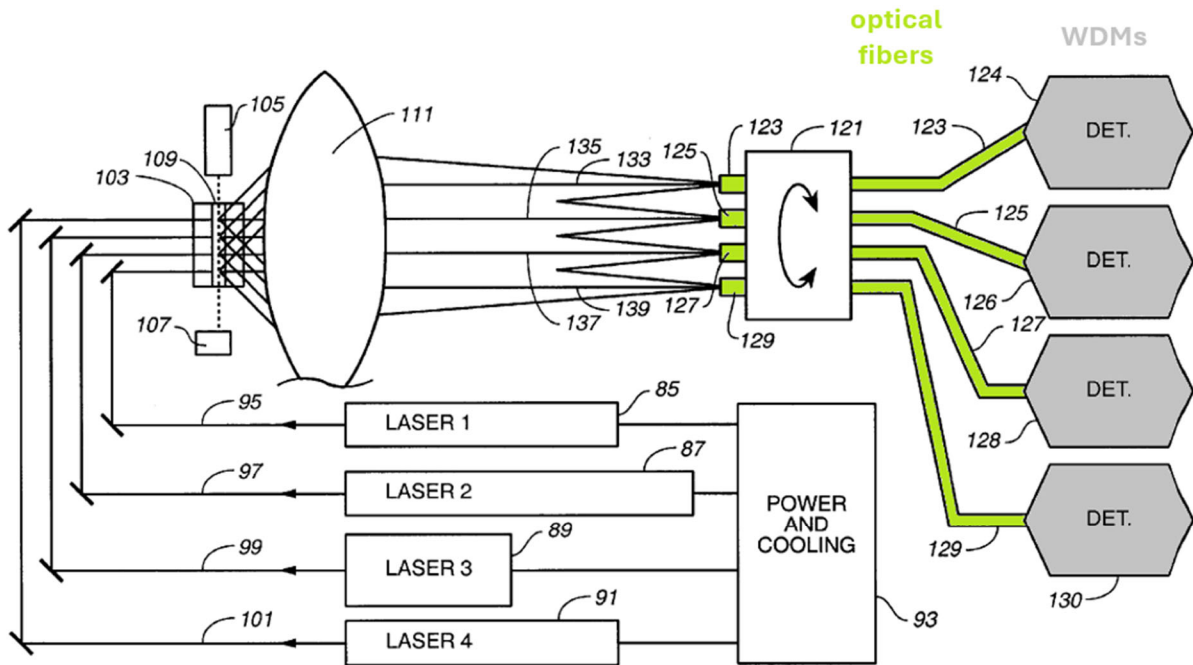


FIG. 4

(Oostman, FIG. 4 (annotated).)

The combination of Oostman and Goodman replaces Oostman’s polygonal detector arrays with Goodman’s alternate, known zig-zag demultiplexing configuration. (EX1002, ¶273.)

d. Claim 1[c]: “an array of mirrors;”

Goodman discloses Claim 1[c] for the same reasons provided for Claim 1[c]

in Ground 8, incorporated here. (EX1002, ¶274.)

e. Claim 1[d]: “an array of filters; and”

Goodman discloses Claim 1[d] for the same reasons provided for Claim 1[d] in Ground 8, incorporated here. (EX1002, ¶275.)

f. Claim 1[e]: “an array of avalanche photodiodes (APDs) configured to receive light that passed through one or more filters in the array of filters;”

The combination of Goodman and Frazier discloses Claim 1[e]. For the same reasons provided in Claim 1[e] in Ground 8, Goodman generally teaches an array of focusing lenses where each focusing lens may “focus a selected wavelength beam onto a corresponding optical receiver such as an optical detector.” (Goodman, 11:40-42). Frazier teaches that its photodetectors can include “photo avalanche detectors” (i.e., “APDs”). (Frazier, 4:19-21.) The “**array of avalanche photodiodes (APDs)**” in the combined Oostman-Goodman-Frazier system are Frazier’s APDs, “optical detectors” each associated with a focusing lens in Goodman’s set of focusing lenses **42**. (EX1002, ¶¶276-277.)

g. Claim 1[f]: “wherein each of the filters in the array of filters is configured to receive light such that: a portion of the light passes through the filter; and another portion of the light is reflected; and”

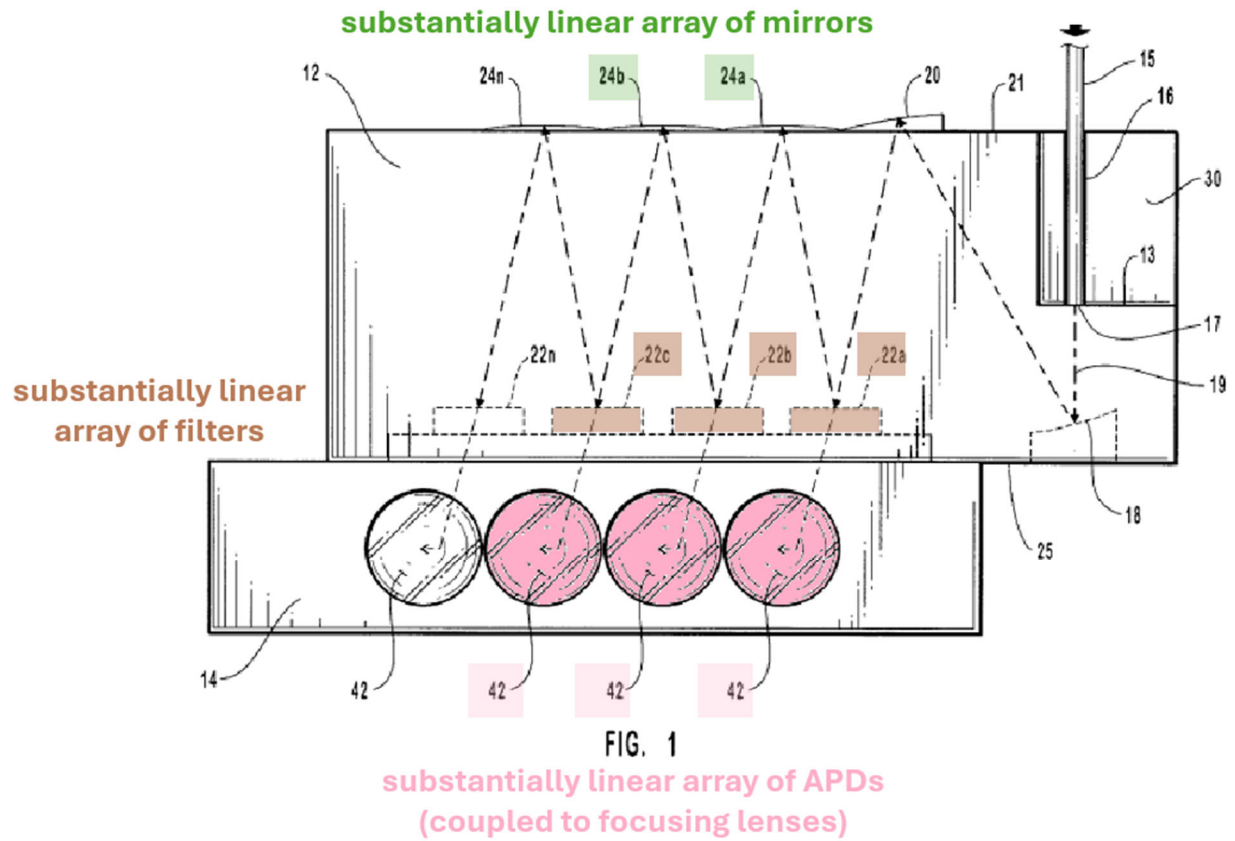
Goodman discloses Claim 1[f] for the same reasons provided for Claim 1[f] in Ground 8, incorporated here. (EX1002, ¶278.)

- h. Claim 1[g]: “wherein each of the mirrors in the array of mirrors is configured to: receive light reflected by a filter in the array of filters; and reflect light to another filter in the array of filters.”**

Goodman discloses Claim 1[g] for the same reasons provided for Claim 1[g] in Ground 8, incorporated here. (EX1002, ¶279.)

4. Dependent Claim 2

Goodman discloses Claim 2 for the same reasons provided for Claim 2 in Ground 8, fully incorporated here. A POSA would also have understood that Frazier’s array of APDs, optically coupled to Goodman’s linearly arranged focusing lenses, would also be linearly arranged. (Goodman, 11:37-42.) FIG. 1 shows “**substantially linear**” arrays. (EX1002, ¶280.)



(Goodman, FIG. 1 (annotated).)

5. Dependent Claim 3

Goodman discloses Claim 3 for the same reasons provided for Claim 3 in Ground 8, incorporated here. (EX1002, ¶281.)

6. Dependent Claim 5

Goodman discloses Claim 5 for the same reasons provided for Claim 5 in Ground 8, incorporated here. (EX1002, ¶282.)

7. Dependent Claim 6

A POSA would have understood that Oostman teaches Claim 6. (EX1002, ¶283.) Each of Oostman's laser beams "has a characteristic color produced by

different types of lasing material,” such as “argon ion lasers, copper vapor lasers, and helium neon lasers.” (Oostman, 5:46-61.) Argon ion lasers include lasing wavelengths considered “**blue light**” at 351 nm, 364 nm, 458 nm, and 477 nm. (EX1085.) Argon-ion lasers also include lasing wavelengths considered “**yellow-green light**” at 488 nm, 515 nm, and 529 nm. (*Id.*) Helium neon lasers may emit “**yellow-green light**” and were available at 543 nm and 594 nm as early as 2003. (EX1007, p.132.) Copper vapor lasers also emit “**yellow-green light**” at 510 nm (green) and 578 nm (yellow). (EX1086, p.002.)

8. Dependent Claim 7

The term “**benchtop flow cytometer**” only appears within the ’107 claims and is absent from the specification. Nevertheless, a POSA would have understood the Oostman-Goodman-Frazier system to disclose a benchtop flow cytometer. Each of Oostman’s “array of detectors is arranged in a polygonal compact cluster,” (Oostman, 3:34-35 (underlining added); *see also id.*, Abstract), and Goodman’s WDM is (advantageously) compact, (Goodman, Title, 1:1-2, 1:8-12, 3:65-67, 5:42-45). Frazier’s invention provides a solution for prior art detector arrays utilizing a boulevard arrangement that would have had an “unnecessarily large footprint.” (Frazier, 6:61-7:1.) Oostman, as modified to include Goodman’s compact WDMs and Frazier’s APDs, would have predictably resulted in a “**benchtop flow cytometer**.” (EX1002, ¶284.)

9. Dependent Claim 8

A POSA would have found the Oostman-Goodman-Frazier system to disclose Claim 8 for the same reasons provided for Claim 7, fully incorporated here. A POSA would have further pursued Oostman's and Frazier's design goals by incorporating Goodman's compact WDM, (Goodman, Title, 1:1-2, 1:8-12, 3:65-67, 5:42-45), resulting in the Oostman-Goodman-Frazier "**compact**" flow cytometer, utilizing the zig-zag detector arrangement and APDs. (*See also supra* Section XI.D.1; EX1002, ¶285.)

10. Dependent Claim 9

Claim 9 lacks written description support and is not enabled for the same reasons provided in Grounds 5 and 6. (*See supra* Grounds 5, 6; EX1002, ¶286.)

To the extent Patent Owner contends that Claim 9 captures a WDM capable of processing light where excitation wavelengths from light sources may span the visible light spectrum, Oostman discloses Claim 9. Each of Oostman's laser beams "has a characteristic color produced by different types of lasing material," such as "argon ion lasers, copper vapor lasers, and helium neon lasers." (Oostman, 5:46-61.) Accounting for varying power levels, the excitation wavelengths for these exemplary lasers in the UV-to-visible light range span substantially the full visible light spectrum because they may include 458 nm (Ar-ion), 477 nm (Ar-ion), 488 nm (Ar-ion), 510 nm (copper vapor), 515 nm (Ar-ion), 529 nm (Ar-ion), 543 nm (He-

Ne), 578 nm (copper vapor), and 594 nm (He-Ne). (EX1007, pp.129-130, 132; EX1085; EX1086; *see also* EX1002, ¶287.)

To the extent Patent Owner argues that Claim 9 contemplates a WDM that can separate short-wavelength light into color bands that substantially cover the full visible light spectrum, the combination of Oostman, Goodman, and Frazier discloses Claim 9 for the same reasons provided for Claim 9 in Ground 8. (EX1002, ¶288.)

11. Dependent Claim 10

Goodman discloses Claim 10 for the same reasons provided for Claim 10 in Ground 8, incorporated here. (EX1002, ¶289.)

12. Dependent Claim 11

The combination of Oostman, Goodman, and Frazier discloses Claim 11 for the same reasons provided for Claim 7, incorporated here. (EX1002, ¶290.)

13. Dependent Claim 12

The combination of Oostman, Goodman, and Frazier discloses Claim 12 for the same reasons provided for Claim 8, incorporated here. (EX1002, ¶291.)

14. Dependent Claim 13

The combination of Oostman, Goodman, and Frazier, in view of a POSA's general knowledge regarding the state of the art in small-area APDs by December 2011 and later, renders obvious Claim 13 for the same reasons provided for Claim 13 in Ground 8, incorporated here. The APDs in the Oostman-Goodman-Frazier

system are taught by Frazier. (EX1002, ¶292.)

15. Dependent Claim 14

The combination of Oostman, Goodman, and Frazier, in view of a POSA's general knowledge regarding the state of the art in small-area APDs by December 2011 and later, renders obvious Claim 14 for the same reasons provided for Claim 14 in Ground 8, incorporated here. (EX1002, ¶293.)

16. Independent Claim 16

a. Claim 16[pre]: “A flow cytometer comprising:”

The combination of Oostman, Goodman, and Frazier discloses Claim 16[pre] for the same reasons provided for Claim 1[pre], incorporated here. (EX1002, ¶294.)

b. Claim 16[a]: “a flow cell configured to permit liquid to flow through the flow cell;”

Oostman discloses Claim 16[a]. Oostman's “**flow cell**” is a “fluidic system **105**” that “feeds tagged target liquid substances into a stream **103** in a controlled manner.” (Oostman, 5:41-42.) Fluidic system **105** includes a flow channel **109** that is “**configured to permit liquid to flow through the flow cell**” via flow stream **103**. (*Id.*, 5:42-44, 5:58-61.) FIG. 4 depicts fluidic system **105** that includes flow channel **109** (in pink) that enables passage of sample material (in red) in flow stream **103** (in orange). (EX1002, ¶295.)

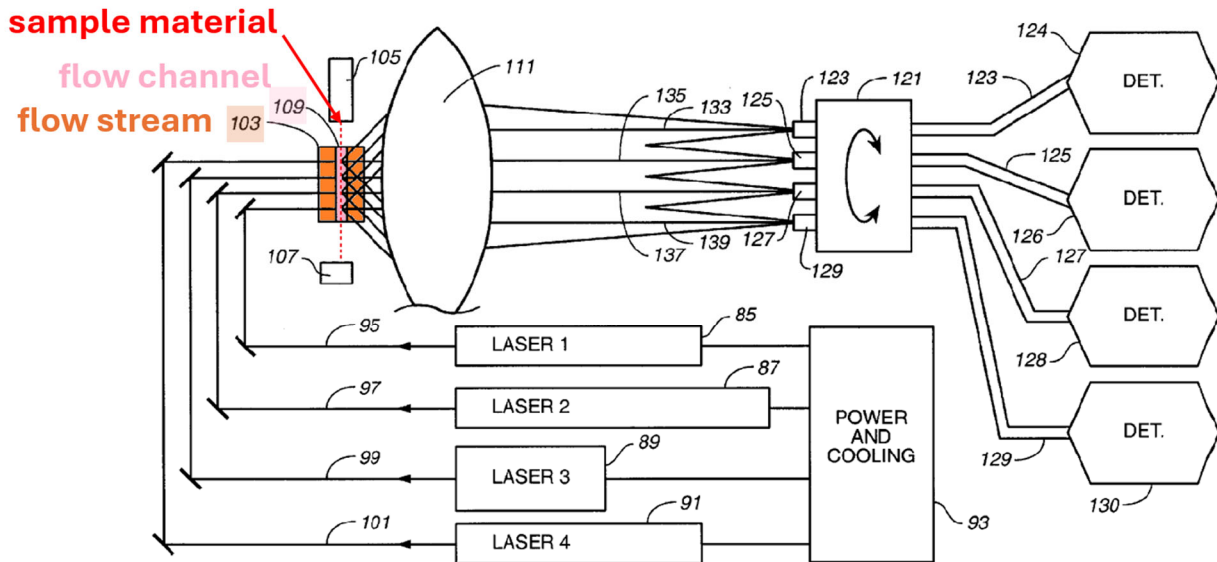


FIG._4

(Oostman, FIG. 4 (annotated).)

c. Claim 16[b]: “a laser configured to project light into the flow cell;”

Oostman discloses Claim 16[b]. Each of Oostman’s “a first laser **85**, a second laser **87**, a third laser **89**, and a fourth laser **91**” that “all produce light with unique wavelength profiles” discloses “a laser” that is “**configured to project light into the flow cell.**” (Oostman, 5:28-30.) “Light of different colors intersects the flow stream **103** and interacts with fluid sample causing scattering and fluorescence that is spatially separated along a line parallel to the flow channel **109.**” (*Id.*, 5:42-44, 5:58-61 (underlining added).) FIG. 4 shows first laser (in purple) projecting light into the flow stream **103** (in orange) and flow channel **109** (in pink) part of the flow cell. (EX1002, ¶¶296-297.)

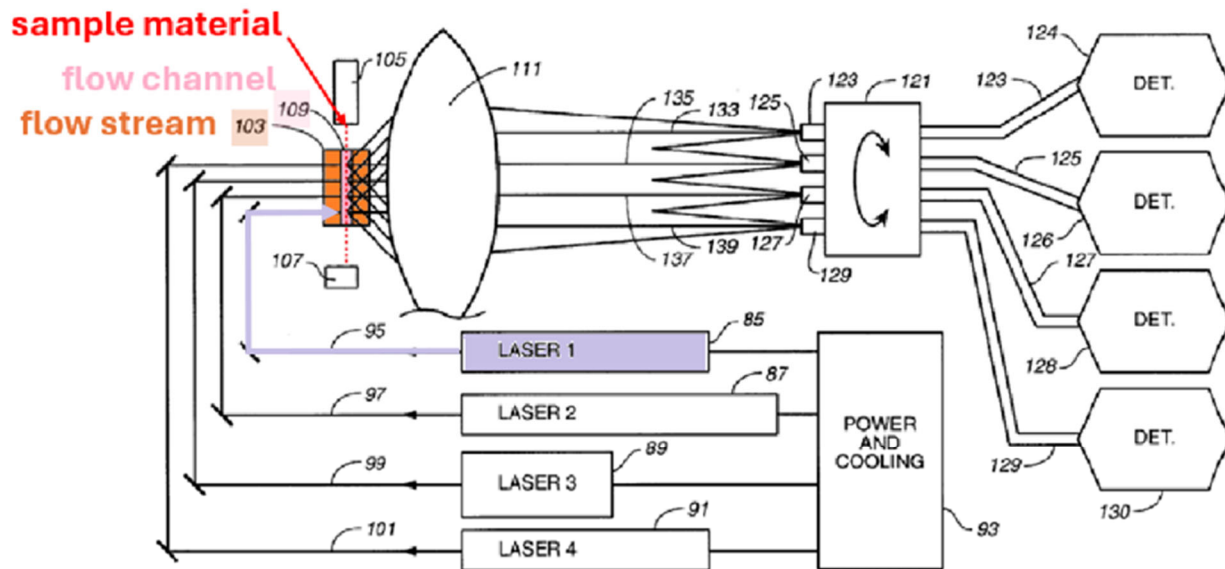


FIG._4

(Oostman, FIG. 4 (annotated).)

d. Claim 16[c]: “a multimode optical fiber configured to receive light from the flow cell; and”

The combination of Oostman, Goodman, and Frazier discloses Claim 16[c] for the same reasons provided for Claim 1[a], incorporated here. “The focal spots produced by collector **111** enter the tip of each respective fiber **123**, **125**, **127** and **129**, each of which is a multi-mode fiber.” (Oostman, 6:4-7, 6:26-28, 6:34-39 (underlining added); *see also* EX1002, ¶298.)

e. Claim 16[d]: “a wavelength division multiplexer (WDM) configured to receive light from the multimode optical fiber, wherein the WDM comprises:”

The combination of Oostman, Goodman, and Frazier discloses Claim 16[d] for the same reasons provided for Claim 1[b], incorporated here. (EX1002, ¶299.)

f. Claim 16[e]: “a plurality of mirrors,”

Goodman discloses Claim 16[e] for the reasons provided for Claims 1[c] in this Ground and 16[e] in Ground 8, incorporated here. (EX1002, ¶300.)

g. Claim 16[e][i]: “wherein at least one of the mirrors is a concave mirror;”

Goodman discloses Claim 16[e][i] for the reasons provided for Claim 3 in Ground 8, incorporated here. (EX1002, ¶301.)

h. Claim 16[f]: “a plurality of filters; and”

Goodman discloses Claim 16[f] for the reasons provided for Claims 1[d] and 16[f] in Ground 8, incorporated here. (EX1002, ¶302.)

i. Claim 16[g]: “a plurality of avalanche photodiodes (APDs) configured to receive light that passed through one or more filters of the plurality of filters;”

The combination of Oostman, Goodman, and Frazier discloses Claim 16[g] for the same reasons provided for Claim 1[e], incorporated here, as a POSA would have understood that an “array of avalanche photodiodes (APDs)” in Claim 1[e] constitutes a plurality. (EX1002, ¶303.)

j. Claim 16[h]: “wherein each of the plurality of filters is configured to receive light such that: a portion of light passes through the filter; and another portion of light is reflected; and”

Goodman discloses Claim 16[h] for the reasons provided for Claim 1[f] in Ground 8, incorporated here. (EX1002, ¶304.)

- k. Claim 16[i]: “wherein each of the plurality of mirrors is configured to: receive light reflected by a filter of the plurality of filters; and reflect light to another filter of the plurality of filters.”**

Goodman discloses Claim 16[i] for the reasons provided for Claim 1[g] in Ground 8, incorporated here. (EX1002, ¶305.)

17. Dependent Claim 17

The combination of Oostman, Goodman, and Frazier discloses Claim 17 for the same reasons provided for Claim 13, incorporated here. (EX1002, ¶306.)

18. Dependent Claim 18

The combination of Oostman, Goodman, and Frazier discloses Claim 18 for the same reasons provided for Claim 14, incorporated here. (EX1002, ¶307.)

19. Dependent Claim 20

Goodman discloses Claim 20 for the same reasons provided for Claim 20 in Ground 8, incorporated here. (EX1002, ¶308.)

20. Dependent Claim 21

Goodman discloses Claim 21 for the same reasons provided for Claim 5 in Ground 8, incorporated here. (EX1002, ¶309.)

21. Dependent Claim 22

The combination of Oostman, Goodman, and Frazier discloses Claim 22 for the same reasons provided for Claim 6, incorporated here. (EX1002, ¶310.)

22. Dependent Claim 26

Goodman discloses Claim 26 for the same reasons provided for Claim 10 in Ground 8, incorporated here. (EX1002, ¶311.)

23. Dependent Claim 27

The combination of Oostman, Goodman, and Frazier discloses Claim 27 for the same reasons provided for Claim 7, incorporated here. (EX1002, ¶312.)

24. Dependent Claim 28

The combination of Oostman, Goodman, and Frazier discloses Claim 28 for the same reasons provided for Claim 8, incorporated here. (EX1002, ¶313.)

25. Dependent Claim 29

The combination of Oostman, Goodman, and Frazier discloses Claim 29 for the same reasons provided for Claim 9, incorporated here. (EX1002, ¶314.)

26. Dependent Claim 30

Goodman discloses Claim 30 for the same reasons provided Claim 30 in Ground 8, fully incorporated here. (EX1002, ¶315.)

E. Ground 11: Oostman in View of Goodman, Frazier, and Hamamatsu Render Obvious Claims 13, 14, 17 and 18

1. Motivation to Combine Oostman, Goodman, and Frazier with Hamamatsu and Reasonable Expectation of Success

A POSA would have been motivated to combine Oostman, Goodman, and Frazier with Hamamatsu for the same reasons provided with respect to Ground 9. (EX1002, ¶316.)

2. Dependent Claim 13

The combination of Oostman, Goodman, and Frazier discloses Claim 13 for the same reasons provided for Claim 13 in Ground 10, fully incorporated here. Hamamatsu merely makes express what would have been well-known to a POSA at the time of invention as explained for Claim 13 in Ground 9 related to Hamamatsu. (EX1002, ¶317.)

3. Dependent Claim 14

The combination of Oostman, Goodman, Frazier, and Hamamatsu discloses Claim 14 for the same reasons provided for Claim 14 in Ground 10 and for Claim 13 in Ground 9 related to Hamamatsu's disclosures. (EX1002, ¶318.)

4. Dependent Claim 17

The combination of Oostman, Goodman, Frazier, and Hamamatsu discloses Claim 17 for the same reasons provided for Claim 17 in Ground 10 and for Claim 13 in Ground 9 related to Hamamatsu's disclosures. (EX1002, ¶319.)

5. Dependent Claim 18

The combination of Oostman, Goodman, Frazier, and Hamamatsu discloses Claim 18 for the same reasons provided for Claim 18 in Ground 10 and for Claim 13 in Ground 9 related to Hamamatsu's disclosures. (EX1002, ¶320.)

XII. CONCLUSION

Petitioner respectfully requests institution.

Petition for Post-Grant Review of
U.S. Patent No. 12,174,107 B2

Dated: September 23, 2025

Respectfully submitted,

COOLEY LLP
ATTN: Patent Group
1299 Pennsylvania Avenue NW
Suite 700
Washington, DC 20004
Tel: (202) 776-2066
Fax: (202) 842-7899

By: / Dustin M. Knight /
Dustin M. Knight
(Reg. No. 76,239)
Counsel for Petitioner

CERTIFICATE OF COMPLIANCE WITH WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), I certify that this petition complies with the type-volume limits of 37 C.F.R. § 42.24(a)(1)(i) because it contains 17,576 words, according to the word-processing system used to prepare this petition, excluding the parts of this petition that are exempted by 37 C.F.R. § 42.24(a) (including the table of contents, a table of authorities, mandatory notices, a certificate of service or this certificate word count, appendix of exhibits, and claim listings).

DATED: September 23, 2025

COOLEY LLP
ATTN: Patent Docketing
1299 Pennsylvania Avenue NW
Suite 700
Washington, D.C. 20004
Tel: (202) 776-2066
Fax: (202) 842-7899

/ Dustin M. Knight /
Dustin M. Knight
(Reg. No. 76,239)

CERTIFICATE OF SERVICE

I hereby certify, pursuant to 37 C.F.R. Sections 42.6 and 42.105, that a complete copy of the attached **PETITION FOR POST-GRANT REVIEW OF U.S. PATENT NO. 12,174,107 B2**, including all exhibits (**Nos. 1001-1107**) and related documents, are being served via Federal Express on the 23rd day of September, 2025, the same day as the filing of the above-identified document in the United States Patent and Trademark Office/Patent Trial and Appeal Board, upon Patent Owner by serving the correspondence address of record with the USPTO as follows:

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

And, via Federal Express upon counsel of record for Patent Owner in the litigation pending before the U.S. District Court for the District of Delaware titled *Beckman Coulter, Inc. v. Cytek Biosciences, Inc.*, No. 1:24-cv-00945-CFC-EGT (D. Del.) as follows:

Frederick L. Cottrell III
Kelly E. Farnan
Christine D. Haynes
RICHARDS, LAYTON & FINGER P.A.
One Rodney Square
920 North King Street
Wilmington, DE 19801

Omar A. Khan
Jeffrey A. Dennhardt
Lauren E. Matlock-Colangelo
WILMER CUTLER PICKERING HALE
AND DORR LLP
7 World Trade Center
250 Greenwich Street
New York, NY 10007

Asher S. McGuffin
WILMER CUTLER PICKERING HALE
AND DORR LLP
60 State Street
Boston, MA 02109

DATED: September 23, 2025

/ Dustin M. Knight /
Dustin M. Knight
(Reg. No. 76,239)
COOLEY LLP
ATTN: Patent Docketing
1299 Pennsylvania Avenue
NW Suite 700
Washington, DC 20004
Tel: (202) 776-2066
Fax: (202) 842-7899