8552302

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

December 10, 2024

THIS IS TO CERTIFY THAT ANNEXED IS A TRUE COPY FROM THE RECORDS OF THIS OFFICE OF THE FILE WRAPPER AND CONTENTS OF:

APPLICATION NUMBER: ***17/858,825***
FILING DATE: ***July 06, 2022***
PATENT NUMBER: ***11648090***
ISSUE DATE: ***May 16, 2023***

Certified by

Katherine Kelly Vidal

Performing the Functions and Duties of the
Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

PTO/AIA/15 (10-17)
Approved for use through 11/30/2020. OMB 0651-0032
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	22773-826.310
First Named Inventor	Chunhua LI, et al.
Title	MULTILAYER POLYMER SHEETS
Priority Mail Express® Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☐ **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. ☐ **Applicant asserts small entity status.** See 37 CFR 1.27
3. ☐ **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. ☑ **Specification** [*Total Pages* 17] Both the claims and abstract must start on a new page. *(See MPEP § 608.01(a) for information on the preferred arrangement)*
5. ☑ **Drawing(s)** (35 U.S.C. 113) [*Total Sheets* 8]
6. **Inventor's Oath or Declaration** [*Total Pages* 6] *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))*
   a. ☐ Newly executed (original or copy)
   b. ☑ A copy from a prior application (37 CFR 1.63(d))
7. ☑ **Application Data Sheet** ** See note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R** in duplicate, large table, or Computer Program (*Appendix*)
   ☐ Landscape Table on CD
9. **Nucleotide and/or Amino Acid Sequence Submission** (*if applicable, items a. – c. are required*)
   a. ☐ Computer Readable Form (CRF)
   b. ☐ Specification Sequence Listing on:
      i. ☐ CD-ROM or CD-R (2 copies); or
      ii. ☐ Paper
   c. ☐ Statements verifying identity of above copies

ADDRESS TO: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450**

ACCOMPANYING APPLICATION PAPERS

10. ☐ **Assignment Papers** (cover sheet & document(s)) Name of Assignee _____
11. ☑ **37 CFR 3.73(c) Statement** (*when there is an assignee*) ☑ **Power of Attorney**
12. ☐ **English Translation Document** (*if applicable*)
13. ☐ **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    ☐ Copies of citations attached
14. ☐ **Preliminary Amendment**
15. ☐ **Return Receipt Postcard** (*MPEP § 503*) (*Should be specifically itemized*)
16. ☐ **Certified Copy of Priority Document(s)** (*if foreign priority is claimed*)
17. ☐ **Nonpublication Request** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. ☑ **Other:** Certification and Request for Prioritized Examination Under 37 CFR 1.102(e) - Track 1

***Note**: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

☑ The address associated with Customer Number: 107046 **OR** ☐ Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	

Signature	/Garrett T. Potter/	Date	July 6, 2022
Name (Print/Type)	Garrett T. POTTER	Registration No. (Attorney/Agent)	76,602

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

Doc Code: TRACK1.REQ
Document Description: TrackOne Request

PTO/AIA/424 (04-14)

CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e) (Page 1 of 1)

First Named Inventor:	Chunhua LI, et al.	Nonprovisional Application Number (if known):	
Title of Invention:	MULTILAYER POLYMER SHEETS		

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i)(1) and the prioritized examination fee set forth in 37 CFR 1.17(c) have been filed with the request. The publication fee requirement is met because that fee, set forth in 37 CFR 1.18(d), is currently $0. The basic filing fee, search fee, and examination fee are filed with the request or have been already been paid. I understand that any required excess claims fees or application size fee must be paid for the application.

2. I understand that the application may not contain, or be amended to contain, more than four independent claims, more than thirty total claims, or any multiple dependent claims, and that any request for an extension of time will cause an outstanding Track I request to be dismissed.

3. The applicable box is checked below:

I. ☑ Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)

i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.

---OR---

(b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.

ii. An executed inventor's oath or declaration under 37 CFR 1.63 or 37 CFR 1.64 for each inventor, **or** the application data sheet meeting the conditions specified in 37 CFR 1.53(f)(3)(i) is filed with the application.

II. ☐ Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)

i. A request for continued examination has been filed with, or prior to, this form.
ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature /Garrett T. Potter/	Date July 6, 2022
Name (Print/Typed) Garrett T. POTTER	Practitioner Registration Number 76,602

Note: *This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required.**

☐ *Total of _____ forms are submitted.

PTO/AIA/14 (01-22)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	22773-826.310
	Application Number	
Title of Invention	MULTILAYER POLYMER SHEETS	

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

Secrecy Order 37 CFR 5.2:

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

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Chunhua		LI	

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

City	Cupertino	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	19688 Vicksburg Drive
Address 2	

City	Cupertino	State/Province	CA
Postal Code	95014	Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Yan		CHEN	

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

City	Cupertino	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	10461 Pineville Avenue
Address 2	

City	Cupertino	State/Province	CA
Postal Code	95014	Country	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Heinz		PUDLEINER	

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

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	22773-826.310
	Application Number	
Title of Invention	MULTILAYER POLYMER SHEETS	

City	Krefeld	Country of Residence i	DE

Mailing Address of Inventor:

Address 1	Bethelstr, 39		
Address 2			
City	Krefeld	State/Province	
Postal Code	47800	Country i	DE

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Klaus		MEYER	

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

City	Dormagen	Country of Residence i	DE

Mailing Address of Inventor:

Address 1	Kamillenstr, 40		
Address 2			
City	Dormagen	State/Province	
Postal Code	41539	Country i	DE

Inventor 5 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Joerg		NICKEL	

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

City	Dormagen	Country of Residence i	DE

Mailing Address of Inventor:

Address 1	Krokusweg 2		
Address 2			
City	Dormagen	State/Province	
Postal Code	41539	Country i	DE

Inventor 6 Remove

Legal Name

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	22773-826.310
	Application Number	
Title of Invention	MULTILAYER POLYMER SHEETS	

Prefix	Given Name	Middle Name	Family Name	Suffix
	Craig		PEHLERT	

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

City	Lenox	State/Province	MA	Country of Residence	US

Mailing Address of Inventor:

Address 1	29 St. Ann's Avenue
Address 2	

City	Lenox	State/Province	MA
Postal Code	01240	Country	US

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

Correspondence Information:

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

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

Customer Number	107046		
Email Address	patentdocket@wsgr.com	Add Email	Remove Email

Application Information:

Title of the Invention	MULTILAYER POLYMER SHEETS		
Attorney Docket Number	22773-826.310	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	8	Suggested Figure for Publication (if any)	

Filing By Reference:

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

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

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

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	22773-826.310
	Application Number	
Title of Invention	MULTILAYER POLYMER SHEETS	

Publication Information:

☐	Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐	**Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

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

Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	107046		

Domestic Benefit/National Stage Information:

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

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	17/553590	2021-12-16

Prior Application Status	Patented		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
17/553590	Continuation of	16/835101	2020-03-30	11213369	2022-01-04

Prior Application Status	Patented		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
16/835101	Continuation of	15/476655	2017-03-31	10973613	2021-04-13

Prior Application Status	Patented		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15/476655	Division of	13/470681	2012-05-14	9655691	2017-05-23

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	22773-826.310
	Application Number	
Title of Invention	MULTILAYER POLYMER SHEETS	

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

Foreign Priority Information:

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

Remove

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

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

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

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

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	22773-826.310
	Application Number	
Title of Invention	MULTILAYER POLYMER SHEETS	

Authorization or Opt-Out of Authorization to Permit Access:

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

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

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

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

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

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

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

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

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

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

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

ClearCorrect Exhibit 1137, Page 9 of 337
ClearCorrect v. Align - IPR2025-00819

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	22773-826.310
	Application Number	
Title of Invention	MULTILAYER POLYMER SHEETS	

Applicant Information:

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

Applicant 1 — Remove

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

Clear

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

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

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	ALIGN TECHNOLOGY, INC.		
Mailing Address Information For Applicant:			
Address 1	2820 Orchard Parkway		
Address 2			
City	San Jose	**State/Province**	CA
Country	US	Postal Code	95134
Phone Number		Fax Number	
Email Address			

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

Assignee Information including Non-Applicant Assignee Information:

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

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	22773-826.310
	Application Number	
Title of Invention	MULTILAYER POLYMER SHEETS	

Assignee 1

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

Remove

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

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

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

Signature:

Remove

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

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

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

Signature	/Garrett Potter/			Date (YYYY-MM-DD)	2022-07-06
First Name	Garrett	Last Name	POTTER	Registration Number	76,602

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

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	22773-826.310
	Application Number	
Title of Invention	MULTILAYER POLYMER SHEETS	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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PATENT APPLICATION

MULTILAYER POLYMER SHEETS

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MULTILAYER POLYMER SHEETS

CROSS-REFERENCE

[0001] This application is a continuation of U.S. Patent Application No. 17/553,590, filed December 16, 2021, which is a continuation of U.S. Patent Application No. 16/835,101, filed March 30, 2020, now U.S. Patent No. 11,213,369, issued January 4, 2022, which is a continuation of U.S. Patent Application No. 15/476,655, filed March 31, 2017, now U.S. Patent No. 10,973,613, issued April 13, 2021, which is a divisional of U.S. Patent Application No. 13/470,681, filed May 14, 2012, now U.S. Patent No. 9,655,691 issued May 23, 2017, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] The present invention generally relates to the field of orthodontics, and more particularly to the design of multilayer dental positioning appliances.

[0003] An objective of orthodontics is to move a patient's teeth to positions where function and/or aesthetics are optimized. Traditionally, appliances such as braces are applied to a patient's teeth by a treating practitioner and the set of braces exerts continual force on the teeth and gradually urges them toward their intended positions. Over time and with a series of clinical visits and reactive adjustments to the braces by the practitioner, the appliances to move the teeth toward their final destination.

[0004] More recently, alternatives to conventional orthodontic treatment with traditional affixed appliances (*e.g.*, braces) have become available. For example, systems including a series of preformed appliances/aligners have become commercially available from Align Technology, Inc., San Jose, CA, under the trade name Invisalign® System. The Invisalign® System is described in numerous patents and patent applications assigned to Align Technology, Inc. including, for example in U.S. Pat. Nos. 6,450,807, and 5,975,893, as well as on the company's website, which is accessible on the World Wide Web (see, *e.g.*, the url invisalign.com"). The Invisalign® System includes designing and/or fabricating multiple, and sometimes all, of the aligners to be worn by the patient before the aligners are administered to the patient and used to reposition the teeth (*e.g.*, at the outset of treatment). Often, designing and planning a customized treatment for a patient makes use of computer-based 3-dimensional planning/design tools, such as Treat™ software from Align Technology, Inc. The design of the aligners relies on computer modeling of the patient's teeth in a series of planned successive tooth arrangements, and the individual aligners are designed to be worn over the teeth, such that each

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aligner exerts force on the teeth and elastically repositions the teeth to each of the planned tooth arrangements.

[0005] While recently developed orthodontic treatment technologies, such as those described above, represent a considerable advancement in the field of orthodontics, additional advancements remain of interest. For example, in some instances it may be advantageous to develop materials that improve properties of the appliances/aligners used for orthodontic treatment. As such, there is a need for shell aligners that can, for example, produce more continuous force and better bring a patient's teeth into a desired occlusion.

BRIEF SUMMARY OF THE INVENTION

[0006] The present invention provides multilayer orthodontic positioning appliances, as well as related methods and systems. The disclosed multilayer appliances include a removable orthodontic tooth positioning appliance having teeth receiving cavities shaped to directly receive at least some of the patient's teeth and apply a resilient positioning force to the patient's teeth. The multilayer appliances can include a hard polymer layer disposed between two soft polymer layers. The multilayer dental appliances of the present invention, among many aspects, provide, for example, improved material performance, stress relaxation properties and longer working range. In addition, the mechanical properties of the materials and appliances described herein can improve orthodontic treatments by, for example, reducing the need for midcourse corrections during treatment and the number of aligners used for a given treatment.

[0007] The disclosed methods include methods for making multilayer dental appliances. The disclosed systems including a plurality of appliances having teeth receiving cavities shaped to directly receive at least some of the patient's teeth and apply a resilient positioning force to the patient's teeth. The appliances can be successively worn by a patient to move teeth from one arrangement to a successive arrangement. At least one of the appliances in the system can include a hard polymer layer disposed between two soft polymer layers.

[0008] For a fuller understanding of the nature and advantages of the present invention, reference should be made to the ensuing detailed description and accompanying drawings. Other aspects, objects and advantages of the invention will be apparent from the drawings and detailed description that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Figure 1 illustrates a jaw and an incremental positioning appliance for the jaw, in accordance with an embodiment of the present invention.

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[0010] Figure 2 shows an arrangement of polymer layers in a sheet having a hard polymer layer disposed between two soft polymer layers, in accordance with an embodiment of the present invention.

[0011] Figure 3 depicts a method of making a multilayer dental appliance, in accordance with an embodiment of the present invention.

[0012] Figure 4 is a simplified block diagram illustrating a method for fabricating a dental appliance, in accordance with an embodiment of the present invention.

[0013] Figure 5 provides a stress relaxation comparison for dental appliances, in accordance with an embodiment of the present invention.

[0014] Figure 6 provides another stress relaxation comparison for dental appliances, in accordance with an embodiment of the present invention.

[0015] Figure 7 shows a long-term unloading comparison for dental appliances, in accordance with an embodiment of the present invention.

[0016] Figure 8 provides a long-term movement comparison for dental appliances, in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0017] In the following description, various embodiments of the present invention will be described. For purposes of explanation, specific configurations and details are set forth in order to provide a thorough understanding of the embodiments. However, it will also be apparent to one skilled in the art that the present invention may be practiced without the specific details. Furthermore, well-known features may be omitted or simplified in order not to obscure the embodiment being described.

[0018] Multilayer orthodontic positioning appliances are provided, as well as related methods and systems. During orthodontic treatment, it may be necessary to apply forces to a tooth to generate movement of the tooth to, for example, bring the patient's teeth into a better occlusion in a mesial or distal direction. The presently disclosed appliances, methods, and systems provide means by which such forces can be applied during orthodontic treatment where appliances having teeth receiving cavities are used, such as preformed appliances/aligners available from Align Technology, Inc., San Jose, CA, under the trade name Invisalign® System. As provided by the present invention, the aligners that include multilayer sheets can, for example, provide increased durability of the aligners so that they can better withstand wear due to aligner reinsertion and removal and other mechanical stresses put on the aligner during treatment. In addition, the aligners have improved elastic properties that allow for less degradation in the shape of the teeth receiving cavities during a stage of treatment. For example, during a multistage orthodontic treatment, the force exerted by an aligner to perform defined

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tooth movement can degrade and may cause the treatment to include more aligners to reach a final ideal arrangement and/or result in a mid-course correction that could be prevented by using aligners with improved physical properties, such as those provided herein.

[0019] In one embodiment, the present invention provides a dental appliance for positioning a patient's teeth. The dental appliance can include a removable orthodontic tooth positioning appliance having teeth receiving cavities shaped to directly receive at least some of the patient's teeth and apply a resilient positioning force to the patient's teeth, the appliance comprising a hard polymer layer disposed between a first soft polymer layer and a second soft polymer layer.

[0020] In another embodiment, the present invention provides an orthodontic system for positioning a patient's teeth. The orthodontic system can include a plurality of incremental position adjustment appliances having teeth receiving cavities shaped to directly receive at least some of the patient's teeth and apply a resilient positioning force to the patient's teeth, wherein the appliances are successively worn by a patient to move teeth from one arrangement to a successive arrangement, and wherein at least one of the appliances comprises a hard polymer layer disposed between a first soft polymer layer and a second soft polymer layer.

[0021] In yet another embodiment, the present invention provides a method of making a dental appliance for positioning a patient's teeth. The method can include providing a sheet comprising a hard polymer layer of polymeric material disposed between a first soft polymer layer and a second soft polymer layer, providing a positive model of the patient's teeth in a target position; and fabricating an appliance as a negative of the positive model comprising thermoforming the sheet over the positive model.

[0022] Referring now to the drawings, in which like reference numerals represent like parts throughout the several views, Figure 1 provides an appropriate starting point in a detailed discussion of various embodiments of the present invention with respect to tooth repositioning appliances designed to apply repositioning forces to teeth. A tooth repositioning appliance 10 can be worn by a patient in order to achieve an incremental repositioning of individual teeth in the jaw 12. The appliance can include a shell (*e.g.*, a polymeric shell) having teeth-receiving cavities that receive and resiliently reposition the teeth. In many embodiments, a polymeric appliance can be formed from a sheet of suitable layers of polymeric material. An appliance can fit over all teeth present in an upper or lower jaw, or less than all of the teeth. In some cases, only certain teeth received by an appliance will be repositioned by the appliance while other teeth can provide a base or anchor region for holding the appliance in place as it applies force against the tooth or teeth targeted for repositioning. In some cases, many or most, and even all, of the teeth will be repositioned at some point during treatment.

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Teeth that are moved can also serve as a base or anchor for holding the appliance as it is worn by the patient. Typically, no wires or other means will be provided for holding an appliance in place over the teeth. In some cases, however, it may be desirable or necessary to provide individual anchors on teeth with corresponding receptacles or apertures in the appliance so that the appliance can apply a selected force on the tooth. Exemplary appliances, including those utilized in the Invisalign® System, are described in numerous patents and patent applications assigned to Align Technology, Inc. including, for example, in U.S. Pat. Nos. 6,450,807, and 5,975,893, as well as on the company's website, which is accessible on the World Wide Web (see, *e.g.*, the url invisalign.com").

[0023] An appliance can be designed and/or provided as part of a set of a plurality of appliances. In such an embodiment, each appliance may be configured so a tooth-receiving cavity has a geometry corresponding to an intermediate or final tooth arrangement intended for the appliance. The patient's teeth can be progressively repositioned from an initial tooth arrangement to a target tooth arrangement by placing a series of incremental position adjustment appliances over the patient's teeth. A target tooth arrangement can be a planned final tooth arrangement selected for the patient's teeth at the end of all planned orthodontic treatment. Alternatively, a target arrangement can be one of many intermediate arrangements for the patient's teeth during the course of orthodontic treatment, which may include where surgery is recommended, where inter-proximal reduction (IPR) is appropriate, where a progress check is scheduled, where anchor placement is best, where palatal expansion is desirable, etc. As such, it is understood that a target tooth arrangement can be any planned resulting arrangement for the patient's teeth that follows one or more incremental repositioning stages. Likewise, an initial tooth arrangement can be any initial arrangement for the patient's teeth that is followed by one or more incremental repositioning stages. The adjustment appliances can be generated all at the same stage or in sets or batches, *e.g.*, at the beginning of a stage of the treatment, and the patient wears each appliance until the pressure of each appliance on the teeth can no longer be felt or has resulted in the maximum amount of expressed tooth movement for that given stage. A plurality of different appliances (*e.g.*, set) can be designed and even fabricated prior to the patient wearing any appliance of the plurality. After wearing an appliance for an appropriate period of time, the patient replaces the current appliance with the next appliance in the series until no more appliances remain. The appliances are generally not affixed to the teeth and the patient may place and replace the appliances at any time during the procedure (*e.g.*, patient-removable appliances). The final appliance or several appliances in the series may have a geometry or geometries selected to overcorrect the tooth arrangement, *i.e.*, have a geometry which would (if fully achieved) move individual teeth beyond the tooth arrangement which has been selected as the "final." Such over-correction may be

desirable in order to offset potential relapse after the repositioning method has been terminated, *i.e.*, to permit movement of individual teeth back toward their pre-corrected positions. Over-correction may also be beneficial to speed the rate of correction, *i.e.*, by having an appliance with a geometry that is positioned beyond a desired intermediate or final position, the individual teeth will be shifted toward the position at a greater rate. In such cases, the use of an appliance can be terminated before the teeth reach the positions defined by the appliance.

[0024] In general, structures, methods and systems of the present invention utilize a multilayer sheet for use in orthodontic appliances. The multilayer sheet can include three layers, in which a hard polymer layer is disposed between two soft polymer layers. The multilayer sheets used in the present invention can be used in making dental aligners having improved durability for use, e.g., to the elastic properties of the multilayer sheet when formed into an aligner. In addition, the bonding strength between the layers further improves the durability of the aligners, for example, by withstanding teeth grinding by a patient.

[0025] Figure 2 shows a multilayer structure according to the present invention. As shown, a multilayer sheet 20 can include a three layer structure: a hard polymer layer 24 and two soft polymer layers 22, 26. The hard polymer layer can be disposed between a first soft polymer layer and a second soft polymer layer. In some embodiments, the hard polymer layer can be thicker than either of the soft polymer layers. The soft polymer layers can have the same or different thicknesses. For example, the hard polymer layer can have a thickness in a range from about 400 μm to about 1100 μm, about 450 μm to about 1000 μm, about 500 μm to about 900 μm, or about 550 μm to about 750 μm. The soft polymer layers can have a thickness in a range from about 25 μm to about 100 μm, about 30 μm to about 90 μm, or about 35 μm to about 80 μm. Multilayer sheets used for making appliances having a hard polymer layer disposed between two soft polymer layers can range from a thickness of about 500 μm to about 1200 μm, about 550 μm to about 1100 μm, or about 600 μm to about 1000 μm. In some embodiments, the thicknesses of the various layers can be tailored for a particular stage of treatment for the patient.

[0026] Suitable polymeric materials for the hard polymer layer can include a polyester, a co-polyester, a polycarbonate, a thermoplastic polyurethane, a polypropylene, a polyethylene, a polypropylene and polyethylene copolymer, an acrylic, a cyclic block copolymer, a polyetheretherketone, a polyamide, a polyethylene terephthalate, a polybutylene terephthalate, a polyetherimide, a polyethersulfone, a polytrimethylene terephthalate or a combination thereof (e.g., a blend of at least two of the listed hard polymeric materials). In some embodiments, the hard polymer layer of the appliances can include polymeric materials, such as a polycarbonate, a co-polyester, a polyester, and a thermoplastic

polyurethane. In some embodiments, the hard layer can be composed of multiple hard layers, e.g., two or three hard polymer layers 24-1, 24-2, 24-N co-extruded to form one hard layer.

[0027] The hard polymer layer of the appliances of the present invention can have a variety of physical properties that can, e.g., improve treatment options for a practitioner. For example, physical properties such as tensile strength, elongation at yield, elongation at break, tensile modulus, flexural modulus, stress relaxation over time, and light transmission can each be specifically tailored for a particular application. In some embodiments, the hard polymer layer of the appliances can have a physical property of at least one of a tensile strength at yield of between about 4000 pounds per square inch (psi) and 6500 psi, an elongation at yield of greater than about 4%, an elongation at break of greater than about 70%, a tensile modulus of greater than about 150,000 psi, a flexural modulus greater than about 150,000 psi, a stress relaxation at 24 hours testing in a wet environment (e.g., between about 90%-100% relative humidity) is greater than 10%, and a light transmission between 400 nm and 800 nm of greater than about 75%.

[0028] Suitable polymeric materials for the soft polymer layers of the appliance can include a styrenic block copolymer (SBC), a silicone rubber, an elastomeric alloy, a thermoplastic elastomer (TPE), a thermoplastic vulcanizate (TPV) elastomer, a polyurethane elastomer, a block copolymer elastomer, a polyolefin blend elastomer, a thermoplastic co-polyester elastomer, a thermoplastic polyamide elastomer, or a combination thereof (e.g., a blend of at least two of the listed soft polymeric materials). The soft polymer layers can be the same material or a different material. In certain embodiments, the first soft polymer layer and the second soft polymer layer are the same polymeric material.

[0029] The soft polymer layers of the appliances can have a variety of physical properties. For example, physical properties such as hardness, ultimate tensile strength, elongation at break, tensile modulus, compression set, flexural modulus, and light transmission can each be specifically tailored for a particular application. In some embodiments, the soft polymer layers of the appliances can independently have a physical property of at least one of a hardness of about 60A to about 85D, an ultimate tensile strength of greater than about 5000 psi, an elongation at break of greater than about 200 %, a compression set at about 70°C of greater than 40% after 24 hours, a flexural modulus of greater than about 35,000 psi, and a light transmission between 400 nm and 800 nm of greater than about 75%.

[0030] As described herein, the layers of the appliances can include a hard polymer layer disposed between two soft polymer layers. In one embodiment, the multilayer appliances can include a hard polymer layer of one type of material (e.g., a co-polyester), and two soft polymer layers of other types of material that can be the same or different (e.g., two soft polymer layers of thermoplastic

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polyurethane elastomer). In some embodiments, the multilayer appliances can also include a hard polymer layer of at least two layers of polymer material. For example, the hard polymer layer can include several polymer layers laminated together to form the hard polymer layer. The laminated hard polymer layer can include at least two layers of any combination of the following polymer materials: a polyester, a co-polyester, a polycarbonate, a thermoplastic polyurethane, a polypropylene, a polyethylene, a polypropylene and polyethylene copolymer, an acrylic, a cyclic block copolymer, a polyetheretherketone, a polyamide, a polyethylene terephthalate, a polybutylene terephthalate, a polyetherimide, a polyethersulfone, and a polytrimethylene terephthalate. Similarly, in some embodiments, the multilayer appliances can include a soft polymer layer of at least two layers of polymer material. For example, the soft polymer layers 22, 26 can include a layer of several polymer layers 22-1, 22-2, 22-N and 26-1, 26-2, 26-N, respectively, laminated together. The laminated soft polymer layers can include at least two layers of any combination of the following polymer materials: a styrenic block copolymer (SBC), a silicone rubber, an elastomeric alloy, a thermoplastic elastomer (TPE), a thermoplastic vulcanizate (TPV) elastomer, a polyurethane elastomer, a block copolymer elastomer, a polyolefin blend elastomer, a thermoplastic co-polyester elastomer, and a thermoplastic polyamide elastomer.

[0031] The tooth positioning appliances can be fabricated using a variety of methods. For example, methods for making the appliances can include thermoforming a multilayer sheet into an aligner by heating the sheet and then molding the sheet to a particular configuration. Exemplary methods for fabricating the appliances, including those utilized in the Invisalign® System, are described in numerous patents and patent applications assigned to Align Technology, Inc. including, for example, in U.S. Appl. No. 13/186,374 as well as on the company's website, which is accessible on the World Wide Web (see, *e.g.*, the url invisalign.com").

[0032] Figure 3 depicts an example embodiment of a process 30 for forming a multilayer tooth positioning appliance, in accordance with an embodiment of the present invention. As shown, a multilayer sheet 32 can be formed into a tooth positioning appliance 36. The multilayer sheet 32, as depicted, can include three layers: a hard polymer layer disposed between two soft polymer layers. In this example process, the tooth positioning appliance 36 can be produced with the use of a physical tooth model, or mold, 34. The tooth positioning appliance 36 can be produced by heating the thermoformable multilayer sheet 32 and then vacuum or pressure forming the sheet over the teeth in the physical tooth model 34. The tooth positioning appliance 36 is a direct representation of the physical tooth model. Excess material from the sheet can be trimmed to form a final tooth positioning appliance that can be used for orthodontic treatment of a patient.

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[0033] One or a series of physical tooth models, such as the model described above, may be used in the generation of elastic repositioning appliances for orthodontic treatment. Similar to the process above, each of the appliances can be generated by thermoforming a multilayer polymeric material over a mold of a desired tooth arrangement to form a dental appliance. The tooth positioning appliance of the desired tooth arrangement generally conforms to a patient's teeth but is slightly out of alignment with the initial tooth configuration. Placement of the elastic positioner over the teeth applies controlled forces in specific locations to gradually move the teeth into the desired configuration. Repetition of this process with successive appliances comprising new configurations eventually moves the teeth through a series of intermediate configurations to a final desired configuration.

[0034] The present invention includes a variety of methods for fabricating dental appliances. Figure 4 shows a simple schematic for a method 40 of fabricating a removable orthodontic tooth positioning appliance having teeth receiving cavities shaped to directly receive at least some of the patient's teeth and apply a resilient positioning force to the patient's teeth, in accordance with an embodiment of the present invention. The method can include providing a multilayer sheet having a hard polymer layer disposed between two soft polymer layers (Step 42). The method can further include providing a positive physical model of a patient's teeth (Step 44). The tooth positioning appliance can be fabricated by thermoforming the multilayer sheet over the positive physical model (Step 46), in which the tooth positioning appliance is a negative of the positive model. As described above, the methods of fabrication can further include trimming or cutting portions of the sheet to render a final, usable appliance for orthodontic treatment.

[0035] Multilayer sheets of the present invention were analyzed and determined to provide a variety of improved properties for aligners used in orthodontic treatment. As further described herein, the multilayer sheets formed into aligners can, for example, provide increased durability of the aligners so that they can better withstand wear due to teeth grinding and other mechanical stresses put on the aligner during treatment. In addition, the aligners have improved elastic properties that allow for less degradation in the shape of the teeth receiving cavities during a stage of treatment. For example, during a multistage orthodontic treatment, the capability of an aligner to force tooth movement can degrade and may cause the treatment to include more aligners to reach a final ideal arrangement and/or result in a mid-course correction that could be prevented by using aligners with improved physical properties, such as those provided herein.

[0036] Figures 5-8 provide example test results that compare various physical properties of the multilayer sheet appliances of the present invention with other already existing aligner materials (Material 1). Samples of varied thicknesses were tested. For example, multilayer sheets were tested

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having a hard polymer layer with thicknesses ranging from about 580 μm to about 715 μm thick. In some examples, the hard layer was a co-polyester hard polymer layer. The soft layers tested ranged between about 50 μm to about 100 μm. In some examples, the hard polymer layer was disposed between thermoplastic polyurethane elastomer soft polymer layers. As shown in Figures 5 and 6, one example of the multilayer sheet material (Material 2) showed improved stress relaxation properties as compared to another already existing material (Material 1) at room temperature and at a 37 °C/90-100% relative humidity condition. In addition, Figure 7 shows improved long-term unloading characteristics of the multilayer sheet Material 2 versus the already existing Material 1 in a 37 ºC/90-100% relative humidity condition. The multilayer sheet showed less deflection under force loads. Figure 8 also shows improved long-term movement data for the multilayer sheet Material 2 versus Material 1 in a 37 ºC/90-100% relative humidity condition.

[0037] The use of the terms "a" and "an" and "the" and similar referents in the context of describing embodiments (especially in the context of the following claims) are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. The terms "comprising," "having," "including," and "containing" are to be construed as open-ended terms (i.e., meaning "including, but not limited to,") unless otherwise noted. The term "connected" is to be construed as partly or wholly contained within, attached to, or joined together, even if there is something intervening. Recitation of ranges of values herein are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g., "such as") provided herein, is intended merely to better illuminate embodiments and does not pose a limitation on the scope unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of at least one embodiment.

[0038] Variations of the embodiments described herein may become apparent to those of ordinary skill in the art upon reading the foregoing description. The inventors expect skilled artisans to employ such variations as appropriate, and the inventors intend for embodiments to be constructed otherwise than as specifically described herein. Accordingly, suitable embodiments include all modifications and equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law. Moreover, any combination of the above-described elements in all possible variations thereof is contemplated as being incorporated into some suitable embodiment unless otherwise indicated herein

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or otherwise clearly contradicted by context. The scope of the invention should, therefore, be determined not with reference to the above description, but instead should be determined with reference to the pending claims along with their full scope or equivalents.

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CLAIMS

WHAT IS CLAIMED IS:

1. A method of making a multilayer dental aligner for repositioning a patient's teeth from a first arrangement toward a second arrangement, the method comprising:

providing a multilayer sheet comprising three polymer layers, the three polymer layers comprising:

a first layer comprising a co-polyester having a flexural modulus greater than 150,000 psi, an elongation at yield of greater than 4%, a tensile modulus greater than 150,000 psi, a tensile strength at yield of 4000-6500 psi, and an elongation at break of greater than 70%; and

a second layer comprising a thermoplastic polyurethane elastomer having a flexural modulus greater than 35,000 psi, an ultimate tensile strength of greater than 5000 psi; an elongation at break of greater than 200%, and a hardness of 60A to 85D; and

a third layer;

wherein the co-polyester has an elastic modulus greater than the thermoplastic polyurethane elastomer;

providing a mold;

thermoforming the multilayer sheet over the mold to form a plurality of tooth-receiving cavities configured to receive and reposition the patient's teeth from the first arrangement toward the second arrangement; and

trimming excess material from the thermoformed multilayer sheet to form the multilayer dental aligner.

2. The method of claim 1, wherein the co-polyester has a light transmission between 400 nm and 800 nm of greater than about 75%.

3. The method of claim 1, wherein the third layer comprises a same or different co-polyester.

4. The method of claim 1, wherein the first layer is disposed adjacent to the third layer.

5. The method of claim 1, wherein the first layer is coextruded with or laminated to the third layer.

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6. The method of claim 1, wherein the multilayer sheet further comprises a fourth layer comprising a same or different thermoplastic polyurethane elastomer.

7. The method of claim 6, wherein the first layer and the third layer are disposed between the second layer and the fourth layer.

8. A method of making a multilayer dental aligner for repositioning a patient's teeth from a first arrangement toward a second arrangement, the method comprising:

providing a multilayer sheet comprising polymer layers, the polymer layers comprising:

a first layer comprising a co-polyester having a flexural modulus greater than 150,000 psi; and

a second layer comprising a thermoplastic polyurethane elastomer;

providing a mold;

thermoforming the multilayer sheet over the mold to form a plurality of tooth-receiving cavities configured to receive and reposition the patient's teeth from the first arrangement toward the second arrangement; and

trimming excess material from the thermoformed multilayer sheet to form the multilayer dental aligner.

9. The method of claim 8, wherein the thermoplastic polyurethane elastomer of the second layer has an elongation at break of greater than 200% and wherein the co-polyester of the first layer has an elongation at break of greater than 70%.

10. The method of claim 8, wherein the co-polyester of the first layer has an elongation at yield of greater than 4%.

11. The method of claim 8, wherein the co-polyester of the first layer has a light transmission between 400 nm and 800 nm of greater than about 75%.

12. The method of claim 8, wherein the multilayer sheet comprises a third layer comprising a same or different co-polyester, or a same or different thermoplastic polyurethane elastomer.

13. The method of claim 12, wherein the first layer is disposed adjacent to the third layer.

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14. The method of claim 12, wherein the first layer is co-extruded with or laminated to the third layer.

15. The method of claim 12, wherein the first layer is disposed between the second layer and the third layer.

16. The method of claim 12, wherein the multilayer sheer comprises a fourth layer; wherein the fourth layer comprises a same or different thermoplastic polyurethane elastomer; and wherein the first layer and the third layer are disposed between the fourth layer and the second layer.

17. The method of claim 8, wherein the co-polyester has an elastic modulus greater than the thermoplastic polyurethane elastomer.

18. A method of making a multilayer dental aligner for positioning a patient's teeth from a first arrangement toward a second arrangement, the method comprising:

providing a multilayer sheet comprising:

a first layer;

a second layer; and

a third layer; and

wherein the first layer comprises a co-polyester having:

a flexural modulus greater than 150,000 psi;

an elongation at break of greater than 70%;

wherein the second layer comprises a thermoplastic polyurethane elastomer having:

an elongation at break of greater than 200%;

providing a mold;

thermoforming the multilayer sheet over the mold to form a plurality of tooth-receiving cavities configured to receive and reposition the patient's teeth from the first arrangement toward the second arrangement; and

trimming excess material from the thermoformed multilayer sheet to form the multilayer dental aligner.

19. The method of claim 18, wherein the first layer and the third layer are disposed adjacent to one another.

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20. The method of claim 18, wherein the first layer and the third layer are coextruded or laminated together.

21. The method of claim 18, wherein the first layer is disposed between the second layer and the third layer.

22. The method of claim 18, wherein the multilayer sheet further comprises a fourth layer and wherein the first layer and the third layer are disposed between the second layer and the fourth layer.

23. The method of claim 18, wherein the third layer comprises a same or different co-polyester, or a same or different thermoplastic polyurethane elastomer.

24. The method of claim 18, wherein the co-polyester of the first layer has a tensile strength at yield of 4000 psi to 6500 psi.

25. The method of claim 18, wherein the co-polyester of the first layer has an elongation at yield of greater than 4%.

26. The method of claim 18, wherein the co-polyester of the first layer has a tensile modulus of greater than 150,000 psi.

27. The method of claim 18, wherein the co-polyester of the first layer has a light transmission of between 400 nm and 800 nm of greater than 75%.

28. The method of claim 18, wherein the thermoplastic polyurethane elastomer of the second layer has a hardness from 60A to 85D.

29. The method of claim 18, wherein the thermoplastic polyurethane elastomer of the second layer has an ultimate tensile strength of greater than 5000 psi.

30. The method of claim 18, wherein the co-polyester has an elastic modulus greater than the thermoplastic polyurethane elastomer.

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ABSTRACT OF THE DISCLOSURE

Multilayer polymer sheets are provided, as well as related methods, systems, and appliances.

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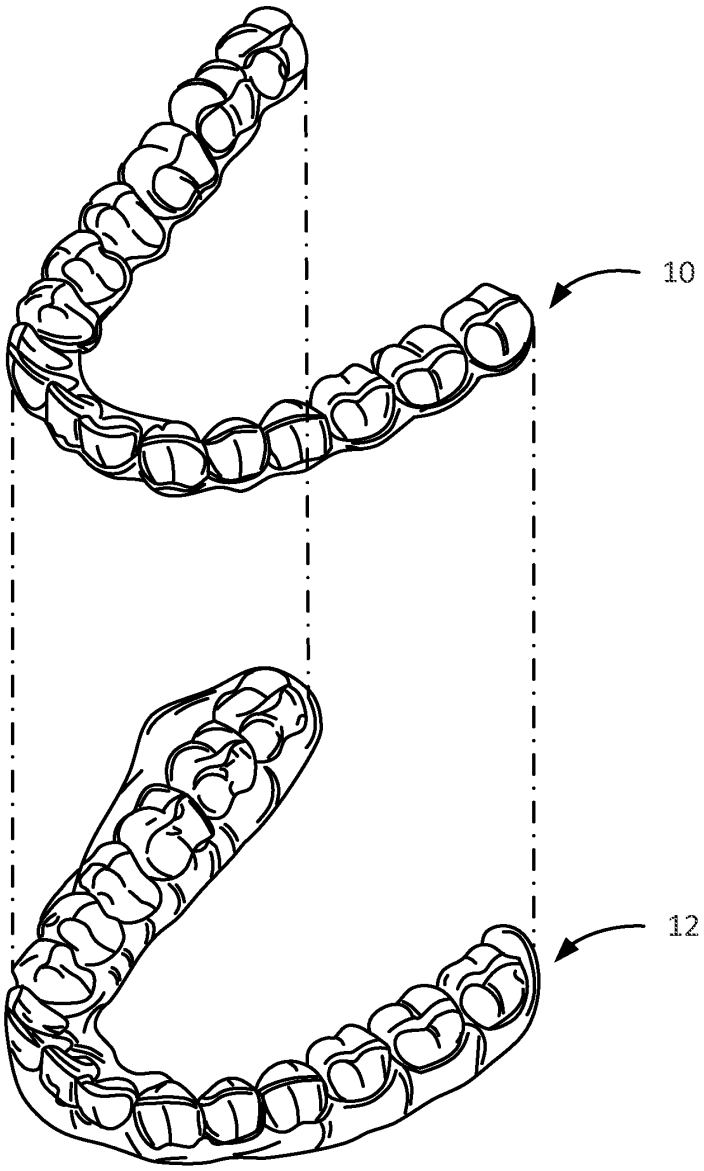


FIG. 1

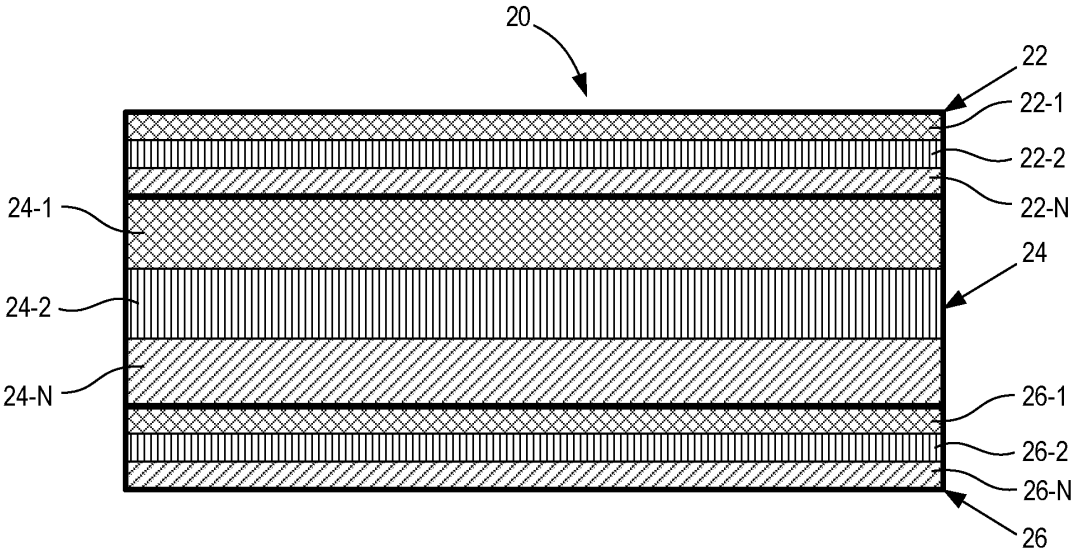


FIG. 2

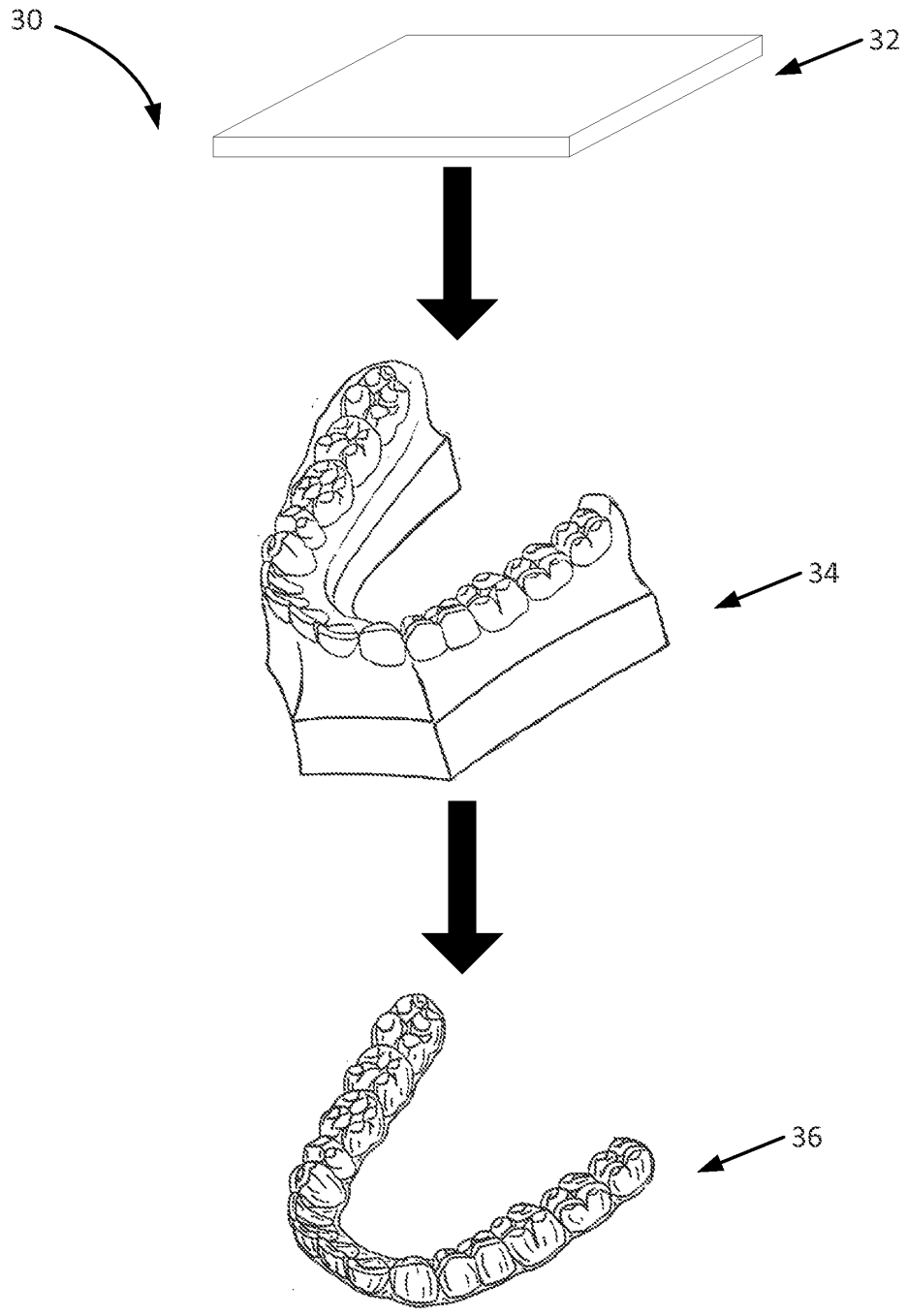


FIG. 3

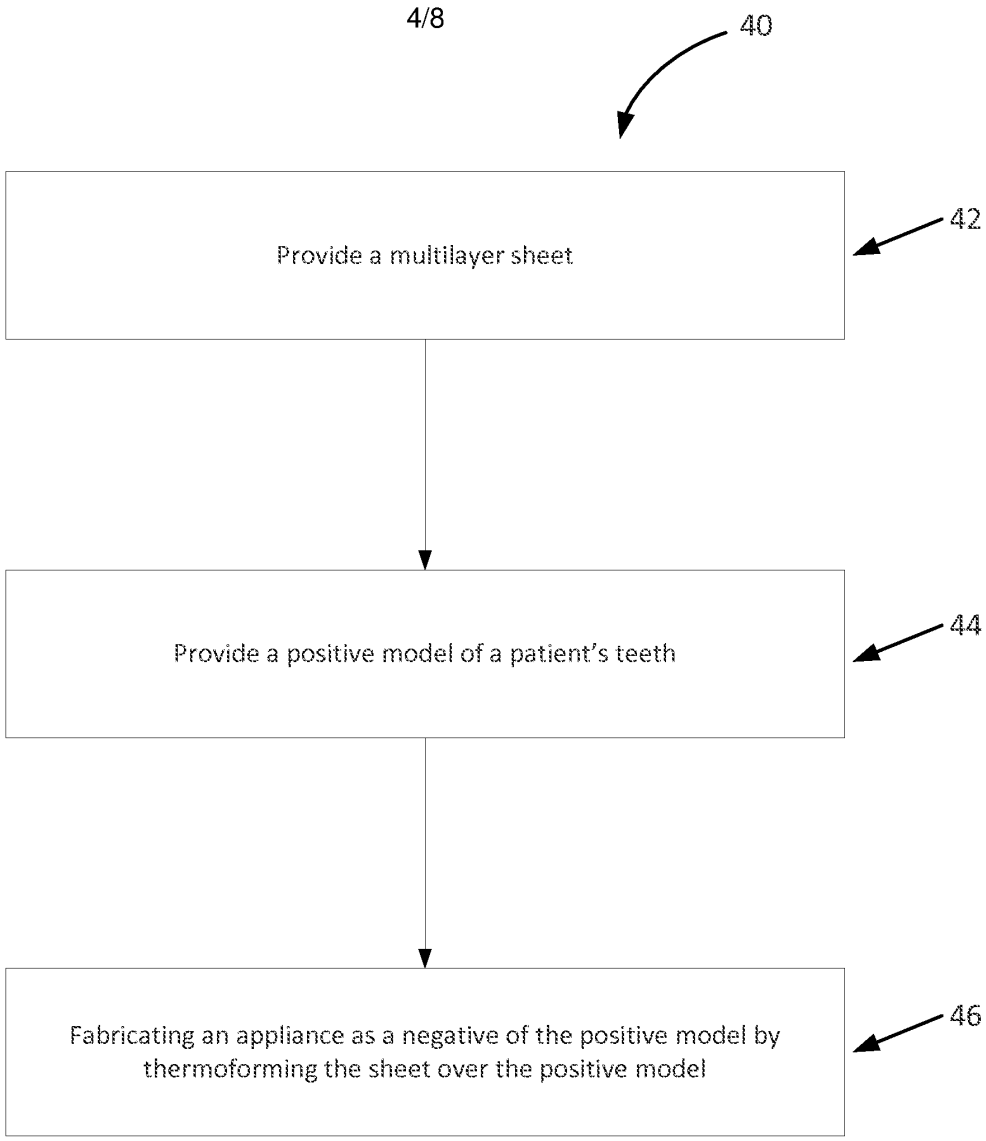

40
Provide a multilayer sheet
42
Provide a positive model of a patient's teeth
44
Fabricating an appliance as a negative of the positive model by thermoforming the sheet over the positive model
46

FIG. 4

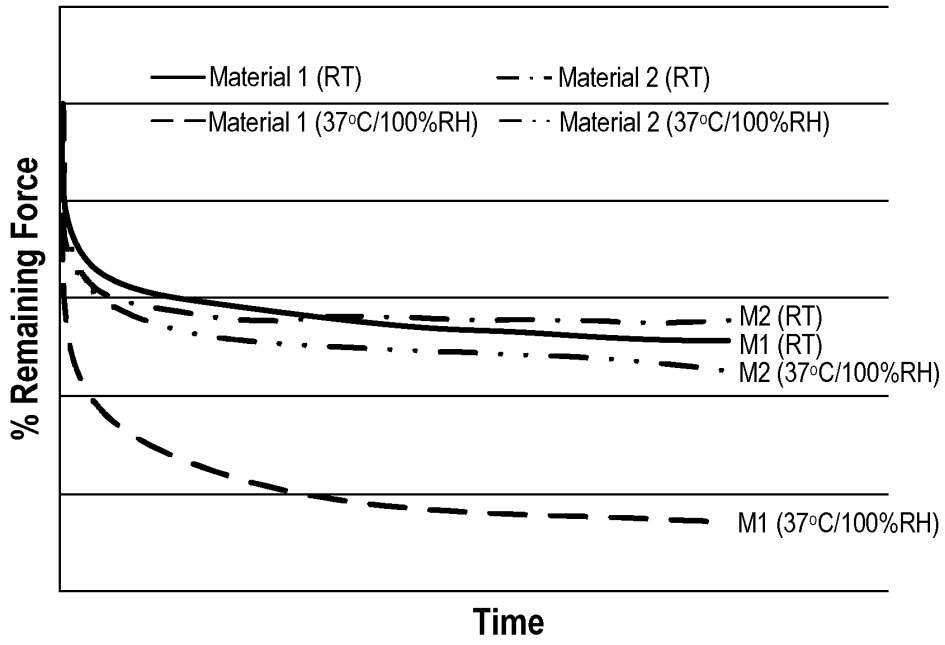

Material 1 (RT)
Material 2 (RT)
Material 1 (37°C/100%RH)
Material 2 (37°C/100%RH)
% Remaining Force
M2 (RT)
M1 (RT)
M2 (37°C/100%RH)
M1 (37°C/100%RH)
Time

FIG. 5

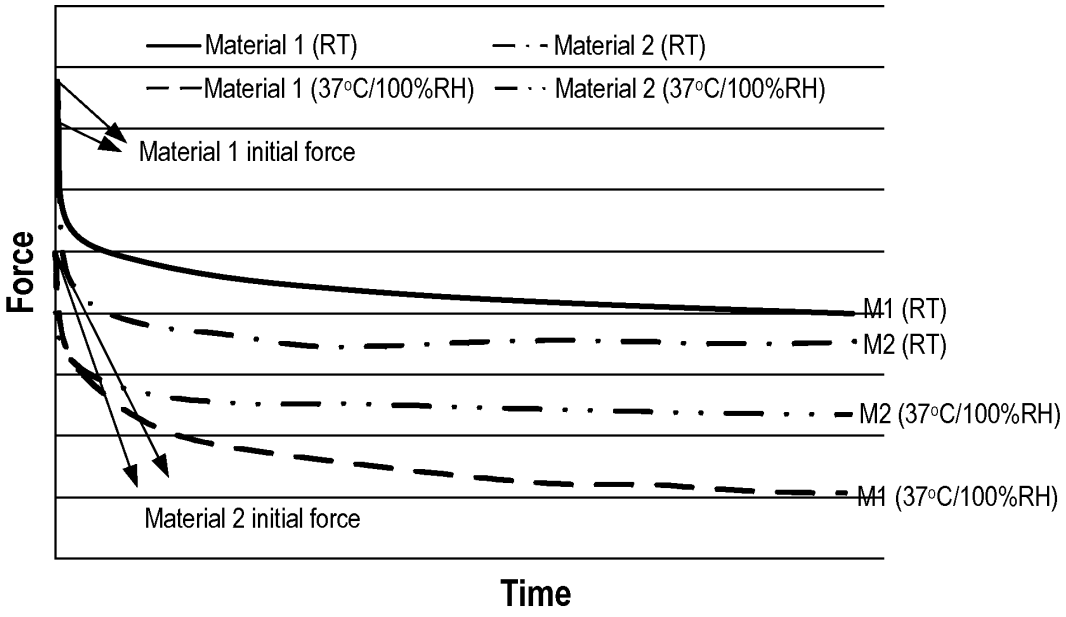

Material 1 (RT)
Material 2 (RT)
Material 1 (37°C/100%RH)
Material 2 (37°C/100%RH)
Material 1 initial force
Force
M1 (RT)
M2 (RT)
M2 (37°C/100%RH)
M1 (37°C/100%RH)
Material 2 initial force
Time

FIG. 6

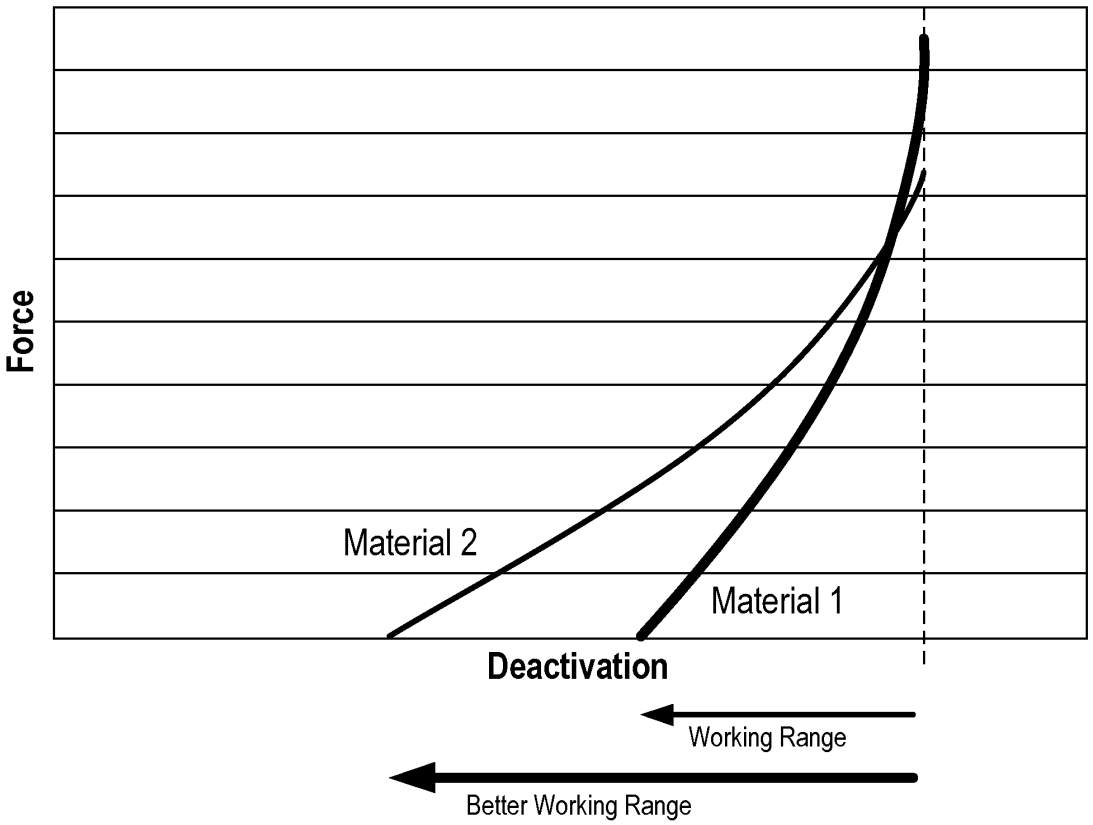

Force
Material 2
Material 1
Deactivation
Working Range
Better Working Range

FIG. 7

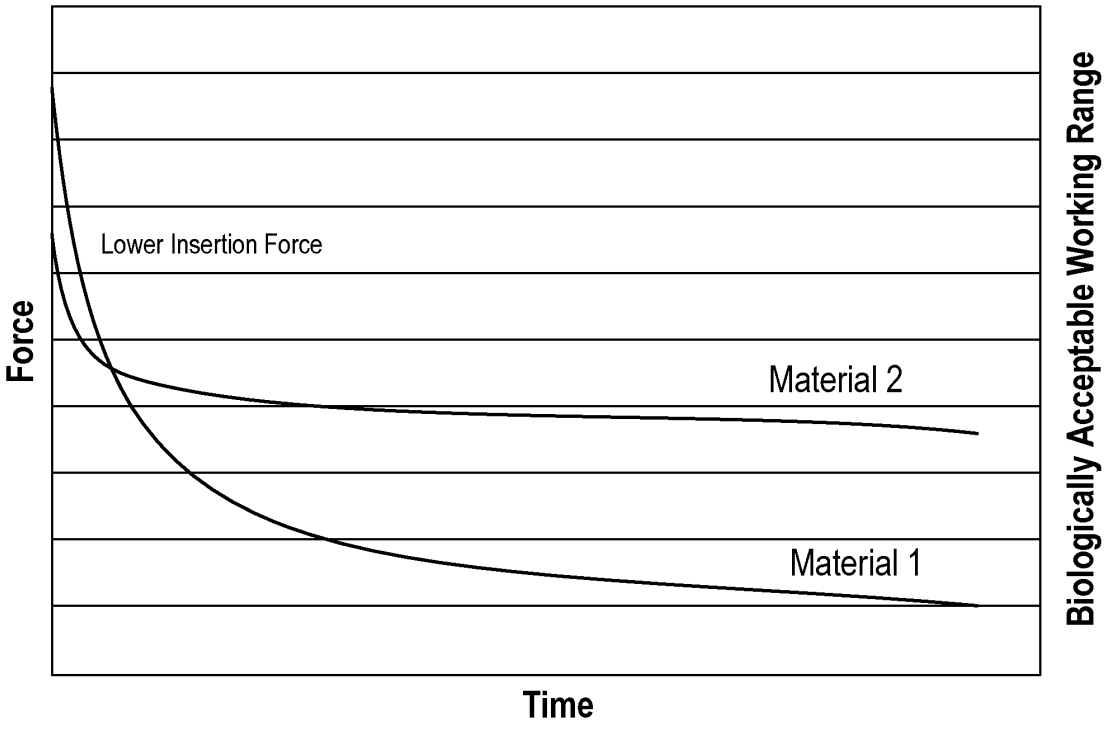

Force
Lower Insertion Force
Material 2
Material 1
Time
Biologically Acceptable Working Range

FIG. 8

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	MULTILAYER DENTAL APPLIANCES AND RELATED METHODS AND SYSTEMS

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 15/476,655 filed on March 31, 2017.

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

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

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LEGAL NAME OF INVENTOR

Inventor: Joerg NICKEL Date (Optional): April 11, 2017

Signature: Joerg Nickel

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

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LEGAL NAME OF INVENTOR

Inventor: Craig PEHLERT Date (Optional): _____

Signature: _____

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LEGAL NAME OF INVENTOR

Inventor: Heinz PUDLEINER Date (Optional): 11.04.2017

Signature: H. Pudleiner

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LEGAL NAME OF INVENTOR

Inventor: Yan CHEN Date (Optional): _____

Signature: _____

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LEGAL NAME OF INVENTOR

Inventor: Chunhua LI Date (Optional): 4/18/17

Signature: _____

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LEGAL NAME OF INVENTOR

Inventor: Klaus MEYER Date (Optional): April 11, 2017

Signature: Klaus Meyer

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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

[X] Practitioners associated with Customer Number: 107046

OR

[ ] Practitioner(s) named below (If more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

[X] The address associated with Customer Number: 107046

OR

[ ]

Firm or individual name		
Address		
City	State	Zip
Country		
Telephone	Email	

Assignee name and address: Align Technology, Inc.
2820 Orchard Parkway
San Jose, California 95134

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of the practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee.

Signature	Date September 13, 2017
Name Arthur Hsieh	Telephone 408-470-1000
Title VP, Associate General Counsel, Intellectual Property & Licensing	

This collection of information is required by 37 CFR 1.31, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public, which is to update (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 18 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Align Technology, Inc.

Application No./Patent No.: Unassigned Filed/Issue Date: Herewith (July 6, 2022)

Titled: MULTILAYER POLYMER SHEETS

Align Technology, Inc., a Delaware Corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☑ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____

   The document was recorded in the United States Patent and Trademark Office at

   Reel _____, Frame _____, or for which a copy thereof is attached.

2. From: _____ To: _____

   The document was recorded in the United States Patent and Trademark Office at

   Reel _____, Frame _____, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450**.

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

PTO/AIA/96 (08-12)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Garrett T. Potter/	July 6, 2022
Signature	Date
Garrett T. Potter	76,602
Printed or Typed Name	Title or Registration Number

Attorney Docket No.: 83289-831160 (022900US)
Align Ref No: 1228.US.P

ASSIGNMENT OF PATENT APPLICATION

JOINT

WHEREAS, Chunhua Li of 19688 Vicksburg Dr., Cupertino, CA 95014 and Yan Chen of 10461 Pineville Ave., Cupertino, CA 95014, hereinafter referred to as "Assignors," are the inventors of the invention described and set forth in the below-identified application for United States Letters Patent:

Title of Invention: MULTILAYER DENTAL APPLIANCES AND RELATED METHODS AND SYSTEMS

Date(s) of execution of Declaration:

Filing Date: May 14, 2012

Application No.: 13/470,681; and

WHEREAS, ALIGN TECHNOLOGY, INC., a corporation of the state of Delaware, located at 2560 Orchard Parkway, San Jose, CA 95131, hereinafter referred to as "ASSIGNEE," is desirous of acquiring an interest in the invention and application and in any U.S. Letters Patent and Registrations which may be granted on the same;

For good and valuable consideration, receipt of which is hereby acknowledged by Assignors, Assignors have assigned, and by these presents do assign to Assignee all right, title and interest in and to the invention and application and to all foreign counterparts (including patent, utility model and industrial designs), and in and to any Letters Patent and Registrations which may hereafter be granted on the same in the United States and all countries throughout the world, and to claim the priority from the application as provided by the Paris Convention. The right, title and interest is to be held and enjoyed by Assignee and Assignee's successors and assigns as fully and exclusively as it would have been held and enjoyed by Assignors had this Assignment not been made, for the full term of any Letters Patent and Registrations which may be granted thereon, or of any division, renewal, continuation in whole or in part, substitution, conversion, reissue, prolongation or extension thereof.

Assignors further agree that they will, without charge to Assignor, but at Assignee's expense, (a) cooperate with Assignee in the prosecution of U.S. Patent applications and foreign counterparts on the invention and any improvements, (b) execute, verify, acknowledge and deliver all such further papers, including patent applications and instruments of transfer, and (c) perform such other acts as Assignee lawfully may request to obtain or maintain Letters Patent and Registrations for the invention and improvements in any and all countries, and to vest title thereto in Assignee, or Assignee's successors and assigns.

IN TESTIMONY WHEREOF, Assignors have signed their names on the dates indicated.

Dated: 5/16/12

Chunhua Li

Dated: 5/16/2012

Yan Chen

Dated: 5-16-2017

Signature of Representative
For Assignee

William G. Becker
Printed Name

Sr. Director, IP
Title

64247543v.1

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ACKNOWLEDGMENT

State of California
County of Santa Clara)

On May 16, 2012 before me, Linda R. Vajretti, Notary Public
(Insert name and title of the officer)

personally appeared Chunhua Li and Yan Chen,
who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) ~~is~~/are subscribed to the within instrument and acknowledged to me that ~~he/she~~/they executed the same in ~~his/her~~/their authorized capacity(ies), and that by ~~his/her~~/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____ (Seal)

LINDA R. VAJRETTI
COMM. NO. 1962847
NOTARY PUBLIC – CALIFORNIA
COUNTY OF SANTA CLARA
COMM. EXPIRES DEC. 3, 2015

CORPORATE TO CORPORATE ASSIGNMENT	Docket Number 22773-826.201

WHEREAS Covestro Deutschland Aktiengesellschaft, Kaiser-Wilhelm Allee 60, D-51373 Leverkusen, Federal Republic of Germany (hereinafter "Assignor 1"), Covestro LLC, 1 Covestro Circle, Pittsburgh, Pennsylvania 15205, United States of America (hereinafter "Assignor 2") and Align Technology Inc., a corporation of the State of Delaware, having a place of business at 2560 Orchard Parkway, San Jose, California 95131, United States of America (hereinafter "Assignee"), and wherein [redacted], and wherein an application entitled:

MULTILAYER DENTAL APPLIANCES AND RELATED METHODS AND SYSTEMS

for which application serial number 13/470,681 was filed on May 14, 2012, in the United States Patent and Trademark Office [redacted].

Said application names inventors from Assignor 1, Assignor 2 and Assignee. These inventors have assigned their invention to their respective company.

WHEREAS the parties have determined [redacted] U.S. Ser. Appl. No. 13/470,681, U.S. Ser. Appl. No. 15/132,171, and the divisional application having Docket Number 22773-826.401 and continuation application having Docket Number 22773-826.302 to be filed according to the claims of Annex 1 (hereinafter together "Applications") belongs to Assignee.

WHEREAS to effect the ownership of said Applications to Assignee [redacted], Assignor 1 and 2 assign their respective share to Assignee and Assignee accepts such assignment.

NOW, THEREFORE, the parties agree as follows:

1. Assignor 1 and 2 hereby assign, all right, title and interests (a) in and to said Applications in the United States, including the right to claim priority to and from said Applications in and for the United States; (b) in and to each and every patent issuing or reissuing from said Applications in the United States; (c) in and to each and every reissue, reexamination, renewal or extension of any kind of any of the foregoing; and (d) in and to all claims for past, present and future infringement of the patent(s) issuing or reissuing from said Applications in the United States, including all rights to sue for and to receive and recover for Assignee's own use all past, present, and future lost profits, royalties, and damages of whatever nature recoverable from an infringement of the patent(s) in the United States. No other rights are hereby assigned or transferred to Assignee by Assignor 1 or Assignor 2 than those set forth in this paragraph 1.

2. Assignor 1 and 2 hereby covenant and agree to cooperate with said Assignee to enable said Assignee to enjoy to the fullest extent the right, title and interest herein conveyed in the United States. Such cooperation by the Assignor 1 and 2 shall include prompt production of pertinent facts and documents, giving of testimony, execution of petitions, oaths, specifications, declarations or other papers, and other assistance all to the extent reasonable necessary (a) for perfecting in said Assignee the right, title and interest herein conveyed; (b) for prosecuting said Applications in the United States (c) for filing and prosecuting substitute, divisional or continuing applications claiming priority on said Applications in the United States; (d) for filing and prosecuting applications for reissuance of any patent(s) issuing from said Applications in the United States; (e) for interference or other priority proceedings involving said Applications in the United States; Assignee shall reimburse Assignor 1 and Assignor 2 for costs incurred by Assignor 1 and Assignor 2 in providing assistance and support to Assignee in connection with this paragraph 2.

3. The terms and covenants of this assignment shall inure to the benefit of said Assignee, its successors, assigns and other legal representatives, and shall be binding upon the Assignor 1 and 2, its successors, assigns and other legal representatives.

4. Assignor 1 and 2 hereby warrant, represent and covenant that said Assignor 1 and 2 have not entered and will not enter into any assignment, contract, or understanding in conflict herewith.

5. Assignor 1 and 2 hereby request that any patent(s) issuing in the United States, be issued in the name of the Assignee, or its successors and assigns, for the sole use of said Assignee, its successors, legal representatives and assigns.

6. This instrument will be interpreted and construed in accordance with the laws of the State of Delaware, without regard to conflict of law principles. If any provision of this instrument is found to be illegal or unenforceable, the other provisions shall remain effective and enforceable to the greatest extent permitted by law. This instrument may be executed in counterparts, each of which is deemed an original, but all of which together constitute one and the same agreement.

IN WITNESS WHEREOF, said Assignor 1 and 2 have executed and delivered this instrument to said Assignee as of the date written below.

ASSIGNOR 1

Date: 30. MRZ. 2017

By: Dr. Gilbert Voormans, LLM
Name:
Title: Vice President
Head of Intellectual Property Rights

Date: 2017-03-30

By:
Name:
Title: Dr. Katrin Joschek
IP Counsel

CORPORATE TO CORPORATE ASSIGNMENT	Docket Number 22773-826.201

Date: 3/29/2017

ASSIGNOR 2

By: _____ 3/29/17

Name: Scott G. Brown

Title: Vice President, General Counsel and Secretary

RECEIVED AND AGREED TO BY ASSIGNEE:

Date: March 30, 2017

By: _____

Name: Roger E. George

Title: Vice President, Corporate & Legal Affairs, General Counsel & Corporate Secretary

Annex 1

DIVISIONAL CLAIMS

1. A method of making a dental appliance for positioning a patient's teeth, the method comprising:

providing a sheet comprising a hard polymer layer of polymeric material disposed between a first soft polymer layer and a second soft polymer layer;

providing a positive model of the patient's teeth in a target position; and

fabricating an appliance as a negative of the positive model comprising thermoforming the sheet over the positive model.

2. The method of claim 1, wherein the hard polymer layer comprises a layer of a polyester, a co-polyester, a polycarbonate, a thermoplastic polyurethane, a polypropylene, a polyethylene, a polypropylene and polyethylene copolymer, an acrylic, a cyclic block copolymer, a polyetheretherketone, a polyamide, a polyethylene terephthalate, a polybutylene terephthalate, a polyetherimide, a polyethersulfone, a polytrimethylene terephthalate, or a combination thereof.

3. The method of claim 1, wherein the hard polymer layer comprises at least two layers and the at least two layers are independently selected from a group consisting of a polyester, a co-polyester, a polycarbonate, a thermoplastic polyurethane, a polypropylene, a polyethylene, a polypropylene and polyethylene copolymer, an acrylic, a cyclic block copolymer, a polyetheretherketone, a polyamide, a polyethylene terephthalate, a polybutylene terephthalate, a polyetherimide, a polyethersulfone, and a polytrimethylene terephthalate.

4. The method of claim 1, wherein each of the first soft polymer layer and the second soft polymer layer independently comprises a layer of a styrenic block copolymer (SBC), a silicone rubber, an elastomeric alloy, a thermoplastic elastomer (TPE), a thermoplastic vulcanizate (TPV) elastomer, a polyurethane elastomer, a block copolymer elastomer, a polyolefin blend elastomer, a thermoplastic co-polyester elastomer, a thermoplastic polyamide elastomer, or a combination thereof.

5. The method of claim 1, wherein at least one of the first soft polymer layer and the second soft polymer layer comprises at least two layers, and wherein the at least two layers are independently selected from the group consisting of a styrenic block copolymer (SBC), a silicone rubber, an elastomeric alloy, a thermoplastic elastomer (TPE), a thermoplastic vulcanizate (TPV) elastomer, a polyurethane elastomer, a block copolymer elastomer, a polyolefin blend elastomer, a thermoplastic co-polyester elastomer, or a thermoplastic polyamide elastomer.

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6. The method of claim 1, wherein the hard polymer layer comprises at least one of a tensile strength at yield of between about 4000 pounds psi and 6500 psi, an elongation at yield of greater than about 4%, an elongation at break of greater than about 70%, a tensile modulus of greater than about 150,000 psi, a flexural modulus greater than about 150,000 psi, a stress relaxation at 24 hours testing in a wet environment greater than about 10%, and a light transmission between 400 nm and 800 nm of greater than about 75%.

7. The method of claim 1, wherein the first soft polymer layer and the second soft polymer layer each independently comprise at least one of a hardness of about 60A to about 85D, an ultimate tensile strength of greater than about 5000 psi, an elongation at break of greater than about 200 %, a compression set at about 70 °C of greater than 40% after 24 hours, a flexural modulus of greater than about 35,000 psi, and a light transmission between 400 nm and 800 nm of greater than about 75%.

8. The method of claim 1, further comprising fabricating a plurality of appliances corresponding to different arrangements of the patient's teeth.

9. The method of claim 8, wherein fabricating the plurality of appliances comprises digitally staging a plurality of digital models of the patient's teeth and generating a plurality of physical models from the digital models.

10. The method of claim 8, wherein two or more of the plurality of appliances comprise a sheet comprising a hard polymer layer of polymeric material disposed between a first soft polymer layer and a second soft polymer layer.

11. The method of claim 1, wherein the hard polymer layer comprises a plurality of co-extruded or laminated polymer layers.

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CONTINUATION CLAIMS

1. A removable orthodontic tooth positioning appliance having teeth receiving cavities shaped to directly receive at least some of a patient's teeth and apply a resilient positioning force to the patient's teeth, the appliance comprising:

a first soft outer polymer layer comprising a first soft polymeric material and a second soft outer polymer layer comprising a second soft polymeric material, each of the first and second soft polymer layers having a flexural modulus of greater than about 35,000 psi, a hardness of about 60A to about 85D, and a thickness in a range from 25 μm to 100 μm; and

a hard inner polymer layer comprising a co-polyester disposed between the first soft outer polymer layer and the second soft outer polymer layer so as to reduce degradation of the resilient positioning force applied to the teeth when the appliance is worn.

2. The appliance of claim 1, wherein the first and second soft polymeric material each respectively comprise a material selected from the group consisting of: a thermoplastic polyurethane elastomer, a silicone rubber, an elastomeric alloy, a thermoplastic elastomer (TPE), a thermoplastic vulcanizate (TPV) elastomer, a block copolymer elastomer, a polyolefin blend elastomer, a thermoplastic co-polyester elastomer, a thermoplastic polyamide elastomer, or a combination thereof.

3. The appliance of claim 2, wherein the first and second soft polymeric materials each comprise the same material.

4. The appliance of claim 2, wherein the first and second soft polymeric materials comprise different materials.

5. The appliance of claim 2, wherein the first and second soft polymeric materials each comprise a blend of polymeric materials, each respective blend including two or more materials selected from the group consisting of: a thermoplastic polyurethane elastomer, a silicone rubber, an elastomeric alloy, a thermoplastic elastomer (TPE), a thermoplastic vulcanizate (TPV) elastomer, a block copolymer elastomer, a polyolefin blend elastomer, a thermoplastic co-polyester elastomer, and a thermoplastic polyamide elastomer.

6. The appliance of claim 2, wherein at least one of the first soft outer polymer layer and the second soft outer polymer layer comprises at least two layers.

7. The appliance of claim 1, wherein the hard inner polymer layer comprises a blend of

polymeric materials including the co-polyester and one or more of: a polyester, a thermoplastic polyurethane, a polypropylene, a polyethylene, a polypropylene and polyethylene copolymer, an acrylic, a polyetheretherketone, a polyamide, a polyethylene terephthalate, a polybutylene terephthalate, a polyetherimide, a cyclic block copolymer, a polyethersulfone, a polytrimethylene terephthalate, or a combination thereof.

8. The appliance of claim 1, wherein the hard inner polymer layer comprises at least two layers including a first layer comprising the co-polyester and a second layer comprising one or more of: a polyester, a co-polyester, a thermoplastic polyurethane, a polypropylene, a polyethylene, an acrylic, a polyetheretherketone, a polyamide, a polyethylene terephthalate, a polybutylene terephthalate, a polyetherimide, a cyclic block copolymer, a polyethersulfone, or a polytrimethylene terephthalate.

9. The appliance of claim 1, wherein the hard inner polymer layer has a thickness in a range from 400 μm to 1100 μm.

10. The appliance of claim 1, wherein the hard inner polymer layer, the first soft outer polymer layer, and the second soft outer polymer layer combined have a thickness of 500 μm to 1200 μm.

11. The appliance of claim 1, wherein the hard inner polymer layer comprises at least one of: a tensile strength at yield of between about 4000 pounds per square inch (psi) and 6500 psi, an elongation at yield of greater than about 4%, an elongation at break of greater than about 70%, a tensile modulus of greater than about 150,000 psi, a flexural modulus greater than about 150,000 psi, a stress relaxation at 24 hours testing in a high humidity environment of greater than about 10%, or a light transmission between 400 nm and 800 nm of greater than about 75%.

12. The appliance of claim 1, wherein the first soft outer polymer layer and the second soft outer polymer layer each independently comprise at least one of: an ultimate tensile strength of greater than about 5000 psi, an elongation at break of greater than about 200%, a compression set at about 70 °C of greater than 40% after 24 hours, or a light transmission between 400 nm and 800 nm of greater than about 75%.

13. A plurality of incremental position adjustment appliances having teeth receiving cavities shaped to directly receive at least some of the patient's teeth and apply a resilient positioning force to the patient's teeth, wherein the appliances are shaped to move teeth from one arrangement to a successive arrangement when successively worn by a patient, and wherein at least one of the appliances comprises a

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removable orthodontic tooth positioning appliance having teeth receiving cavities shaped to directly receive at least some of a patient's teeth and apply a resilient positioning force to the patient's teeth, the appliance comprising:

a first soft outer polymer layer comprising a first soft polymeric material and a second soft outer polymer layer comprising a second soft polymeric material, each of the first and second soft polymer layers having a flexural modulus of greater than about 35,000 psi, a hardness of about 60A to about 85D, and a thickness in a range from 25 μm to 100 μm; and

a hard inner polymer layer comprising a co-polyester disposed between the first soft outer polymer layer and the second soft outer polymer layer so as to reduce degradation of the resilient positioning force applied to the teeth when the appliance is worn.

14. The plurality of appliances of claim 13, wherein the first and second soft polymeric material each respectively comprise a material selected from the group consisting of: a thermoplastic polyurethane elastomer, a silicone rubber, an elastomeric alloy, a thermoplastic elastomer (TPE), a thermoplastic vulcanizate (TPV) elastomer, a block copolymer elastomer, a polyolefin blend elastomer, a thermoplastic co-polyester elastomer, a thermoplastic polyamide elastomer, or a combination thereof.

15. A method of moving a patient's teeth from an initial configuration to a target configuration, the method comprising providing a removable orthodontic tooth positioning appliance having teeth receiving cavities shaped to directly receive at least some of a patient's teeth and apply a resilient positioning force to the patient's teeth, the appliance comprising:

a first soft outer polymer layer comprising a first soft polymeric material and a second soft outer polymer layer comprising a second soft polymeric material, each of the first and second soft polymer layers having a flexural modulus of greater than about 35,000 psi, a hardness of about 60A to about 85D, and a thickness in a range from 25 μm to 100 μm; and

a hard inner polymer layer comprising a co-polyester disposed between the first soft outer polymer layer and the second soft outer polymer layer so as to reduce degradation of the resilient positioning force applied to the teeth when the appliance is worn.

16. The method of claim 15, wherein providing the removable orthodontic tooth positioning appliance comprises placing the removable orthodontic tooth positioning appliance on the teeth of a patient.

17. The method of claim 15, wherein providing the removable orthodontic tooth positioning appliance comprises providing a series of incremental position adjustment appliances, said series of incremental position adjustment appliances including the removable orthodontic tooth positioning

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appliance.

18. The method of claim 17, wherein providing the series of incremental position adjustment appliances comprises placing said series of incremental position adjustment appliances over the patient's teeth.

19. The method of claim 15, wherein the first and second soft polymeric material each respectively comprise a material selected from the group consisting of: a thermoplastic polyurethane elastomer, a silicone rubber, an elastomeric alloy, a thermoplastic elastomer (TPE), a thermoplastic vulcanizate (TPV) elastomer, a block copolymer elastomer, a polyolefin blend elastomer, a thermoplastic co-polyester elastomer, a thermoplastic polyamide elastomer, or a combination thereof.

20. The method of claim 18, wherein the first and second soft polymeric materials comprise different materials.

21. The method of claim 18, wherein the first and second soft polymeric materials each comprise a blend of polymeric materials, each respective blend including two or more materials selected from the group consisting of: a thermoplastic polyurethane elastomer, a silicone rubber, an elastomeric alloy, a thermoplastic elastomer (TPE), a thermoplastic vulcanizate (TPV) elastomer, a block copolymer elastomer, a polyolefin blend elastomer, a thermoplastic co-polyester elastomer, and a thermoplastic polyamide elastomer.

22. The method of claim 18, wherein the first and second soft polymeric materials each comprise a thermoplastic polyurethane elastomer.

23. The method of claim 15, wherein the hard inner polymer layer comprises a blend of polymeric materials including the co-polyester and one or more of: a polyester, a thermoplastic polyurethane, a polypropylene, a polyethylene, a polypropylene and polyethylene copolymer, an acrylic, a polyetheretherketone, a polyamide, a polyethylene terephthalate, a polybutylene terephthalate, a polyetherimide, a cyclic block copolymer, a polyethersulfone, a polytrimethylene terephthalate, or a combination thereof.

24. The method of claim 15, wherein the hard inner polymer layer comprises at least two layers including a first layer comprising the co-polyester and a second layer comprising one or more of: a polyester, a co-polyester, a thermoplastic polyurethane, a polypropylene, a polyethylene, an acrylic, a

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polyetheretherketone, a polyamide, a polyethylene terephthalate, a polybutylene terephthalate, a polyetherimide, a cyclic block copolymer, a polyethersulfone, or a polytrimethylene terephthalate.

25. The method of claim 15, wherein the first soft outer polymer layer and the second soft outer polymer layer each independently comprise at least one of: an ultimate tensile strength of greater than about 5000 psi, an elongation at break of greater than about 200%, a compression set at about 70 °C of greater than 40% after 24 hours, or a light transmission between 400 nm and 800 nm of greater than about 75%.

26. The method of claim 15, further comprising fabricating the removable orthodontic tooth positioning appliance.

27. A method of moving a patient's teeth from an initial configuration to a target configuration, the method comprising the steps of:

providing a removable orthodontic tooth positioning appliance having teeth receiving cavities shaped to directly receive at least some of a patient's teeth;

applying a resilient positioning force to the patient's teeth; and

moving the teeth into the target configuration, wherein the appliance comprises:

a first soft outer polymer layer comprising a first soft polymeric material and a second soft outer polymer layer comprising a second soft polymeric material, each of the first and second soft polymer layers having a hardness of about 60A to about 85D, and a thickness in a range from 25 μm to 100 μm; and

a hard inner polymer layer comprising a co-polyester disposed between the first soft outer polymer layer and the second soft outer polymer layer so as to reduce degradation of the resilient positioning force applied to the teeth when the appliance is worn.

28. The method of claim 27, wherein the first and second soft polymeric material each respectively comprise a material selected from the group consisting of: a thermoplastic polyurethane elastomer, a silicone rubber, an elastomeric alloy, a thermoplastic elastomer (TPE), a thermoplastic vulcanizate (TPV) elastomer, a block copolymer elastomer, a polyolefin blend elastomer, a thermoplastic co-polyester elastomer, a thermoplastic polyamide elastomer, or a combination thereof.

ClearCorrect Exhibit 1137, Page 59 of 337
ClearCorrect v. Align - IPR2025-00819

ASSIGNMENT

WHEREAS I , 1) Craig Pehlert

of 1) 29 St. Ann's Avenue, Lenox, MA 01240

have invented certain improvements in MULTILAYER DENTAL APPLIANCES AND RELATED METHODS AND SYSTEMS

described in a patent application executed by me and identified in the United States Patent Office as follows:

Serial No.: 13/470,681

Filed: May 14, 2012

and Attorney's Docket No.: 22773-826.201; and

WHEREAS, COVESTRO LLC, of Pittsburgh, Pennsylvania, a limited liability company of the State of Delaware is desirous of acquiring the entire right, title and interest in and to said invention or inventions and any and all patents to be obtained therefore; this document may be executed in any number of counterparts, each of which so executed shall be deemed to be an original, but all such counterparts shall together constitute but one and the same document.

NOW, THEREFORE, for valuable consideration and in accordance with the obligations in my employment contracts with COVESTRO LLC, I do hereby sell, assign and transfer unto said COVESTRO LLC, its successors and assigns, the entire right, title, and interest in and to said invention or inventions, as described in the aforesaid application, in any form or embodiment thereof, and in and to the aforesaid application; and in and to any applications filed in any foreign country based thereon, including the right to file said foreign applications under the provisions of the International Convention; also any improvements on said invention or inventions now or hereafter made by me during the period of my employment; also the entire right, title and interest in and to any and all patents or reissues or extensions thereof to be obtained in this or any foreign country upon said invention, inventions or improvements and any divisional, continuation, continuation-in-part or substitute applications which may be filed upon said invention, inventions or improvements in this or any foreign country; and I hereby authorize and request the issuing authority to issue any and all patents on said application or applications to said COVESTRO LLC, as assignee of the entire interest.

I further agree, without any payment by COVESTRO LLC, other than expenses incurred by the undersigned, to communicate to said COVESTRO LLC, its representatives or agents, any facts relating to said invention, inventions or improvements, including evidence for interference purposes or for other legal proceedings, whenever requested, testify in any interference or other legal proceedings, whenever requested; and execute and deliver, on request, all lawful papers required to make any of the foregoing provisions effective.

SIGNED AT Sheffield, Massachusetts, USA.

2/17/2017
(Date)

(L.S.) 1) Craig Pehlert
Craig Pehlert

/vjt/pehlertassignmentalign21617

ASSIGNMENT

WHEREAS We, 1) Dr. Heinz Pudleiner; 2) Klaus Meyer; 3) Joerg Nickel

of 1) Bethelstr. 39, 47800 Krefeld, Germany; 2) Kamillenstr. 40, 41539 Dormagen, Germany;

3) Krokusweg 2, 41539 Dormagen, Germany

have invented certain improvements in MULTILAYER DENTAL APPLIANCES AND RELATED METHODS AND SYSTEMS

described in a patent application executed by us and identified in the United States Patent Office as follows:

Serial No.: 13/470,681

Filed: May 14, 2012

and Attorney's Docket No.: 22773-826.201 ; and

WHEREAS, COVESTRO DEUTSCHLAND AKTIENGESELLSCHAFT, of Leverkusen, Germany, a corporation of Germany, is desirous of acquiring the entire right, title and interest in and to said invention or inventions and any and all patents to be obtained therefore; this document may be executed in any number of counterparts, each of which so executed shall be deemed to be an original, but all such counterparts shall together constitute but one and the same document.

NOW, THEREFORE, for valuable consideration and in accordance with the obligations in our employment contract with COVESTRO DEUTSCHLAND AKTIENGESELLSCHAFT, we do hereby sell, assign and transfer unto said COVESTRO DEUTSCHLAND AKTIENGESELLSCHAFT, their successors and assigns, the entire right, title, and interest in and to said invention or inventions, as described in the aforesaid application, in any form or embodiment thereof, and in and to the aforesaid application; and in and to any applications filed in any foreign country based thereon, including the right to file said foreign applications under the provisions of the International Convention; also any improvements on said invention or inventions now or hereafter made by us during the period of our employment; also the entire right, title and interest in and to any and all patents or reissues or extensions thereof to be obtained in this or any foreign country upon said invention, inventions or improvements and any divisional, continuation, continuation-in-part or substitute applications which may be filed upon said invention, inventions or improvements in this or any foreign country we hereby authorize and request the issuing authority to issue any and all patents on said application or applications to said COVESTRO DEUTSCHLAND AKTIENGESELLSCHAFT, as assignees of the entire interest.

We further agree, without any payment by COVESTRO DEUTSCHLAND AKTIENGESELLSCHAFT, other than expenses incurred by the undersigned, to communicate to said COVESTRO DEUTSCHLAND AKTIENGESELLSCHAFT, their representatives or agents, any facts relating to said invention, inventions or improvements, including evidence for interference purposes or for other legal proceedings, whenever requested, testify in any interference or other legal proceedings, whenever requested; and execute and deliver, on request, all lawful papers required to make any of the foregoing provisions effective.

SIGNED AT DORMAGEN, Germany,

23.02.2017 (Date) L.S.) 1) Heinz Pudleiner
Dr. Heinz Pudleiner

SIGNED AT Dormagen, Germany,

22.2.2017 (Date) L.S.) 2) Klaus Meyer
Klaus Meyer

SIGNED AT Dormagen, Germany,

22.02.2017 (Date) L.S.) 3) Joerg Nickel
Joerg Nickel

/vjt/27773assignmentgermaninventors

Electronic Patent Application Fee Transmittal	
Application Number:	
Filing Date:	
Title of Invention:	MULTILAYER POLYMER SHEETS
First Named Inventor/Applicant Name:	Chunhua LI
Filer:	Garrett T Potter/Selena Whitaker-Paquiet
Attorney Docket Number:	22773-826.310
Filed as Large Entity	
Filing Fees for Track I Prioritized Examination - Nonprovisional Application under 35 USC 111(a)	

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	320	320
UTILITY SEARCH FEE	1111	1	700	700
UTILITY EXAMINATION FEE	1311	1	800	800
REQUEST FOR PRIORITIZED EXAMINATION	1817	1	4200	4200
Pages:				
Claims:				
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
PROCESSING FEE, EXCEPT PROV. APPLS.	1830	1	140	140
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**6160**

Electronic Acknowledgement Receipt	
EFS ID:	46128861
Application Number:	17858825
International Application Number:	
Confirmation Number:	1348
Title of Invention:	MULTILAYER POLYMER SHEETS
First Named Inventor/Applicant Name:	Chunhua LI
Customer Number:	107046
Filer:	Garrett T Potter/Selena Whitaker-Paquiet
Filer Authorized By:	Garrett T Potter
Attorney Docket Number:	22773-826.310
Receipt Date:	06-JUL-2022
Filing Date:	
Time Stamp:	18:30:45
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$6160
RAM confirmation Number	E202276I31531908
Deposit Account	232415
Authorized User	Selena Whitaker-Paquiet
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.21 (Miscellaneous fees and charges) 37 CFR 1.16 (National application filing, search, and examination fees)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	22773_826_310_exAppln_TRNSMTL.pdf	223668 30d928befb6880237de1add15cde2dce1353a668	no	1
Warnings:					
Information:					
2	Track One Request	22773_826_310_exREQ_Prioritized_Exam_TRACK_1.pdf	108989 ccb738f08ead2c107cf2d695f0fa58c58925cea3	no	1
Warnings:					
Information:					
3	Application Data Sheet	22773_826_310_exADS.pdf	2197177 9a1ff221d486773e62767ad8930f412ca5825bd1	no	10
Warnings:					
Information:					
4		22773_826_310_Spec_Claims_Abstract_Final.pdf	196844 15fa9ac9c2ca4c3fd3ec314702e4fb0c2b45dbbb	yes	17

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	12
Claims	13	16
Abstract	17	17

Warnings:					
Information:					
5	Drawings-only black and white line drawings	22773_826_310_Drawings.pdf	240737 d4d758d4a30dea421c17b443a74a1d9fda54de9f	no	8

Warnings:					
Information:					
6	Oath or Declaration filed	22773_826_310_Parent401_exInv_Declarations.pdf	722926 3fdd6a4f7a19db48b994b812c21540111c2dab9d	no	6
Warnings:					
Information:					
7	Power of Attorney	22773_Gen_POA.pdf	807616 d8bac50de0e1b0100ffda6bc3e3dddad956f63ef	no	1
Warnings:					
Information:					
8	Assignee showing of ownership per 37 CFR 3.73	22773_826_310_exStmnt_Under_3_73c.pdf	6761534 9f20539eb58a528399f61bb0dccd58b35897c7f7	no	16
Warnings:					
Information:					
9	Fee Worksheet (SB06)	fee-info.pdf	50833 7f5328429241c71a8969ea907853fefea599f9f0	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	11310324		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 10

Complete if Known	
Application Number	17/858,825
Filing Date	07-06-2022
First Named Inventor	LI; Chunhua
Art Unit	-
Examiner Name	-
Attorney Docket Number	22773-826.310

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	001	US-D865180	10-29-2019	BAUER; Laura et al.	
	002	US-5820368	10-13-1998	WOLK; Roger S.	
	003	US-6386864	05-14-2002	KUO; Eric	
	004	US-6450807	09-17-2002	CHISHTI; Muhammad et al.	
	005	US-6471511	10-29-2002	CHISHTI; Muhammad et al.	
	006	US-6607382	08-19-2003	KUO; Eric et al.	
	007	US-6783604	08-31-2004	TRICCA; Robert E.	
	008	US-6790035	09-14-2004	TRICCA; Robert E. et al.	
	009	US-6814574	11-09-2004	ABOLFATHI; Amir et al.	
	010	US-6830450	12-14-2004	KNOPP; Peter G. et al.	
	011	US-6947038	09-20-2005	ANH; JAE H. et al.	
	012	US-7074039	07-11-2006	KOPELMAN; AVI et al.	
	013	US-7104792	09-12-2006	TAUB; Eldad et al.	
	014	US-7160107	01-09-2007	KOPELMAN; AVI et al.	
	015	US-7192273	03-20-2007	McSURDY, Jr.; David W.	
	016	US-7347688	03-25-2008	KOPELMAN; AVI et al.	
	017	US-7448514	11-11-2008	WEN; Huafeng	
	018	US-7481121	01-27-2009	CAO; Heng	
	019	US-7543511	06-09-2009	KIMURA; Ryan et al.	
	020	US-7553157	06-30-2009	ABOLFATHI; Amir et al.	
	021	US-7600999	10-13-2009	KNOPP; Peter G.	
	022	US-7658610	02-09-2010	KNOPP; Peter G.	
	023	US-7766658	08-03-2010	TRICCA; Robert E. et al.	
	024	US-7771195	08-10-2010	KNOPP; Peter et al.	
	025	US-7854609	12-21-2010	CHEN; Jennifer C. et al.	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Sheet 2 of 10

Complete if Known	
Application Number	17/858,825
Filing Date	07-06-2022
First Named Inventor	LI; Chunhua
Art Unit	-
Examiner Name	-
Attorney Docket Number	22773-826.310

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	026	US-7871269	01-18-2011	WU; KEN et al.	
	027	US-7878801	02-01-2011	ABOLFATHI; Amir et al.	
	028	US-7878805	02-01-2011	MOSS; Jon F. et al.	
	029	US-7914283	03-29-2011	KUO; Eric	
	030	US-7947508	05-24-2011	TRICCA; Robert E. et al.	
	031	US-8152518	04-10-2012	KUO; Eric E.	
	032	US-8172569	05-08-2012	MATTY; Rick M. et al.	
	033	US-8235715	08-07-2012	KUO; Eric	
	034	US-8292617	10-23-2012	BRANDT; Douglas et al.	
	035	US-8337199	12-25-2012	WEN; Huafeng	
	036	US-8401686	03-19-2013	MOSS; Jon et al.	
	037	US-8517726	08-27-2013	KAKAVAND; Ali et al.	
	038	US-8562337	10-22-2013	KUO; Eric et al.	
	039	US-8641414	02-04-2014	BOROVINSKIH; Artem et al.	
	040	US-8684729	04-01-2014	WEN; Huafeng	
	041	US-8708697	04-29-2014	LI; Chunhua et al.	
	042	US-8771149	07-08-2014	RAHMAN; Tariq et al.	
	043	US-8899976	12-02-2014	CHEN; Jennifer C. et al.	
	044	US-8899977	12-02-2014	CAO; Heng et al.	
	045	US-8936463	01-20-2015	MASON; David et al.	
	046	US-8936464	01-20-2015	KOPELMAN; Avi	
	047	US-9022781	05-05-2015	KUO; Eric et al.	
	048	US-9108338	08-18-2015	SIROVSKIY; Yevgeniy et al.	
	049	US-9119691	09-01-2015	NAMIRANIAN; Parshan et al.	
	050	US-9161823	10-20-2015	MORTON; John et al.	
	051	US-9241774	01-26-2016	LI; Chunhua et al.	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Sheet 3 of 10

Complete if Known	
Application Number	17/858,825
Filing Date	07-06-2022
First Named Inventor	LI; Chunhua
Art Unit	-
Examiner Name	-
Attorney Docket Number	22773-826.310

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	052	US-9326831	05-03-2016	CHEANG; Ka Man	
	053	US-9433476	09-06-2016	KHARDEKAR; Rahul et al.	
	054	US-9610141	04-04-2017	KOPELMAN; Avi et al.	
	055	US-9675427	06-13-2017	KOPELMAN; Avi	
	056	US-9700385	07-11-2017	WEBBER; Peter	
	057	US-9744001	08-29-2017	CHOI; Jeeyoung et al.	
	058	US-9844424	12-19-2017	WU; Ken et al.	
	059	US-10045835	08-14-2018	BORONKAY; Allen et al.	
	060	US-10111730	10-30-2018	WEBBER; Peter et al.	
	061	US-10150244	12-11-2018	SATO; Jun et al.	
	062	US-10201409	02-12-2019	MASON; David et al.	
	063	US-10213277	02-26-2019	WEBBER; Peter et al.	
	064	US-10299894	05-28-2019	TANUGULA et al.	
	065	US-10363116	07-30-2019	BORONKAY; Allen	
	066	US-10383705	08-20-2019	SHANJANI; Yaser et al.	
	067	US-10449016	10-22-2019	KIMURA; Ryan et al.	
	068	US-10463452	11-05-2019	MATOV; Vadim et al.	
	069	US-10470847	11-12-2019	SHANJANI; Yaser et al.	
	070	US-10517701	12-31-2019	BORONKAY; Allen R.	
	071	US-10537406	01-21-2020	WU; Ken et al.	
	072	US-10537463	01-21-2020	KOPELMAN; Avi	
	073	US-10548700	02-04-2020	FERNIE; Michael Lawrence	
	074	US-10555792	02-11-2020	KOPELMAN; Avi et al.	
	075	US-10588776	03-17-2020	CAM; Bruce et al.	
	076	US-10613515	04-07-2020	CRAMER; Christopher Eric et al.	
	077	US-10639134	05-05-2020	SHANJANI; Yaser et al.	

Examiner Signature		Date Considered	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 4 of 10

Complete if Known	
Application Number	17/858,825
Filing Date	07-06-2022
First Named Inventor	LI; Chunhua
Art Unit	-
Examiner Name	-
Attorney Docket Number	22773-826.310

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	078	US-10743964	08-18-2020	WU; Fuming et al.	
	079	US-10758323	09-01-2020	KOPELMAN; Avi	
	080	US-10781274	09-22-2020	LISKA; Robert et al.	
	081	US-10813720	10-27-2020	GROVE; Bob et al.	
	082	US-10874483	12-29-2020	BORONKAY; Allen	
	083	US-10881487	01-05-2021	CAM; Bruce et al.	
	084	US-10912629	02-09-2021	TANUGULA; Rohit et al.	
	085	US-10959810	03-30-2021	LI; Chunhua et al.	
	086	US-10993783	05-04-2021	WU; Fuming et al.	
	087	US-11026768	06-08-2021	MOSS; Jon F. et al.	
	088	US-11026831	06-08-2021	KUO; Eric	
	089	US-11045282	06-29-2021	KOPELMAN; Avi et al.	
	090	US-11045283	06-29-2021	RILEY; Jeremy et al.	
	091	US-11103330	08-31-2021	WEBBER; Peter et al.	
	092	US-11123156	09-21-2021	CAM; Bruce et al.	
	093	US-11154382	10-26-2021	KOPELMAN; Avi et al.	
	094	US-11166788	11-09-2021	WEBBER; Peter	
	095	US-11174338	11-16-2021	ROBERT; Liska et al.	
	096	US-11219506	01-11-2022	SHANJANI; Yaser et al.	
	097	US-11259896	03-01-2022	MATOV; Vadim et al.	
	098	US-11273011	03-15-2022	SHANJANI; Yaser et al.	
	099	US-11278375	03-22-2022	YUXIANG; Wang et al.	
	100	US-11318667	05-03-2022	MOJDEH; Mehdi et al.	
	101	US-11331166	05-17-2022	JOHN; Y. Morton et al.	
	102	US-11344385	05-31-2022	MORTON; John et al.	
	103	US-11376101	07-05-2022	SATO; Jun et al.	

Examiner Signature		Date Considered	

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Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 5 of 10

Complete if Known	
Application Number	17/858,825
Filing Date	07-06-2022
First Named Inventor	LI; Chunhua
Art Unit	-
Examiner Name	-
Attorney Docket Number	22773-826.310

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	104	US-20040166462	08-26-2004	PHAN; LOC X. et al.	
	105	US-20040166463	08-26-2004	WEN; Huafeng et al.	
	106	US-20050014105	01-20-2005	ABOLFATHI; Amir et al.	
	107	US-20050186524	08-25-2005	ABOLFATHI; Amir et al.	
	108	US-20050244768	11-03-2005	TAUB; Eldad et al.	
	109	US-20060019218	01-26-2006	KUO; Eric E.	
	110	US-20060078841	04-13-2006	DESIMONE; Joseph M. et al.	
	111	US-20060115782	06-01-2006	LI; Chunhua et al.	
	112	US-20060115785	06-01-2006	LI; Chunhua et al.	
	113	US-20060199142	09-07-2006	LIU; Frank Z. et al.	
	114	US-20060234179	10-19-2006	WEN; Huafeng et al.	
	115	US-20080118882	05-22-2008	SU; Li-Hung	
	116	US-20080160473	07-03-2008	LI; Chunhua et al.	
	117	US-20080286716	11-20-2008	SHERWOOD; Mark	
	118	US-20080286717	11-20-2008	SHERWOOD; Mark	
	119	US-20090280450	11-12-2009	KUO; Eric	
	120	US-20100055635	03-04-2010	KAKAVAND; ALI	
	121	US-20100129763	05-27-2010	KUO; Eric	
	122	US-20110269092	11-03-2011	KUO; Eric et al.	
	123	US-20140067334	03-06-2014	KUO; Eric	
	124	US-20150265376	09-24-2015	KOPELMAN; Avi	
	125	US-20150366638	12-24-2015	AVI; Kopelman et al.	
	126	US-20160193014	07-07-2016	MORTON; John et al.	
	127	US-20170007359	01-12-2017	AVI; Kopelman et al.	
	128	US-20170007360	01-12-2017	KOPELMAN; Avi et al.	
	129	US-20170007361	01-12-2017	ALLEN; Boronkay et al.	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 6 of 10

Complete if Known	
Application Number	17/858,825
Filing Date	07-06-2022
First Named Inventor	LI; Chunhua
Art Unit	-
Examiner Name	-
Attorney Docket Number	22773-826.310

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	130	US-20170007366	01-12-2017	KOPELMAN; Avi et al.	
	131	US-20170007386	01-12-2017	MASON; David et al.	
	132	US-20170135792	05-18-2017	WEBBER; Peter	
	133	US-20170135793	05-18-2017	WEBBER; Peter et al.	
	134	US-20170165032	06-15-2017	WEBBER; Peter et al.	
	135	US-20180360567	12-20-2018	XUE; Ya et al.	
	136	US-20190000592	01-03-2019	CAM; Bruce et al.	
	137	US-20190000593	01-03-2019	BRUCE; CAM et al.	
	138	US-20190021817	01-24-2019	SATO; Jun et al.	
	139	US-20190046297	02-14-2019	KOPELMAN; Avi et al.	
	140	US-20190099129	04-04-2019	KOPELMAN; Avi et al.	
	141	US-20190125494	05-02-2019	LI; Huizhong et al.	
	142	US-20190125497	05-02-2019	MITRA; Derakhshan et al.	
	143	US-20190152152	05-23-2019	O'LEARY; Siobhan et al.	
	144	US-20190175304	06-13-2019	MORTON; John Y. et al.	
	145	US-20190262101	08-29-2019	YASER; Shanjani et al.	
	146	US-20190298494	10-03-2019	WEBBER; Peter et al.	
	147	US-20190314119	10-17-2019	KOPELMAN; Avi et al.	
	148	US-20190343606	11-14-2019	WU; Fuming et al.	
	149	US-20200000553	01-02-2020	SVETLANA; Makarenkova et al.	
	150	US-20200100864	04-02-2020	YUXIANG; Wang et al.	
	151	US-20200100865	04-02-2020	YUXIANG; Wang et al.	
	152	US-20200100866	04-02-2020	VIKTORIA; Medvinskaya et al.	
	153	US-20200155276	05-21-2020	BRUCE; CAM et al.	
	154	US-20200188062	06-18-2020	AVI; Kopelman et al.	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 7 of 10

Complete if Known	
Application Number	17/858,825
Filing Date	07-06-2022
First Named Inventor	LI; Chunhua
Art Unit	-
Examiner Name	-
Attorney Docket Number	22773-826.310

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	155	US-20200214598	07-09-2020	HUIZHONG; Li et al.	
	156	US-20200214801	07-09-2020	WANG; Yuxiang et al.	
	157	US-20200390523	12-17-2020	SATO; Jun et al.	
	158	US-20210147672	05-20-2021	COLE; Michael Christopher et al.	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
		None				

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

Substitute for form 1449/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)				Application Number	17/858,825
				Filing Date	07-06-2022
				First Named Inventor	LI; Chunhua
				Art Unit	-
				Examiner Name	-
Sheet	8	of	10	Attorney Docket Number	22773-826.310

NON-PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	Include name of the author(in CAPITAL LETTERS),title of the article(when appropriate), title of the item (book,magazine,journal,serial,symposium,catalog,etc.),date,page(s),volume-issue number(s),publisher, city and/or country where published.	T[2]
		None	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant's unique citation designation number (optional). 2 Applicant is to place a check mark here if English language Translation is attached.

Substitute for form 1449/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)				Application Number	17/858,825
				Filing Date	07-06-2022
				First Named Inventor	LI; Chunhua
				Art Unit	-
				Examiner Name	-
Sheet	9	of	10	Attorney Docket Number	22773-826.310

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Garrett T. Potter/	Date (YYYY-MM-DD)	2022-07-08
Name/Print	Garrett T. Potter	Registration Number	76,602

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

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

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

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt	
EFS ID:	46147640
Application Number:	17858825
International Application Number:	
Confirmation Number:	1348
Title of Invention:	MULTILAYER POLYMER SHEETS
First Named Inventor/Applicant Name:	Chunhua LI
Customer Number:	107046
Filer:	Garrett T Potter/James Brady
Filer Authorized By:	Garrett T Potter
Attorney Docket Number:	22773-826.310
Receipt Date:	08-JUL-2022
Filing Date:	
Time Stamp:	15:31:25
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		IDS22773-826-310-07-08-2022.pdf	347012 90e56b1eed01b3d8178a3dfbdd890ecffc9a74ff	yes	14

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Transmittal Letter	1	4
	Information Disclosure Statement (IDS) Form (SB08)	5	14
Warnings:			
Information:			
	Total Files Size (in bytes):	347012	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

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

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor:	LI; Chunhua et al.	Group Art Unit:	-
Serial Number:	17/858,825	Examiner:	-
Filing or 371 (c) Date:	2022-07-06	**CONFIRMATION NO:**	**1348**
Title:	MULTILAYER POLYMER SHEETS		

FILED ELECTRONICALLY ON: July 8, 2022

Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

INFORMATION DISCLOSURE STATEMENT UNDER 37 CFR § 1.97

Commissioner for Patents:

An Information Disclosure Statement along with attached PTO/SB/08 is hereby submitted. A copy of each listed publication is submitted, if required, pursuant to 37 CFR §§1.97-1.98, as indicated below.

The Examiner is requested to review the information provided and to make the information of record in the above-identified application. The Examiner is further requested to initial and return the attached PTO/SB/08 in accordance with MPEP § 609.

The right to establish the patentability of the claimed invention over any of the information provided herewith, and/or to prove that this information may not be prior art, and/or to prove that this information may not be enabling for the teachings purportedly offered, is hereby reserved.

This statement is not intended to represent that a search has been made or that the information cited in the statement is, or is considered to be, prior art or material to patentability as defined in § 1.56.

ClearCorrect Exhibit 1137, Page 79 of 337
ClearCorrect v. Align - IPR2025-00819

A. ☒ *37 CFR § 1.97 (b).* This Information Disclosure Statement should be considered by the Office because:

☐ (1) It is being filed within 3 months of the filing date of a national application and is other than a continued prosecution application under § 1.53 (d);

-- OR --

☐ (2) It is being filed within 3 months of entry of the national stage as set forth in § 1.491 in an international application;

-- OR --

☒ (3) It is being filed before the mailing of a first Office action on the merits;

-- OR --

☐ (4) It is being filed before the mailing of a first Office action after the filing of a request for continued examination under § 1.114.

B. ☐ *37 CFR § 1.97(c).* Although this Information Disclosure Statement is being filed after the period specified in *37 CFR § 1.97(b),* above, it is filed before the mailing date of the earlier of (1) a final office action under § 1.113, (2) a notice of allowance under § 1.311, or (3) an action that otherwise closes prosecution in the application, this Information Disclosure Statement should be considered because it is accompanied by one of:

☐ a statement as specified in §1.97 (e) provided concurrently herewith;

-- OR --

☐ a fee of $260.00 as set forth in § 1.17 (p) authorized below, enclosed, or included with the payment of other papers filed together with this statement.

C. ☐ *37 CFR § 1.97 (d).* Although this Information Disclosure Statement is being filed after the mailing date of the earlier of (1) a final office action under § 1.113, (2) a notice of allowance under § 1.311, or (3) an action that otherwise closes prosecution in the application, it is being filed before payment of the issue fee and should be considered because it is accompanied by:

i. a statement as specified in § 1.97 (e);

-- AND --

ii. a fee of $260.00 as set forth in §1.17(p) is authorized below, enclosed, or included with the payment of other papers filed together with this Statement.

D. ☐ *37 CFR §1.97 (e).* Statement.

☐ A statement is provided herewith to satisfy the requirement under 37 CFR §§ 1.97 (c);

-- AND/OR --

☐ A statement is provided herewith to satisfy the requirement under 37 CFR §§ 1.97 (d);

-- AND/OR --

☐ A copy of a dated communication from a foreign patent office clearly showing that the information disclosure statement is being submitted within 3 months of the filing date on the communication is provided in lieu of a statement under 37 C.F.R. § 1.97(e) (1) as provided for under MPEP 609.04(b) V.

ClearCorrect Exhibit 1137, Page 80 of 337
ClearCorrect v. Align - IPR2025-00819

E. ☐ *Statement Under 37 C.F.R. §1.704(d).* Each item of information contained in the information disclosure statement was first cited in any communication from a patent office in a counterpart foreign or international application or from the Office or is a communication that was issued by a patent office in a counterpart foreign or international application or by the Office that was received by an individual designated in § 1.56(c) not more than thirty (30) days prior to the filing of this information disclosure statement. This statement is made pursuant to the requirements of 37 C.F.R. §1.704(d) to avoid reduction of the period of adjustment of the patent term for Applicant(s) delay.

F. ☒ *37 CFR §1.98 (a) (2).* The content of the Information Disclosure Statement is as follows:

☐ Copies of each of the references listed on the attached Form PTO/SB/08 are enclosed herewith.

-- OR --

☒ Copies of U.S. Patent Documents (issued patents and patent publications) listed on the attached Form PTO/SB/08 are not enclosed.

-- AND/OR --

☐ Copies of Foreign Patent Documents and/or Non Patent Literature Documents listed on the attached Form PTO/SB/08 are enclosed in accordance with 37 CFR §1.98 (a)(2).

-- AND/OR --

☐ Copies of pending unpublished U.S. patent applications are enclosed in accordance with 37 CFR §1.98 (a) (2) (iii).

G. ☐ *37 CFR §1.98(a)(3).* The Information Disclosure Statement includes non-English patents and/or references.

☐ Pursuant to 37 CFR §1.98(a)(3)(i), a concise explanation of the relevance of each patent, publication or other information provided that is not in English is provided herewith.

☐ Pursuant to MPEP 609(B), an English language copy of a foreign search report is submitted herewith to satisfy the requirement for a concise explanation where non-English language information is cited in the search report.

-- OR --

☐ A concise explanation of the relevance of each patent, publication or other information provided that is not in English is as follows: _____

☐ Pursuant to 37 CFR §1.98(a) (3) (ii), a copy of a translation, or a portion thereof, of the non-English language reference(s) is provided herewith.

H. ☐ *37 CFR §1.98(d).* Copies of patents, publications and pending U.S. patent applications, or other information specified in 37 C.F.R. § 1.98(a) are not provided herewith because:

☐ Pursuant to 37 CFR §1.98(d)(1) the information was previously submitted in an Information Disclosure Statement, or cited by examiner for another application under which this application claims priority for an earlier effective filing date under 35 U.S.C. 120.

Application in which the information was submitted: _____

Information Disclosure Statement(s) filed on: _____

AND

☐ The information disclosure statement submitted in the earlier application complied with paragraphs (a) through (c) of 37 CFR §1.98.

I. ☒ *Fee Authorization*. The Commissioner is hereby authorized to charge the above-referenced fees of $0.00 and charge any additional fees or credit any overpayment associated with this communication to Deposit Account No. 23-2415 (Docket No. 22773-826.310).

Respectfully submitted,

WILSON SONSINI GOODRICH & ROSATI

Dated: July 8, 2022

By: /Garrett T. Potter/
Garrett T. Potter, Ph.D.
Reg. No. 76,602

650 Page Mill Road
Palo Alto, CA 94304-1050
(650) 493-9300
Customer No. 107046

United States Patent and Trademark Office

Office of the Chief Financial Officer

Document Code:WFEE

User :Almaz Sahle

Sale Accounting Date:07/14/2022

Sale Item Reference Number	Effective Date
17858825	07/06/2022

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method
I20227DD43492330	1202	CLAIMS IN EXCESS OF 20	$1,000.00	Deposit Account

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
17/858,825	07/06/2022		2820	22773-826.310	30	3

CONFIRMATION NO. 1348

107046
Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304

FILING RECEIPT

OC000000135191282

Date Mailed: 07/19/2022

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

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

Inventor(s)

Chunhua LI, Cupertino, CA;
Yan CHEN, Cupertino, CA;
Heinz PUDLEINER, Krefeld, GERMANY;
Klaus MEYER, Dormagen, GERMANY;
Joerg NICKEL, Dormagen, GERMANY;
Craig PEHLERT, Lenox, MA;

Applicant(s)

ALIGN TECHNOLOGY, INC., San Jose, CA;

Power of Attorney: The patent practitioners associated with Customer Number 107046

Domestic Priority data as claimed by applicant

This application is a CON of 17/553,590 12/16/2021
which is a CON of 16/835,101 03/30/2020 PAT 11213369
which is a CON of 15/476,655 03/31/2017 PAT 10973613
which is a DIV of 13/470,681 05/14/2012 PAT 9655691

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

ClearCorrect Exhibit 1137, Page 84 of 337
ClearCorrect v. Align - IPR2025-00819

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

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

If Required, Foreign Filing License Granted: 07/14/2022
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/858,825**
Projected Publication Date: 10/27/2022
Non-Publication Request: No
Early Publication Request: No
Title

MULTILAYER POLYMER SHEETS

Preliminary Class

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

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

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Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative,

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ClearCorrect v. Align - IPR2025-00819

this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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ClearCorrect v. Align - IPR2025-00819

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 17/858,825

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	700
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800
TOTAL CLAIMS (37 CFR 1.16(i))	30 minus 20 =	* 10			OR	x 100 =	1000
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*				x 480 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	2820

APPLICATION AS AMENDED - PART II

AMENDMENT A

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

AMENDMENT B

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

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

To: patentdocket@wsgr.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 107046

Jul 19, 2022 04:45:57 AM

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Palo Alto, CA 94304
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Application	Document	Mailroom Date	Attorney Docket No.
17858825	APP.FILE.REC	07/19/2022	22773-826.310

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P.O. Box 1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/858,825	07/06/2022	Chunhua LI	22773-826.310	1348

107046 7590 08/05/2022

Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304

EXAMINER
CENTRAL, DOCKET

ART UNIT	PAPER NUMBER
OPAP	

NOTIFICATION DATE	DELIVERY MODE
08/05/2022	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentdocket@wsgr.com

Decision Granting Request for Prioritized Examination (Track I)	**Application No.** 17/858,825	**Applicant(s)** LI et al.	
	Examiner FIKIRTE A GEREMEW	**Art Unit** OMBL	**AIA (FITF) Status** Yes

1. THE REQUEST FILED 06 July 2022 IS **GRANTED** .

The above-identified application has met the requirements for prioritized examination

A. ☑ for an original nonprovisional application (Track I).
B. ☐ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination**. The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:

A. filing a **petition for extension of time** to extend the time period for filing a reply;

B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims** , or a multiple dependent claim;

C. filing a **request for continued examination** ;

D. filing a notice of appeal;

E. filing a request for suspension of action;

F. mailing of a notice of allowance;

G. mailing of a final Office action;

H. completion of examination as defined in 37 CFR 41.102; or

I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to FIKIRTE GEREMEW at (703) 756-1930. In his/her absence, calls may be directed to Petition Help Desk at (571) 272-3282.

/FIKIRTE A GEREMEW/ PROGRAM SUPPORT ASSISTANT, OMBL	

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ClearCorrect v. Align - IPR2025-00819

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Application	Document	Mailroom Date	Attorney Docket No.
17858825	TRACK1.GRANT	08/05/2022	22773-826.310

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PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet | 1 | of | 4

Complete if Known	
Application Number	17/858,825
Filing Date	07-06-2022
First Named Inventor	LI; Chunhua
Art Unit	1787
Examiner Name	CHEN, VIVIAN
Attorney Docket Number	22773-826.310

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		None			

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
	001	CN-108394152-A	08-14-2018	SUZHOU POLLY POLYMER NEW MATERIAL TECH CO LTD.		☒
	002	JP-H0696486-A	04-08-1994	HITACHI LTD.		☒
	003	JP-H07156349-A	06-20-1995	KUREHA CHEMICAL IND CO LTD., et al.		☒
	004	JP-H11279389-A	10-12-1999	GEN ELECTRIC.		☒

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

Substitute for form 1449/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)				Application Number	17/858,825
				Filing Date	07-06-2022
				First Named Inventor	LI; Chunhua
				Art Unit	1787
				Examiner Name	CHEN, VIVIAN
Sheet	2	of	4	Attorney Docket Number	22773-826.310

NON-PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	Include name of the author(in CAPITAL LETTERS),title of the article(when appropriate), title of the item (book,magazine,journal,serial,symposium,catalog,etc.),date,page(s),volume-issue number(s),publisher, city and/or country where published.	T[2]
		None	

Examiner Signature		Date Considered	

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Substitute for form 1449/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)				Application Number	17/858,825
				Filing Date	07-06-2022
				First Named Inventor	LI; Chunhua
				Art Unit	1787
				Examiner Name	CHEN, VIVIAN
Sheet	3	of	4	Attorney Docket Number	22773-826.310

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Garrett T. Potter/	Date (YYYY-MM-DD)	2022-08-23
Name/Print	Garrett T. Potter	Registration Number	76,602

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Bibliographic data

Title:	Three-layer co-extruded composite film specially used for invisible correction and preparation method of composite film
Pub/Pat no:	CN108394152A
Pub/Issue Date:	2018-08-14
Inventor(s):	WANG WENBIN|
Applicant(s):	SUZHOU POLLY POLYMER NEW MATERIAL TECH CO LTD
Classification:	B32B27/08AI; A61L31/06AI; A61L31/12AI; A61L31/14AI; B32B27/36AI; B32B27/40AI
Application number:	CN20171068144 2017-02-07
Priority number:	CN20171068144 2017-02-07;

Abstract of CN108394152A

The invention relates to a three-layer co-extruded composite film specially used for invisible correction and a preparation method of the composite film. The composite film is divided into three layers from material components, wherein a first layer is a surface layer A and is a rigid transparent thermoplastic polyurethane (TPU) layer with a Shore hardness of 60D-90D, a second layer is a middle layer B and is a transparent polycarbonate (PC) layer, and a third layer is an inner layer C and is a flexible transparent thermoplastic polyurethane (TPU) layer with a Shore hardness of 55A-55D; and the total thickness of the three-layer co-extruded composite film is 0.15-2.0 mm, wherein the thickness of the surface layer A is 0.05-0.5 mm, the thickness of the middle layer B is 0.05-1.0 mm, and thethickness of the inner layer C is 0.05-0.5 mm. The method provided by the invention adopts the three-layer co-extrusion technology, and the prepared film specially used for the invisible correction has a high comfort degree, good transparency, high strength and a good correcting effect.

(19)中华人民共和国国家知识产权局

(12)发明专利申请

(10)申请公布号 CN 108394152 A
(43)申请公布日 2018.08.14

(21)申请号 201710068144.4

(22)申请日 2017.02.07

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地址 215200 江苏省苏州市吴江区益堂路188号科晨工业园1栋4层

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代理人 田媛

(51)Int.Cl.
B32B 27/08(2006.01)
B32B 27/40(2006.01)
B32B 27/36(2006.01)
A61L 31/14(2006.01)
A61L 31/12(2006.01)
A61L 31/06(2006.01)

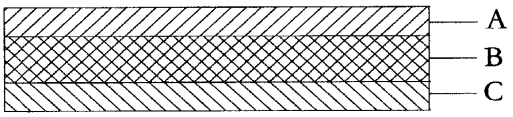
权利要求书1页 说明书6页 附图1页

(54)发明名称

一种隐形矫治专用三层共挤复合膜片及其制备方法

(57)摘要

本发明涉及一种隐形矫治专用三层共挤复合膜片及其制备方法，其从材料组成上看分为三层结构。第一层是表层A，为硬度肖氏硬度60D-90D硬质透明热塑性聚氨酯(TPU)层；第二层是中间层B，为透明聚碳酸酯(PC)层；第三层是内层C，为肖氏硬度55A-55D的软质透明热塑性聚氨酯(TPU)层。所述三层共挤复合膜片的总厚度为0.15-2.0mm，其中表层A厚度为0.05-0.5mm，中间层B厚度为0.05-1.0mm，内层C厚度为0.05-0.5mm。本发明采用三层共挤技术，制得的隐形矫治专用膜片舒适度高，透明性好，强度大，矫治效果好。



CN 108394152 A

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1.一种隐形矫治专用三层共挤复合膜片及其制备方法，其特征在于：从材料组成上看分为三层结构，第一层是表面层，为硬质透明热塑性聚氨酯(TPU)层；第二层是中间层，为透明聚碳酸酯(PC)层；第三层是内层，为软质透明热塑性聚氨酯(TPU)层。

2.根据权利要求1所述隐形矫治专用三层共挤复合膜片及其制备方法，其特征在于：复合膜片总厚度为0.15-2.0mm，其中第一层厚度为0.05-0.5mm，第二层厚度为0.05-1.0mm，第三层厚度为0.05-0.5mm。

3.根据权利要求1所述隐形矫治专用三层共挤复合膜片及其制备方法，其特征在于：表层硬质TPU为肖氏硬度60D-90D透明聚醚型或聚酯型热塑性聚氨酯，其重均分子量为50000-300000，优选为100000-200000。

4.根据权利要求1所述隐形矫治专用三层共挤复合膜片及其制备方法，其特征在于：中间层聚碳酸酯为芳香族聚碳酸酯，其重均分子量为10000-60000，优选为20000-40000。

5.根据权利要求1所述隐形矫治专用三层共挤复合膜片及其制备方法，其特征在于：内层软质TPU为肖氏硬度55A-50D的软质透明聚醚型或聚酯型热塑性聚氨酯，其重均分子量为50000-300000，优选为100000-200000。

6.根据权利要求1所述隐形矫治专用三层共挤复合膜片及其制备方法，其特征在于：它包括以下步骤：

(a)干燥：将软质TPU、PC和硬质TPU分别在90℃～150℃干燥处理2-5h备用；

(b)挤出：将干燥后的软质TPU、PC和硬质TPU分别加入三台双螺杆挤出机在指定温度下挤出。所述的软质TPU双螺杆挤出机的加工温度为180～220℃，主机转速为150～500rpm。所述的PC双螺杆挤出机的加工温度为240～290℃，主机转速为150～500rpm。所述的硬质TPU双螺杆挤出机的加工温度为190～230℃，主机转速为150～500rpm。

(c)压延冷却：将三台挤出机通过三层共挤T型模具共挤出形成三层结构，模具温度为220-270℃，然后通过三辊压延制成片材，三辊的温度为70-160℃。挤出压延的片材经过6个冷却辊进行冷却，冷却辊温度为室温至50℃。

(d)定厚牵引：测量厚度，调节至所需厚度。

(e)裁切收卷：裁去两边多余的宽度，用收卷机进行收卷。

7.根据权利要求6所述隐形矫治专用三层共挤复合膜片及其制备方法，其特征在于：所述双螺杆挤出机的螺杆的长径比优选为32～40。

8.根据权利要求1所述隐形矫治专用三层共挤复合膜片及其制备方法，其特征在于：所述隐形矫治专用三层共挤复合膜片用途为牙齿正畸隐形矫治专用牙套。

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一种隐形矫治专用三层共挤复合膜片及其制备方法

技术领域

[0001] 本发明属于牙齿隐形矫治材料领域，具体涉及一种隐形矫治专用三层共挤复合膜片及其制备方法。

背景技术

[0002] 牙齿矫治是通过正畸或外科手术等方法治疗错颌畸形，错颌畸形是指儿童生长发育过程中，由先天因素或后天因素导致的牙齿、颌骨、颅面的畸形，错颌畸形与龋齿、牙周病一起被列为口腔三大常见病，其患病率高达人口的50％以上。传统正畸是在牙齿上粘结称为“托槽”的小金属片，再将矫正弓丝结扎上去，使牙齿发生移动，从而达到矫治目的。这种钢丝托槽矫治器往往给人留下满嘴“铁齿钢牙”的印象，不仅影响美观，还易出现钢丝刮嘴、牙龈出血等状况，同时食物残渣难于清理，不便口腔卫生维护，还可能导致牙龈发炎、牙齿脱矿变色等问题。口腔正畸隐形矫治技术通过计算机三维重建及辅助软件设计，运用机械设备制得一些列连续的矫治装置，通过连续不断的较小范围和牙周组织移动最后达到矫治目的，这项技术被认为是21世纪正畸临床矫治技术的一次飞跃。与传统的矫治技术相比，隐形矫治技术具有透明美观、佩戴和摘除方便、卫生干净，便于清洁治疗结果可预测、舒适安全等优点。隐形矫治器通常是将透明的高分子膜片加热软化并在一定的机械外力或压力下在所需模具上成型。热压膜片的材料通常采用热塑性高分子材料，制成的矫治器需要符合自身的矫治特点才能保证口腔正畸的应用效果。用于制作无托槽隐形矫治的热压膜材料必须满足以下重要性能：透明性能、力学性能、热性能、耐老化性能和生物相容性。

[0003] 目前隐形矫治专用膜片所用的材料主要有聚对苯二甲酸乙二醇酯-1，4-环己烷二甲醇酯(PETG)、聚碳酸酯(PC)、热塑性聚氨酯(TPU)、聚乙烯-醋酸乙烯酯(EVA)、聚乙烯(PE)、聚丙烯(PP)等，通常用注塑的方法制得。中国专利申请CN200420063272.8采用醋酸纤维软体透明牙齿矫治材料；中国专利申请CN02139224.2采用超高分子量聚乙烯用于制作牙科正畸托槽。然而，这两者存在的问题是制作的高分子材料没有足够的弹性回复力，使得牙齿矫治过程中所产生的应力不够，导致矫治效果不佳。中国专利申请CN201210129701.6建议将PETG与TPU和PC的组合用作牙齿正畸矫治材料。然而，由该材料制成的牙齿正畸矫治材料的吸水率和应力松弛率仍旧需要进一步降低。中国专利CN 105315624A采用PETG、TPU、PC和纳米二氧化硅的共混物通过注塑的方法制得隐形矫正膜片。然而，当TPU用量在20％以下才能保证透明性，由于受制于透明度的要求，TPU用量较少，因而材料的弹性较差。另外注塑工艺要求材料的流动性好，因此共混体系的片材的整体强度偏低，回弹较差，隐形矫治效果差。

[0004] 综上所述，现有技术虽然有隐形矫治膜片的存在，但是这些膜片的透明度差、拉伸强度偏低、韧性及弹性差、撕裂强度低，制成的隐形矫治器治疗效果不够理想。

发明内容

[0005] 本发明目的是为了克服现有的共混改性技术的不足而提供一种隐形矫治专用的

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高强度、高弹性、高透明度的三层共挤复合膜片，该膜片是通过三层共挤技术加工而成，膜片具有透明度高、生物安全性好、强度大、弹性好和韧性佳。

[0006] 为达到上述目的，本发明采用的技术方案是：一种隐形矫治专用三层共挤复合膜片，其从材料组成上看分为三层结构。第一层是表层A，为肖氏硬度60D-90D硬质透明热塑性聚氨酯(TPU)层；第二层是中间层B，为透明聚碳酸酯(PC)层；第三层是内层C，为肖氏硬度55A-50D的软质透明热塑性聚氨酯(TPU)层。所述三层共挤复合膜片的总厚度为0.15-2.0mm，其中第一层厚度为0.05-0.5mm，第二层厚度为0.05-1.0mm，第三层厚度为0.05-0.5mm。

[0007] 优选的，所述表层硬质TPU可以是肖氏硬度60D-90D的聚醚型或聚酯型TPU。对于TPU，它既可以通过本领域中的已知方法制备，也可以市购获得，例如德国科思创(拜耳)公司的TeXin-RXT65D、DP3660DU、460、365、372、DP9665DU、DP9873D、DP3970D；德国巴斯夫(BASF)公司的Elastollan S375D、S364DH-7N、S160D、5778、58091、58144、ALR E65D-V、ALR E68D-V；美国路博润公司的Lubrizol**Estane®**2103-75DS、2103-65D、5778-78D、58091-70D、58144-65D、**Isoplast®**2530、2510、2540；烟台万华公司的WHT-1264、WHT-1172、WHT-1180、WHT-1185、WHT-1190等。本发明中所用的热塑性聚氨酯卫生等级优选均为医疗级或食品级。有利的是，用于本发明的热塑性聚氨酯弹性体的重均分子量为50000-300000，优选为100000-200000。

[0008] 优选的，所述中间层PC可以是脂肪族、芳香族、脂肪族-芳香族聚碳酸酯，优选芳香族聚碳酸酯。聚碳酸酯可由溶液光气法、界面缩聚光气法和非光气酯交换法等方法制得。在本发明中，优选聚碳酸酯为双(4-羟基苯基)C2-C5直链或支链烷基聚碳酸酯，例如2,2-双(4-羟基苯基)丙烷聚碳酸酯、1,1-双(4-羟基苯基)乙烷聚碳酸酯和2,4-双(4-羟基苯基)-2-甲基丁烷聚碳酸酯。对于聚碳酸酯，它既可以通过本领域中的已知方法制备，也可以市购获得，例如德国科思创(拜耳)公司的Makrolon3108、Makrolon3103、Makrolon2858，Makrolon2658，Makrolon2458，Makrolon3258、Makrolon3208、Makrolon3158、Makrolon2808、Makrolon2608、Makrolon2805、Makrolon2558、Makrolon2408、Makrolon2405；美国陶氏的201-8、201-10、201-15、201-22；日本三菱的E2001R、S2001R、S3001R；韩国LG公司的Lupoy 1301-7、Lupoy 1201-8、Lupoy 1200-10、Lupoy 1300-10、Lupoy 1201-22；沙特基础工业公司(SABIC) 公司的Lexan 104R、Lexan 101R、Lexan 144R、Lexan 121R、Lexan 124R；韩国三养的Trilex3027FD、3025FD、3022FD、3020FD；日本出光的TaflonIR2500、IR2200、IR1900；日本尤尼吉卡公司的P5001等。本发明中所用的聚碳酸酯卫生等级优选为医疗级或食品级。有利的是，用于本发明的聚碳酸酯的重均分子量为10000-60000，优选为20000-40000。

[0009] 优选的，所述内层软质TPU可以是肖氏硬度55A-50D的聚醚型或聚酯型TPU。对于TPU，它既可以通过本领域中的已知方法制备，也可以市购获得，例如德国科思创(拜耳)公司的TeXin-RXT50D、TeXin-RXT85A、TeXin-RXT90、DP1060A、DP1485A、DP2586A、DP3070A、DP3080A、5377A、DP5080A、DP6386A、DP6045D、DP1350D、DP9370A、DP9380A、DP9585A、DP9392A、WDP89043D；德国巴斯夫(BASF)公司的Elastollan 1195A、1185A、1180A、1190A、1198A；美国路博润公司的Lubrizol 54640、Lubrizol 355、**Estane®**2102、2103、5712、5719、台湾日胜公司的BTP-85A；烟台万华公司的WHT-8170、WHT-8180、WHT-8185、WHT-8190、WHT-

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8195、WHT-8264、WHT-8280、WHT-8285、WHT-8290、WHT-1164、WHT-1290、WHT-1295、WHT-1298等。本发明中所用的热塑性聚氨酯卫生等级优选均为医疗级或食品级。有利的是，用于本发明的热塑性聚氨酯弹性体的重均分子量为50000-300000，优选为100000-200000。

[0010] 本发明的又一目的在于提供一种上述隐形矫治专用三层共挤复合膜片的制备方法，它包括以下步骤：(a)干燥：将软质TPU、PC和硬质TPU分别在90℃～150℃干燥处理2-5h备用；(b)挤出：将干燥后的软质TPU、PC和硬质TPU分别加入三台双螺杆挤出机在指定温度下挤出。所述的软质TPU双螺杆挤出机的加工温度为180～220℃，主机转速为150～500rpm。所述的PC双螺杆挤出机的加工温度为240～290℃，主机转速为150～500rpm。所述的硬质TPU双螺杆挤出机的加工温度为190～230℃，主机转速为150～500rpm。所述双螺杆挤出机的螺杆的长径比优选为32～40。(c)压延冷却：将三台挤出机通过三层共挤T型模具共挤出形成三层结构，模具温度为220-270℃，然后通过三辊压延制成片材，三辊的温度为70-160℃。挤出压延的片材经过6个冷却辊进行冷却，冷却辊温度为室温至50℃。(d)定厚牵引：测量厚度，调节至所需厚度。(e)裁切收卷：裁去两边多余的宽度，用收卷机进行收卷。

[0011] 由于上述技术方案运用，本发明与现有技术相比具有下列优点：本发明隐形矫治专用三层共挤复合膜片采用三层共挤技术制得的膜片具有三层结构，中间层材料为聚碳酸酯，聚碳酸酯透明度高、强度大，但是弹性和耐撕裂性能差。本发明内层材料采用软质TPU，一方面改善了PC的弹性和耐撕裂性能，另一方面改善患者的体验，软质的TPU层大幅度提高了患者佩戴的舒适度。本发明的表层采用硬质的TPU材料主要目的是改善PVC的弹 性和撕裂性能。总结而言，本发明采用三层共挤工艺技术，制得的隐形矫治专用膜片舒适度高，透明性好，强度大，矫治效果好，生物安全性高。

附图说明

[0012] 图1为本发明的一种隐形矫治专用三层共挤复合膜片的结构示意图，A层为0.05-0.5mm硬质透明热塑性聚氨酯(TPU)表层，B层为0.05-1.0mm硬质透明聚碳酸酯(PC)中间层，C层为0.05-0.5mm的软质透明热塑性聚氨酯(TPU)内层。

[0013] 图2为本发明的一种隐形矫治专用三层共挤复合膜片的制备工艺流程图。

具体实施方式

[0014] 下面将结合实施例对本发明进行进一步说明。

[0015] 实施例1

[0016] 本实施例提供一种隐形矫治专用三层共挤复合膜片，具有三层结构，表层A为厚度0.25mm硬度73D的德国科思创(拜耳)公司的DP9873D TPU，中间层为0.3mm厚度的德国科思创(拜耳)公司Makrolon 3108PC，内层C为厚度0.2mm硬度95A的德国巴斯夫(BASF)公司的Elastollan 1195A TPU。

[0017] 隐形矫治专用三层共挤复合膜片的制备工艺方法如图2所示，具体如下：

[0018] (a)干燥：将Elastollan 1195A TPU在110℃干燥处理3h备用，将Makrolon 3108PC在130℃干燥处理4h备用，将DP9873D TPU在120℃干燥处理3h备用；

[0019] (b)挤出：将干燥后的Elastollan 1195A TPU、Makrolon 3108PC、DP9873D TPU分别加入三台双螺杆挤出机在指定温度下挤出。所述的Elastollan1195A TPU双螺杆挤出机

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的加工温度为180℃、190℃、200℃、200℃、210℃、210℃、200℃、200℃，主机转速为170rpm。所述的Makrolon3108PC双螺杆挤出机的加工温度为240℃、240℃、250℃、260℃、270℃、270℃、260℃、260℃，主机转速为250rpm。所述的DP9873D TPU双螺杆挤出机的加工温度为190℃、200℃、210℃、210℃、220℃、220℃、210℃、210℃，主机转速为200rpm。所述双螺杆挤出机的螺杆的长径比为32。

[0020] (c)压延冷却：将三台挤出机通过三层共挤T型模具共挤出形成三层结构，模具温度为240℃，然后通过三辊压延制成片材，三辊的温度分别为：150℃、120℃、90℃。挤出的片材经过6个冷却辊进行冷却。

[0021] (d)定厚牵引：测量厚度，调节至所需厚度。

[0022] (e)裁切收卷：裁去两边多余的宽度，用收卷机进行收卷打包。

[0023] 本例的膜片经检测，透光率为91.2％，拉伸强度为62.5MPa、断裂伸长率为210％，撕裂强度为145N/mm。

[0024] 实施例2

[0025] 本实施例提供一种隐形矫治专用三层共挤复合膜片，具有三层结构，表层A为厚度0.15mm硬度73D的德国科思创(拜耳)公司的DP9873D TPU，中间层B为0.5mm厚度的德国科思创(拜耳)公司Makrolon 3108PC，内层C为厚度0.1mm硬度95A的德国巴斯夫(BASF)公司的Elastollan 1195A TPU，

[0026] 隐形矫治专用三层共挤复合膜片的制备工艺方法如图2所示，具体如下：

[0027] (a)将Elastollan 1195A TPU在110℃干燥处理3h备用，将Makrolon3108PC在130℃干燥处理4h备用，将DP9873D TPU在120℃干燥处理3h备用；

[0028] (b)挤出：将干燥后的Elastollan 1195A TPU、Makrolon 3108PC、DP9873D TPU分别加入三台双螺杆挤出机在指定温度下挤出。所述的Elastollan 1195A TPU双螺杆挤出机的加工温度为180℃、190℃、200℃、200℃、210℃、210℃、200℃、200℃，主机转速为180rpm。所述的Makrolon3108PC双螺杆挤出机的加工温度为240℃、240℃、250℃、260℃、270℃、270℃、260℃、260℃，主机转速为300rpm。所述的DP9873D TPU双螺杆挤出机的加工温度为190℃、200℃、210℃、210℃、220℃、220℃、210℃、210℃，主机转速为200rpm。所述双螺杆挤出机的螺杆的长径比为32。

[0029] (c)压延冷却：将三台挤出机通过三层共挤T型模具共挤出形成三层结构，模具温度为240℃，然后通过三辊压延制成片材，三辊的温度分别为：150℃、120℃、90℃。挤出的片材经过6个冷却辊进行冷却。

[0030] (d)：定厚牵引：测量厚度，调节至所需厚度。

[0031] (e)裁切收卷：裁去两边多余的宽度，用收卷机进行收卷打包。

[0032] 本例的膜片经检测，透光率为92.4％，拉伸强度(250mm/min)为66.4MPa、断裂伸长率为150％，撕裂强度为152N/mm。

[0033] 实施例3

[0034] 本实施例提供一种隐形矫治专用三层共挤复合膜片，具有三层结构，表层A厚度为0.15mm硬度73D的德国科思创(拜耳)公司的DP9873D TPU，中间层B为0.3mm厚度德国科思创(拜耳)公司的Makrolon 3108PC，内层C为厚度0.3mm硬度95A的德国巴斯夫(BASF)公司的Elastollan 1195A TPU。

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[0035] 隐形矫治专用三层共挤复合膜片的制备工艺方法如图2所示，具体如下：

[0036] (a)将Elastollan 1195A TPU在110℃干燥处理3h备用，将Makrolon 3108PC在130℃干燥处理4h备用，将DP9873D TPU在120℃干燥处理3h备用；

[0037] (b)挤出：将干燥后的Elastollan 1195A TPU、Makrolon 3108PC、DP9873D TPU分别加入三台双螺杆挤出机在指定温度下挤出。所述的Elastollan 1195A TPU双螺杆挤出机的加工温度为180℃、190℃、200℃、200℃、210℃、210℃、200℃、200℃，主机转速为250rpm。所述的Makrolon 3108PC双螺杆挤出机的加工温度为240℃、240℃、250℃、260℃、270℃、270℃、260℃、260℃，主机转速为250rpm。所述的DP9873D TPU双螺杆挤出机的加工温度为190℃、200℃、210℃、210℃、220℃、220℃、210℃、210℃，主机转速为200rpm。所述双螺杆挤出机的螺杆的长径比为32。

[0038] 本例的膜片经检测，透光率为91.3％，拉伸强度(250mm/min)为60.5MPa、断裂伸长率(250mm/min)为230％，撕裂强度为120N/mm。

[0039] 实施例4

[0040] 本实施例提供一种隐形矫治专用三层共挤复合膜片，具有三层结构，表层A为厚度0.25mm美国路博润公司的**Isoplast®**2530TPU，中间层B为0.3mm厚度德国科思创(拜耳)公司的Makrolon2858PC，内层为厚度0.2mm硬度为95A的德国科思创(拜耳)公司的TeXin-RXT50D TPU。

[0041] 隐形矫治专用三层共挤复合膜片的制备工艺方法如图2所示，具体如下：

[0042] (a)将TeXin-RXT50D在110℃干燥处理3h备用，将Makrolon2858在130℃干燥处理4h备用，将**Isoplast®**2530在120℃干燥处理3h备用；

[0043] (b)挤出：将干燥后的软质TPU、PC和硬质TPU分别加入三台双螺杆挤出机在指定温度下挤出。所述的TeXin-RXT50D双螺杆挤出机的加工温度为180℃、190℃、200℃、200℃、210℃、210℃、200℃、200℃，主机转速为300rpm。所述的Makrolon 2858双螺杆挤出机的加工温度为240℃、240℃、250℃、260℃、270℃、270℃、260℃、260℃，主机转速为300rpm。所述的**Isoplast®**2530双螺杆挤出机的加工温度为190℃、200℃、210℃、210℃、220℃、220℃、210℃、210℃，主机转速为250rpm。所述双螺杆挤出机的螺杆的长径比为32。

[0044] (c)压延冷却：将三台挤出机通过三层共挤T型模具共挤出形成三层结构，模具温度为240℃，然后通过三辊压延制成片材，三辊的温度分别为：150℃、120℃、90℃。挤出的片材经过6个冷却辊进行冷却。

[0045] (d)：定厚牵引：测量厚度，调节至所需厚度。

[0046] (e)裁切收卷：裁去两边多余的宽度，用收卷机进行收卷打包。

[0047] 本例的膜片经检测，透光率为89.2％，拉伸强度为65.5MPa、断裂伸长率为230％，撕裂强度为131N/mm。

[0048] 对比例1

[0049] 本例提供TPU/PC复合膜片，按重量份数计，所述膜片原料配方如下：Elastollan 1195A TPU 26份；Makrolon 3108PC 40份，DP9873D TPU 34份。

[0050] TPU/PC复合膜片的制备方法如下：

[0051] (a)将Elastollan 1195A TPU在110℃干燥处理3h备用，将Makrolon3108PC在130

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℃干燥处理4h备用，将DP9873D TPU在120℃干燥处理3h备用；；

[0052] (b)将26份的Elastollan 1195A TPU；40份的Makrolon 3108PC，34份的DP9873D TPU按比例混合均匀，然后将混合后的粒料供入注塑机中，以注塑得到直径为130mm、厚为0.75的膜片，其中注塑温度沿料筒轴向依次为180℃、205℃、215℃和240℃，注射时间为8s，注塑机的模具温度为70℃。

[0053] 本例的膜片经检测，透光率为62.5％，拉伸强度为54.5MPa、断裂伸长率为150％，撕裂强度为115N/mm。

[0054] 对比例2

[0055] 本例提供TPU/PC复合膜片，按重量份数计，所述膜片原料配方如下：Elastollan 1195A TPU 26份；Makrolon 3108PC 40份，DP9873D TPU 34份。

[0056] TPU/PC复合膜片的制备方法如下：

[0057] (a)将Elastollan 1195A TPU在110℃干燥处理3h备用，将Makrolon3108PC在130℃干燥处理4h备用，将DP9873D TPU在120℃干燥处理3h备用；；

[0058] (b)将26份的Elastollan 1195A TPU；40份的Makrolon 3108PC，34份的DP9873D TPU按比例混合均匀，然后将混合后的粒料供入双螺杆挤出机中，所述的双螺杆挤出机的加工温度为190℃、210℃、230℃、230℃、240℃、240℃、220℃、220℃，主机转速为250rpm。所述双螺杆挤出机的螺杆的长径比为32。

[0059] (c)压延冷却：将挤出机通过T型模具挤出，模具温度为240℃，然后通过三辊压延制成片材，三辊的温度分别为：150℃、120℃、90℃。挤出的片材经过6个冷却辊进行冷却。

[0060] (d)：定厚牵引：测量厚度，调节至所需厚度。

[0061] (e)裁切收卷：裁去两边多余的宽度，用收卷机进行收卷打包。

[0062] 本例的膜片经检测，透光率为65.2％，拉伸强度为58.5MPa、断裂伸长率为152％，撕裂强度为125N/mm。

[0063] 上述实施例只为说明本发明的技术构思及特点，其目的在于让熟悉此项技术的人士能够了解本发明的内容并据以实施，并不能以此限制本发明的保护范围，凡根据本发明精神实质所作的等效变化或修饰，都应涵盖在本发明的保护范围之内。

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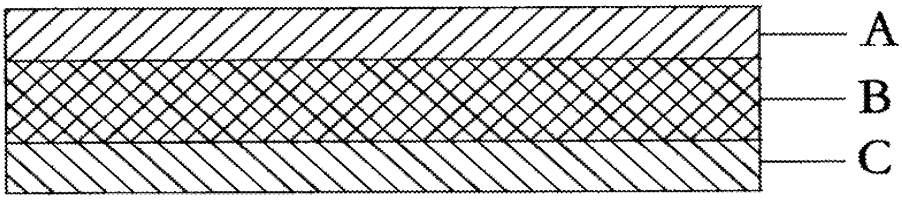


图1

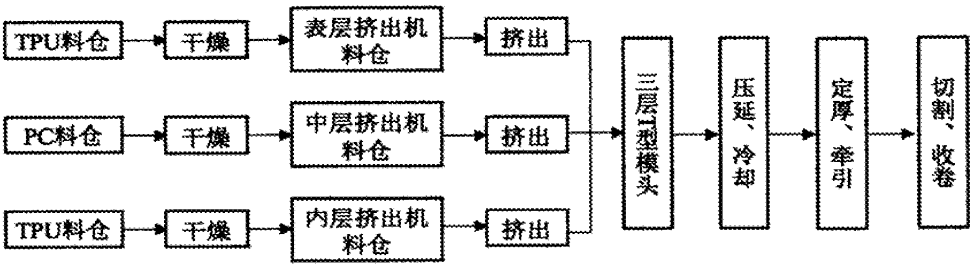


图2

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Bibliographic data

Title:	DEVICE FOR RECORDING AND REPRODUCING MAGNETO-OPTICAL DISK
Pub/Pat no:	JPH0696486A
Pub/Issue Date:	1994-04-08
Inventor(s):	NAKAJIMA JUNJI| SUZUKI YOSHIO| TANAKA HISAMITSU|NAKAJIMA JUNJI |SUZUKI YOSHIO |TANAKA HISAMITSU
Applicant(s):	HITACHI LTD
Classification:	G11B11/10AI; G11B11/105AI; G11B19/00AI; G11B19/04AI
Application number:	JP19920244489 1992-09-14
Priority number:	JP19920244489 1992-09-14;

Abstract of JPH0696486A

PURPOSE:To enable limiting the wear in a magnetic head and a disk and power consumption increase in a spindle motor due to contact between the magnetic head and the disk only to a data recording period. CONSTITUTION:An arm is lowered according to start recording by an arm vertical movement means 23 moving vertically the arm setting the magnetic head 5, and it is detected that the disk and the magnetic head are in contact with each other by the output of a spindle current detection 21 detecting the drive current of the spindle motor and the arm is stopped. Thereafter, when a required recording start position on the disk is detected by the output of a disk address comparison 19, data stored in a data storage part 3 is recorded. Thus, even for erroneous insertion of a disk cartridge, the damage of the magnetic head and the arm are prevented as well.

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特開平6－96486

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Ｇ１１Ｂ　11/10		Ｚ　9075－5D		
19/04		Ａ　7525－5D		

審査請求　未請求　請求項の数６(全 16 頁)

(21)出願番号　特願平4－244489

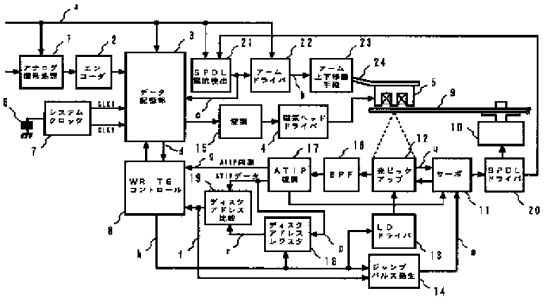
(22)出願日　平成４年(1992)９月14日

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(54)【発明の名称】　光磁気ディスク記録再生装置

(57)【要約】
【構成】磁気ヘッド（５）が設置されたアームを上下させるアーム上下移動手段（２３）は記録開始と同時にアームを降下し、スピンドルモータの駆動電流を検出するスピンドル電流検出（２１）出力によりディスクと磁気ヘッドが接触したことを検出してアームを停止させる。これ以降、ディスクアドレス比較（１９）出力によりディスク上の所望の記録開始位置を検出した時に、データ記憶部（３）に蓄積されたデータの記録を行なう。
【効果】磁気ヘッドとディスクの接触による磁気ヘッドおよびディスクの摩耗と、スピンドルモータの消費電力増を、データ記録期間のみに限定することができる。また、ディスクカートリッジの誤挿入に対しても、磁気ヘッドおよびアームの破損を防止できるという効果もある。

図１



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【特許請求の範囲】
【請求項１】レーザ光によってディスク上の記録材料の温度を上昇させながら、磁気ヘッドから発生する磁界でデータを記録する光磁気ディスク記録再生装置において、磁気ヘッドを設置したアームと、該アームをディスク面と略垂直方向に移動させるアーム上下移動手段と、該アーム上下移動手段を駆動するアームドライバとを備えたことを特徴とする光磁気ディスク記録再生装置。
【請求項２】請求項１記載の光磁気ディスク記録再生装置において、再生専用ディスクあるいは記録禁止を指示されたディスクが装着された場合には、アームおよび磁気ヘッドをディスクに近づける方向に移動させないことを特徴とする光磁気ディスク記録再生装置。
【請求項３】請求項１記載の光磁気ディスク記録再生装置において、記録が許可されたディスクが装着され、かつデータ記録時に限りアームおよび磁気ヘッドをディスク面近傍に移動させることを特徴とする光磁気ディスク記録再生装置。
【請求項４】請求項１記載の光磁気ディスク記録再生装置において、磁気ヘッドがディスク面に対する略垂直方向の位置関係で、所定の位置に到達したことを検出する検出手段を備えたことを特徴とする光磁気ディスク記録再生装置。
【請求項５】請求項１記載のアームドライバは、記録開始時にアームをディスクに近づける方向に移動させるための第１の極性の駆動電流を出力し、前記検出手段の検出出力により駆動電流を停止することを特徴とする光磁気ディスク記録再生装置。
【請求項６】請求項１記載のアームドライバは、記録終了時にアームをディスクから遠ざける方向に移動させるための第１の極性とは逆の第２の極性の駆動電流を出力することを特徴とする光磁気ディスク記録再生装置。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明は、光磁気ディスク記録再生装置に係り、特にディスク着脱時あるいは記録／再生に伴う、磁気ヘッド位置のアップ／ダウン制御に関するものである。
【０００２】
【従来の技術】近年、光ディスクはＣＤ、ＣＤ－ＲＯＭ等に代表される再生専用のみならず、相変化、穴あけ方式によるライトワンス型のディスクや、光磁気方式等のイレーザブル型ディスクが各社より発表されている。このような記録可能な光ディスクは、今後、個人ベースのオーディオ用の記録媒体として応用されることが期待されている。
【０００３】このうち、光磁気ディスクを用いて磁界変調方式で信号の記録再生を行う装置では、光磁気ディスク（以降、単にディスクと略す）を挟んで光ヘッドと磁気ヘッドを配置し、かつディスク上の光スポットの真上に磁気ヘッドの中心を位置させる必要がある。また、ディスク上に十分な磁界を印加するために、磁気ヘッドは出来るだけディスクに接近させるのが望ましい。しかし一方では、ディスクがターンテーブル上に装着されるまでは、ディスクと磁気ヘッドの衝突を避けるため、ディスクから出来るだけ遠い位置に磁気ヘッドを退避させておくことも必要となる。また同様に、ディスクをターンテーブル上から排出する際にも、ディスクから出来るだけ遠い位置に磁気ヘッドを退避させておく必要がある。
【０００４】以上の点を満たすべく、従来の光磁気ディスク記録再生装置では、例えばディスクが収納されたカートリッジに対して、光磁気記録再生装置へのディスクの装着、排出を行なうような場合、光ヘッドの移動方向と略垂直方向に移動可能に設けられたカートリッジを保持するカートリッジホルダを備え、カートリッジを挿入位置と装着位置との間で移送するようにしている。また、光ヘッドと一体に設けられた回転軸と、この回転軸に一端が回転可能に支持されたアームと、このアームの他端の光ヘッドと対向する位置に保持された磁気ヘッドを備えた構成をとっている。ここで、ディスクがターンテーブル上に装着されていない場合、カートリッジホルダは光ヘッドから遠退いた位置にあって、カートリッジホルダの一部がアームの一部と当接して、磁気ヘッドをカートリッジホルダから離間させる方向にアームが回動される。また、ディスクがターンテーブル上に装着されている状態では、カートリッジホルダは光ヘッドに近づく位置に移動し、カートリッジホルダの一部に当接してしていたアームも同様に移動し、磁気ヘッドを光ヘッドに接近させる方向にアームが回動される。
【０００５】このような機構系により、ディスクがターンテーブル上に装着されるまでは、磁気ヘッドは光ヘッドから遠い位置にはね上げられ、ディスクがターンテーブル上に装着されると、磁気ヘッドはディスクに接近した（あるいは接触した）所定の位置に降ろされる。また、ディスクをターンテーブル上から排出する際にも、磁気ヘッドは光ヘッドから遠い位置にはね上げられる。この結果、カートリッジを挿入、排出する際に、磁気ヘッドとディスクおよびカートリッジとの衝突を防ぎ、ディスク装着時には、磁気ヘッドをディスクに接近した（あるいは接触した）所定の位置に設置できる。
【０００６】なお、このような構成の装置は、例えば実開平２－１３５９３１号公報に詳しく記載されている。
【０００７】
【発明が解決しようとする課題】しかし、上記の構成により磁気ヘッド位置のアップ／ダウンを行わせると、ディスクの装着時および排出時には、磁気ヘッドはディスクから遠ざかった位置に退避させることができるが、ディスクが装着された状態では、常に磁気ヘッドをディスクに接近した（あるいは接触した）所定の位置に設置することになる。ここで磁気ヘッドの駆動電流をなるべく

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少なくするためには、あるいは機構系の精度とディスクの面振れ等を考慮すると、実際には、磁気ヘッドとディスクを接触させるのが良い。ところが、磁気ヘッドをディスクに接近させる必要があるのは、ディスクに記録を行うときだけで、それ以外のとき、すなわちディスク再生時には、磁気ヘッドそのものが不要であり、このようにディスク装着時に常時磁気ヘッドとディスクを接触させると、

（１）再生時に、摩擦によりディスクおよび磁気ヘッドが摩耗する。

【０００８】（２）ディスクに負荷がかかるため、ディスク回転数を保持するためにスピンドルモータの駆動電流を増加させなくてはならず、結果的に消費電力の増加につながる。

【０００９】（３）カートリッジホルダの片面のみに開閉シャッタがある例えば再生専用ディスク装着時に、ホルダが光ヘッド側に下がると、これに連動して磁気ヘッドも降りてくるので、磁気ヘッドはカートリッジに衝突することになる。この結果、磁気ヘッドおよび磁気ヘッドが取り付けられたアームに過大な力が加わり、最悪の場合には破損する。

【００１０】という問題がある。

【００１１】本発明の目的は、ディスク再生時において、磁気ヘッドおよびディスクの摩耗と、スピンドルモータの負荷増とこれに伴う消費電力増を生じさせず、さらに例えば、上部に開閉シャッタのない再生専用ディスクカートリッジの挿入に対して、磁気ヘッドおよびアームとディスクカートリッジとの衝突を防止する光磁気ディスク記録再生装置を提供することにある。

【００１２】

【課題を解決するための手段】上記目的を達成するために、本発明の光磁気ディスク記録再生装置は、磁気ヘッドが支持されたアームをディスク略面垂直方向に移動させるアーム上下移動手段と、アーム上下移動手段を駆動するアームドライバと、ディスクと磁気ヘッドが接触したことを検出する磁気ヘッド接触検出手段と、記録データを一時的に記憶する半導体メモリと、半導体メモリの書き込みアドレスと読み出しアドレスの値を比較し、半導体メモリ内のデータ量を検出するＲＡＭアドレス比較手段と、光ディスク上に形成された溝のうねり成分（ウォブル成分）からディスクのアドレスを復調するＡＴＩＰ復調手段と、復調されたアドレスあるいはシステムコントロールからの設定アドレスを記憶するディスクアドレスレジスタと、ＡＴＩＰ復調手段からのアドレスとディスクアドレスレジスタに記憶されたアドレスを比較するディスクアドレス比較手段とを備える。

【００１３】

【作用】アームドライバは、システムコントロールからの記録命令オンを入力すると、アーム上下移動手段に対してアームを降下させる方向の駆動電流を発生し、アームに支持された磁気ヘッドはディスクに接近する方向に移動を開始する。このとき、磁気ヘッド接触検出手段は、例えばスピンドル駆動電流の変化率等から磁気ヘッドとディスクの接触を検出し、この検出信号により、アームドライバはアーム上下移動手段への駆動電流をゼロとしする。これにより、磁気ヘッドはディスクに接触した状態で上下方向の移動を停止し、磁気ヘッドにおける記録準備が終了し、待機状態となる。一方、記録命令ＯＮ以降、ディスクに記録が開始されるまでの間、記録データは半導体メモリに記憶され続けており、その後、ディスクアドレスレジスタとＡＴＩＰ復調手段出力のアドレスとが一致したときに、ディスクアドレス比較がこれを検出し、同時にディスクへのデータ記録を開始する。

【００１４】次に、システムコントロールからの記録命令がオフされると、ＲＡＭアドレス比較手段は、半導体メモリ内に残ったデータを全て読み出したときにこれを検出し、同時にディスクへのデータ記録を停止する。一方これと同時に、アームドライバはアーム上下移動手段に対してアームを上昇させる方向の駆動電流を発生し、アームに支持された磁気ヘッドはディスクから遠ざかる方向に移動を開始する。

【００１５】以上の動作により、ディスク再生時には磁気ヘッドをディスクから遠ざかった位置に退避させておき、ディスクへのデータ記録時のみ磁気ヘッドとディスクを接触させることが可能となる。また、このことから再生専用ディスクあるいは記録禁止を指示されたディスクが装着された場合には、磁気ヘッドはディスクに接近せず、ディスクから離れた位置に退避させておくことができる。

【００１６】

【実施例】以下に、本発明による光磁気ディスク記録再生装置について説明する。

【００１７】図１および図２は本発明の第１の実施例を示す回路ブロック図で、例えばオーディオ情報をデータ圧縮した後、一旦半導体メモリに記憶させ、メモリから読み出したデータをディスクに記録させる光磁気ディスク記録再生装置に適用した例である。両図において、１はアナログ信号処理回路、２はエンコーダで例えば圧縮処理を行うための高能率符号化回路である。３はデータ記憶部で、その内部は図２に示すようにランダムアクセスメモリ（ＲＡＭ）１０２、データ入出力バッファ１０１、１０３、書き込みアドレス生成１０４、読み出しアドレス生成１０６、アドレスセレクタ１０５、ＲＡＭアドレス比較１０７により構成される。７はデータ記憶部３に２つの異なる周波数の動作クロックを供給するシステムクロック、８はデータ記憶部３のデータのリード／ライトを制御するＷＲＩＴＥコントロール、９はディスク、１０はディスクを回転させるためのスピンドルモータ、２０はスピンドルモータを駆動するスピンドルドライバ、１１はスピンドルモータおよびフォーカス、トラ

ッキングアクチュエータのサーボ、１２はレーザダイオード、対物レンズ、光検出器等で構成される光ピックアップ、１７はディスク上に成型されたウォブル信号を復調するＡＴＩＰ復調、１８はＡＴＩＰ復調出力を記憶するディスクアドレスレジスタ、１９はアドレスの比較を行うディスクアドレス比較、２１はスピンドル駆動電流の増加率あるいは振幅等を検出するスピンドル電流検出、５はディスク上に記録磁界を印加するための磁気ヘッド、２４は磁気ヘッドを支持するアーム、２３はアームをディスク面に対して略垂直方向に移動させるアーム上下移動手段、２２はアーム上下移動手段を駆動するアームドライバである。

【００１８】なお、ディスク９は、例えば絶対アドレス情報に対応させて周波数変調したウォブル信号として、ディスク上のトラックのトラック中心を変位させたトラックパターンをもつＡＴＩＰ（Absolute Time In Pregroove）フォーマットのディスクである。このＡＴＩＰフォーマットでは、コンパクトディスクと同様に７５Ｈｚのフレームに区切られ、各フレームにはディスク最内周からの絶対時間が４２ビットの絶対アドレスデータとして表されている。絶対アドレスデータは、４ビットの同期コード、それぞれ８ビットのＢＣＤ（binary code decimal）でなる分データ、秒データ、フレームデータおよび所定のＣＲＣ（cyclic redundancycheck）生成多項式で算出される１４ビットのＣＲＣデータで構成されており、３．１５ｋbpsのビットレートを有するＮＲＺ（non return to zero）符号にコーディングされている。この絶対アドレスデータを６．３ｋＨｚのビットクロックでバイフェーズマーク変調するとともに、この変調されたバイフェーズマーク信号をさらに周波数変調することにより、サブキャリア周波数２２．０５ｋＨｚのＦＭ信号でなるウォブル信号として与えられる。

【００１９】以下、両図を用いて本実施例の光磁気ディスク記録再生装置の動作を、ディスクへのデータ記録時およびその前後の動作に分けて説明する。

【００２０】まず、システムコントロール（図示せず）から、例えばデータの記録期間中だけＨｉｇｈレベルとなるような記録命令信号が、アナログ信号処理１、スピンドル電流検出２１およびアームドライバ２２に入力される。アームドライバ２２は、記録命令信号がＨｉｇｈレベルとなると、第１の方向の駆動電流をアーム上下移動手段２３に出力する。アーム上下移動手段２３はこの駆動電流により、アーム２４をディスク９に近づける方向に移動させる。したがって、アーム２４に支持された磁気ヘッド５は、ディスク９に接近する方向に移動を開始する。また、スピンドル電流検出２１は、記録命令信号がＬｏｗレベルのときには非動作状態で、記録命令信号がＨｉｇｈレベルとなると検出動作を開始する。

【００２１】一方、アームの移動動作と並行して、次の動作が行われる。アナログ信号処理１では、記録開始命令を受け、入力オーディオソースに対し、例えば１６ビットＰＣＭ信号に変換処理を開始する。ＰＣＭ信号はエンコーダ２に入力され、圧縮処理された後、同期情報等を付加されたデータビット列となる。これらの変換処理に関しては周知の技術であるので、ここでは説明を省略する。エンコーダ２の出力はデータ記憶部３に入力され、ここでデータを一時的に記憶する。またシステムクロック７は、水晶発振子６の原発振であるマスタクロックを分周して、第１の繰返し周波数ｆ１のＣＬＫ１と、第２の繰返し周波数ｆ２のＣＬＫ２をデータ記憶部３に入力する。なお、ｆ１＜ｆ２とする。

【００２２】ところで、光ピックアップ１２はディスク９からの反射光を検出し、トラックパターンに応じた前記ウォブル信号は、サブキャリア周波数２２．０５ｋＨｚを中心周波数とするバンドパスフィルタ１６を介してＡＴＩＰ復調１７に入力される。ＡＴＩＰ復調１７は、ウォブル信号よりＡＴＩＰのビットクロックを抜き出し、サーボ１１に出力する。サーボ１１は、例えばこのビットクロックと６．３ｋＨｚの基準クロック（図示せず）との位相比較を行い、位相誤差信号をスピンドルドライバ２０に出力し、スピンドルモータ１０を駆動する。スピンドルドライバ２０の駆動電流はＩ－Ｖ変換され、スピンドル電流検出２１に入力される。スピンドル電流検出２１は、例えば入力信号の増加率、振幅あるいは絶対値を、所定の値と比較し、所定値以上となったことをトリガとして、以後Ｈｉｇｈレベルとなるような検出信号を出力する。なお、記録命令信号がＬｏｗレベルとなると同時に検出信号はＬｏｗレベルに戻ることとする。このスピンドル電流検出の意図は、記録命令信号の立ち上がり以降、降下し続けていた磁気ヘッド５が、ディスク９に接触したか否かを検出するためである。すなわち、磁気ヘッド５がディスク９に接触するとスピンドルモータ１０の負荷が増加し、回転数を保持するために駆動電流を増加させる方向にスピンドル系のサーボが働くため、この駆動電流の増加、あるいは乱れを検出すれば、接触が検出できる。なお、前記したようにスピンドル電流検出２１は、システムコントロールからの記録命令信号を入力し、これがＨｉｇｈレベルの期間だけ動作を行わせ、Ｌｏｗレベルの期間は動作をイネーブル状態にさせるので、ディスク回転起動時の不安定なスピンドルモータ駆動電流を、磁気ヘッドとディスクの接触と誤検出することを防げる。スピンドル電流検出２１の出力は、アームドライバ２２とデータ記憶部３に出力する。アームドライバ２２は、このスピンドル電流検出２１の検出出力を入力すると、それまで出力していた駆動電流をゼロにし、アーム上下手段２３の降下動作を停止する。この時点で、磁気ヘッドの記録準備が終了する。またデータ記憶部３に入力された検出信号は、ＡＮＤゲート１０８に入力される。

【００２３】一方、ＡＴＩＰ復調１７はビットクロック

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の他に、ＡＴＩＰ同期信号と、分データ、秒データ、フレームデータ（以上をまとめて、ＡＴＩＰデータと略す）を復調し出力する。ＡＴＩＰ同期信号はＷＲＩＴＥコントロール８に、ＡＴＩＰデータはディスクアドレスレジスタ１８とディスクアドレス比較１９に入力される。ディスクアドレスレジスタ１８は、ＷＲＩＴＥコントロール８の出力がＨｉｇｈレベルの期間において、ＡＴＩＰデータの値を更新する（なお、図示していないが、ＡＴＩＰデータの値を直接設定できるシステムコントロールからの入力を備える）。ディスクアドレスレジスタ１８の出力とＡＴＩＰ復調１７の出力ＡＴＩＰデータは、ディスクアドレス比較１９に入力され、例えば両データが一致したときにＨｉｇｈレベルとなるような検出信号をＷＲＩＴＥコントロール８およびジャンプパルス発生１４に出力する。ＷＲＩＴＥコントロール８は、このディスクアドレス比較１９出力、ＡＴＩＰ同期、データ記憶部３の出力すなわちＡＮＤゲート１０８出力を入力し、ディスクアドレス比較１９の出力とＡＮＤゲート１０８の出力が共にＨｉｇｈレベルとなるときＨｉｇｈレベルを出力し、どちらか一方あるいは両方の信号がＬｏｗレベルになった後に、最初に入力されるＡＴＩＰ同期の同期パルスをトリガとしてＬｏｗレベルを出力する。ＷＲＩＴＥコントロール８の出力は、アドレスセレクタ１０５、ディスクアドレスレジスタ１８、ＬＤドライバ１３、ジャンプパルス発生１４に入力される。アドレスセレクタ１０５は、ＷＲＩＴＥコントロール出力がＬｏｗレベルのときは書き込みアドレスを選択し、Ｈｉｇｈレベルのときは書き込みアドレスと読み出だしアドレスを交互に選択してＲＡＭ１０２に選択されたアドレスを出力する。ＬＤドライバ１３は、ＷＲＩＴＥコントロール出力がＬｏｗレベルのときはレーザダイオードの出力パワーを再生パワーとし、Ｈｉｇｈレベルのときは記録パワーとする。ジャンプパルス発生１４は、ＷＲＩＴＥコントロール出力の立下りエッジ後のＡＴＩＰ同期信号の立上りエッジをカウントし、このカウント値が所定値になったときにトラックジャンプのためのトリガパルスをサーボ１１に出力する。

【００２４】データ記憶部３内部では、入力されたデータビット列をデータ入力バッファ１０１を介してＲＡＭ１０２に書き込みを行う。このとき、書き込みアドレス生成１０４はＣＬＫ１を動作クロックとしてＲＡＭ１０２の書き込みアドレスをカウントアップし、生成された書き込みアドレスはアドレスセレクタ１０５を介してＲＡＭ１０２のアドレス入力に接続される。これにより、周波数ｆ１にてＲＡＭ１０２にデータが書き込まれる。一方、読み出しアドレス生成１０６は、後述するアドレスセレクタ１０５の出力であるリード／ライト命令を入力し、これがＨｉｇｈレベルのときには、ＣＬＫ２を動作クロックとしてＲＡＭ１０２の読み出しアドレスをカウントアップし、Ｌｏｗレベルのときには読み出しアドレスの値をホールドする。生成された読み出しアドレスはアドレスセレクタ１０５を介してＲＡＭ１０２のアドレス入力に接続される。これにより、周波数ｆ２にてＲＡＭ１０２からデータが読み出され、読み出されたデータはデータ出力バッファ１０３を介して出力される。アドレスセレクタ１０５は、ＷＲＩＴＥコントロール８からの制御信号により、書き込みアドレスと読み出しアドレスを切り替えるとともに、例えばＨｉｇｈレベルのとき読み出しモード、Ｌｏｗレベルのとき書き込みモードとなるようなリード／ライト命令をＲＡＭ１０２に出力する。書き込みアドレスと読み出しアドレスはＲＡＭアドレス比較１０７にも入力され、両アドレスの差が第１の設定値以上になったときに、例えばＨｉｇｈレベルとなり、第２の設定値以下になったときに、例えばＬｏｗレベルとなるような検出信号を出力する。ＲＡＭアドレス比較１０７の出力は、ＡＮＤゲート１０８に入力され、ＡＮＤゲートの他方の入力であるスピンドル電流検出出力との論理積が、ＷＲＩＴＥコントロール８に接続される。なお、ＲＡＭアドレス比較１０７の第１の設定値をＡ１とすれば、

【００２５】

【数１】$A1 \geqq R_0 \times 1 / n$

としなくてはならない。ここで、R_0はディスク最外周の１トラック記録容量である。また、ＲＡＭアドレス比較１０７の第２の設定値をＡ２とすれば、

【００２６】

【数２】$A2 \geqq Ra$

としなくてはならない。ここで、ＲａはＡＴＩＰ１フレーム分（後述）の長さのトラックに記録できる記録容量である。

【００２７】データ記憶部３から出力されたデータ列は、変調１５を介して変調された後、磁気ヘッドドライバ４に入力され、変調１５の出力データ列に応じて磁気ヘッド５を駆動し、ディスク９にデータが記録される。

【００２８】次に、記録命令信号がＨｉｇｈレベルからＬｏｗレベルになったときの動作を説明する。アームドライバ２２は、この記録命令信号のＬｏｗレベルを受け、第１の方向と極性が逆である第２の方向の駆動電流をアーム上下移動手段２３に出力する。アーム上下移動手段２３はこの駆動電流により、アーム２４をディスク９から遠ざける方向に移動させる。したがって、アーム２４に支持された磁気ヘッド５は、ディスク９から離れる方向に移動を開始する。また、スピンドル電流検出２１は、動作状態をイネーブルとして出力信号をＬｏｗレベルにする。なお、以上の動作において、記録命令信号がＬｏｗレベルになった時点で、データ記憶部３内にまだディスクに記録を行なっていないデータが残っているので、実際のディスクへの記録動作は、このデータ記憶部内のデータを全て読み出すまで続ける必要がある。したがって、アームドライバ２２が第２の方向の駆動電流

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を出力するのと、スピンドル電流検出２１が動作状態をイネーブルとするのは、記録命令信号がＨｉｇｈレベルからＬｏｗレベルになってから所定の時間が経過してからとする。あるいは、スピンドル電流検出２１とアームドライバ２２に、ＷＲＩＴＥコントロール８の出力を入力し、記録命令信号がＨｉｇｈレベルからＬｏｗレベルになった後の、ＷＲＩＴＥコントロール出力の立ち下がりエッジで前記動作を切り替えても良い（以上、図示せず）。

【００２９】一方、記録命令信号がＨｉｇｈレベルからＬｏｗレベルに切り替わって、アームの移動動作が開始される直前には、次の動作が行われる。アナログ信号処理１では、記録開始命令がＬｏｗレベルになると、入力オーディオソースに対して行なっていた変換処理を停止する。エンコーダ２も同様に、データが入力されなくなると動作を停止し、したがってデータ記憶部３には新しくデータは蓄積されない。データ記憶部３内部では、ＲＡＭアドレス比較１０７に記録命令信号のＬｏｗレベルが入力され、これを受けてＲＡＭアドレス比較１０７では、第１の設定値Ａ１が（数１）の条件を満足していても、していなくても出力をＨｉｇｈレベルとする。また、（数２）に示した第２の設定値Ａ２を、

【００３０】

【数３】Ａ２＝０

に変更する。この結果、データ記憶部３内に残留している有効データを全て出力することができる。

【００３１】図３は、図１および図２の各部動作波形図で、ディスクへの記録動作開始時の動作について示してある。以下、図面を用いてさらに詳しく動作を説明する。

【００３２】時刻ｔ１１で、システムコントロールからの記録命令信号ａが、ＬｏｗレベルからＨｉｇｈレベルになると、これを受けて同時刻、アームドライバ出力ｂは駆動電流Ｉ１を発生し、磁気ヘッド５がディスクに接近する方向に移動を開始する。一方、時刻ｔ１１以降エンコーダ２からデータがデータ記憶部３に入力され続けており、ＲＡＭ１０２への書き込みアドレスがカウントアップする。この結果、時刻ｔ１２で、ＲＡＭアドレス比較１０７の出力ｄがＬｏｗレベルからＨｉｇｈレベルとなり、ＲＡＭ１０２には所定量のデータが書き込まれていることを示している。しかし、磁気ヘッド５がまだ記録時の位置まで到達していないため、この時点ではディスクへの記録は行えない。時刻ｔ１３で、スピンドル電流検出出力ｃがＨｉｇｈレベルとなり、磁気ヘッド５がディスク９と接触したことを検出している。この検出出力を受け、アームドライバ出力ｂはゼロとなり、磁気ヘッド５のディスク面垂直方向の移動が停止する。また同時刻、ＡＮＤ１０８出力ｄはＨｉｇｈレベルとなり、記録データの蓄積量および磁気ヘッドの位置は記録可能な状態となり、ディスクへの記録開始位置の回転待ちとなる。時刻ｔ１４になると、ディスクアドレス比較１９出力ｆはＨｉｇｈレベルとなり（ディスクアドレス比較の動作については、図４で詳しく説明する）、同時刻、このディスクアドレス比較１９出力ｂを受け、ＷＲＩＴＥコントロール８の出力ｄもＨｉｇｈレベルとなり、ディスクに対する記録動作が時刻ｔ１４より開始される。

【００３３】図４は、図１および図２の各部動作波形図で、図３の時刻ｔ１３の動作について示してある。以下、同面を用いてさらに詳しく動作を説明する。

【００３４】時刻ｔ２１は、図３における時刻ｔ１３を、時刻ｔ２２は、図３における時刻ｔ１４を示しており、図３で説明した動作についてはここでは省略する。時刻ｔ２１以前より、ｒに示すようにディスクアドレスレジスタ１８にはシステムコントロールからアドレス値ｎが転送され、記憶されている。一方、ＡＴＩＰデータｐには、ディスクに記録されているアドレスデータがリアルタイムで復調されている。時刻ｔ２２で、ＡＴＩＰデータｐのアドレス値がｎとなるので、ディスクアドレス比較１９出力ｆは両アドレス入力の一致を検出してＨｉｇｈレベルとなる。同時刻、このディスクアドレス比較１９出力ｆを受け、ＷＲＩＴＥコントロール８の出力ｈもＨｉｇｈレベルとなり、ディスクに対する記録動作が開始される。時刻ｔ２２以降は、アドレスセレクタ１０５は書き込みアドレスと読み出しアドレスを交互に選択し、それに対応してリード／ライト命令もｊに示すように繰返しパルスとなる。時刻ｔ２３で、ＲＡＭアドレス比較１０７の出力ｄがＨｉｇｈレベルからＬｏｗレベルとなり、ＲＡＭ１０２に残る有効データ量（ディスクに未だ記録されていないデータ）が所定量以下になったことを示している。時刻ｔ２３以降の最初のＡＴＩＰ同期である時刻ｔ２４において、ＷＲＩＴＥコントロール８の出力ｄはＬｏｗレベルとなり、ディスクに対する記録動作を一時中断する。また、次のＡＴＩＰ同期である時刻ｔ２５においては、ＷＲＩＴＥコントロール８の出力ｄがＬｏｗレベルであるため、ディスクアドレスレジスタ１８のアドレス値ｈが更新されず、ディスクアドレス比較１９の出力ｂはＬｏｗレベルとなる。同時刻、このディスクアドレス比較１９出力の立ち下りを受けて、ｓに示すようにジャンプパルス発生１４はトラックジャンプトリガを発生し、光スポットは１トラックのリバースジャンプを行う。このときのトラッキングエラー信号を、ｕに示す。なお、ＡＴＩＰデータｐのアドレス値は、ＡＴＩＰ同期毎に更新されるが、実際に光スポットがトレースしているトラックアドレスｋよりも１ＡＴＩＰフレームだけ遅れた値となっており、時刻ｔ２２～ｔ２４において記録されたディスクトラックのアドレスは、ｎ＋１～ｍとなる。また時刻ｔ２４以降、再びＷＲＩＴＥコントロール８の出力ｄがＨｉｇｈレベルとなるまで、ｒに示すようにディスクアドレスレジスタ１８はアドレス値ｍを保つ。したがって、次に記録を開始する

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トラックは、ＡＴＩＰデータのアドレス値でｍ、実際のディスクトラックアドレスでｍ＋１となり、前回の記録動作を一時中断したトラックアドレスの続きから、切れ目なく記録を行うことができる。

【００３５】図５は、図１および図２の各部動作波形図で、ディスクへの記録動作を行わない待機状態の動作の一例を示してある。以下、同面を用いてこのときの動作について説明する。

【００３６】時刻ｔ３３以前は、ＲＡＭアドレス比較１０７の出力ｄはＬｏｗレベルのままで、ＲＡＭ１０２にはまだ所定量のデータが書き込まれていないことを示している。なお予め、ｒに示すようにディスクアドレスレジスタ１８にはアドレス値ｎが、システムコントロールから転送されるか、あるいは前回のディスクへの記録動作でラッチされるか、いずれかにより記憶されている。時刻ｔ３１で、ＡＴＩＰデータｐのアドレス値がｎとなるので、ディスクアドレス比較１９出力ｆは両アドレス入力の一致を検出してＨｉｇｈレベルとなる。しかし図３の場合とは異なり、ＲＡＭアドレス比較１０７の出力ｄがＬｏｗレベルのため、ＡＮＤ１０８出力ｅもＬｏｗレベルとなっており、この結果、ＷＲＩＴＥコントロール８の出力ｄはＬｏｗレベルのまま変化せず、ディスクに対する記録動作は行われない。同時刻、ディスクアドレス比較１９出力ｆの立上りを受けて、ｓに示すようにジャンプパルス発生１４はトラックジャンプトリガを発生し、光スポットは１トラックのリバースジャンプを行う。ジャンプ後の最初のＡＴＩＰ同期である時刻ｔ３２で、ＡＴＩＰデータｐのアドレス値が更新され、ディスクアドレスレジスタ１８のアドレス値ｒは更新されないため、ディスクアドレス比較１９の出力ｂはＬｏｗレベルとなる。以後、この例では時刻ｔ３３で、ＲＡＭアドレス比較１０７の出力ｄがＨｉｇｈレベルとなり、同時刻を図４の時刻ｔ２１と続ければ、前述のような動作により記録動作が行われる。なお時刻ｔ３３において、ＲＡＭアドレス比較１０７の出力ｄがＨｉｇｈレベルとならず、先にディスクアドレス比較１９出力ｆがＨｉｇｈレベルとなった場合には、時刻ｔ３１以降の動作を再び行わせる。

【００３７】図６は、図１および図２の各部動作波形図で、ディスクへの記録動作を行わない待機状態の動作の他の一例を示してある。図５で説明した例では、ディスクアドレス比較出力ｆがＨｉｇｈレベルとなったときに、スピンドル電流検出２１の出力ｃはＨｉｇｈレベルで、ＲＡＭアドレス比較１０７の出力ｄがＬｏｗレベルであった場合を想定したが、これとは逆にスピンドル電流検出２１の出力ｃがＬｏｗレベルで、ＲＡＭアドレス比較１０７の出力ｄがＨｉｇｈレベルである場合でも、ＡＮＤ１０８出力ｅがＬｏｗレベルとなるので、動作は全く同様となる。

【００３８】図７は、図１および図２の各部動作波形図で、ディスクへの記録動作終了時の動作について示してある。以下、これを用いて動作を説明する。

【００３９】時刻ｔ５１で、システムコントロールからの記録命令信号ａが、ＨｉｇｈレベルからＬｏｗレベルになると、これを受けて同時刻、ＲＡＭアドレス比較１０７の出力ｄがＬｏｗレベルからＨｉｇｈレベルとなる。あるいは、同出力ｄが時刻ｔ５１以前からＨｉｇｈレベルである場合には、Ｈｉｇｈレベルを継続する（図では、前者を例にとってある）。すなわち、ＲＡＭ１０２には所定量のデータが蓄積されている、いないに関わらず、ＲＡＭアドレス比較１０７の出力ｄがＬｏｗレベルからＨｉｇｈレベルとなり、同時刻にＡＮＤ１０８出力ｄもＨｉｇｈレベルとなる。時刻ｔ５２になると、ディスクアドレス比較１９出力ｆはＨｉｇｈレベルとなり、同時刻、このディスクアドレス比較１９出力ｂを受け、ＷＲＩＴＥコントロール８の出力ｄもＨｉｇｈレベルとなり、ディスクに対する記録動作が時刻ｔ５２より開始される。時刻ｔ５３に、ＲＡＭアドレス比較１０７の出力ｄがＨｉｇｈレベルからＬｏｗレベルとなり、ＲＡＭ１０２内の有効データがゼロになったことを示している。同時刻にＡＮＤ１０８出力ｄもＬｏｗレベルとなり、これによりＷＲＩＴＥコントロール８の出力ｄもＨｉｇｈレベルとなって、ディスクに対する記録動作が時刻ｔ５３で終了する。また、ＲＡＭアドレス比較１０７の出力ｄを受けて同時刻、スピンドル電流検出出力ｃがＬｏｗレベルとなり、これによりアームドライバ出力ｂは駆動電流Ｉ２を発生する。この結果、磁気ヘッド５がディスクから遠ざかる方向に移動を開始する。時刻ｔ５４に、アームドライバ出力ｂはゼロとなり、磁気ヘッド５はディスクから十分離れた位置で停止し、一連の記録動作が完了する。なお、時刻ｔ５４を設定する方法としては、タイマを用いて所定の時間だけ駆動電流Ｉ２が出力されるようにしても良いし、アーム２４を停止させたい位置でスイッチが切り替わるマイクロスイッチを設置し、このマイクロスイッチ出力により、タイミングを指定しても良い。

【００４０】以上に述べた図３から図７までのの動作を繰り返すことにより、ディスクへのデータ記録時のみ磁気ヘッドをディスクに接触させ、ＲＡＭ１０２に記憶した圧縮データを連続的にディスクに記録することができる。

【００４１】図８は本発明の第２の実施例を示す回路ブロック図で、図１における磁気ヘッドのアップ／ダウン制御部分、すなわちスピンドル電流検出２１、アームドライバ２２およびその周辺部分だけを示してある。同図において、２０１は周波数ｆｗの検波回路、２０２は基準電圧Ｖｒｅｆ、２０３は電圧比較器、２０４はフリップフロップ、２０５は繰返し周波数ｆｗの交流電流を発生する交流電流発生、２０６はステップ状の直流電流を発生する直流電流発生、２０７は電流加算点、である。

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また同図において、図１と同機能のブロックには同符号を付し、ここでは説明を省略する。

【００４２】システムコントロールからの記録命令信号がＨｉｇｈレベルとなると、フリップフロップ２０４はリセットを解除され、動作状態となる。また、交流電流発生２０５と直流電流発生２０６は、それぞれ交流電流と直流電流を発生し、両出力は加算点２０７で加算される。したがって、アーム２４は周波数ｆｗで振動しながらディスク９に接近していく。一方、スピンドルモータ１０の駆動電流はＩ－Ｖ変換され、検波回路２０１に入力される。検波回路２０１は、入力信号中に周波数ｆｗ成分があるとこの振幅レベルを検出し、検出出力は電圧比較器２０３で基準電圧Ｖｒｅｆと比較される。検波回路出力が基準電圧Ｖｒｅｆよりも高いレベルになると、電圧比較器２０３出力はＬｏｗレベルからＨｉｇｈレベルに変わり、この信号を受けて、フリップフロップ２０４はデータ入力であるＨｉｇｈレベルがラッチされ、出力される。交流電流発生２０５と直流電流発生２０６では、このフリップフロップ出力を受けて、それぞれ交流電流と直流電流の発生を停止する。

【００４３】以上のように、ディスク９と磁気ヘッド５の接触の検出を、特定の周波数でアームを振動させ、アーム駆動電流における同周波数の検波により行うので、誤検出が防げ、確実に検出を行うことが可能となる。

【００４４】図９は本発明の第３の実施例を示す回路ブロック図で、図１と同一機能のブロックには同一符号を付し、説明を省略する。同図と図１との違いは、ディスク９と磁気ヘッド５の接触を検出するための検出手段を新たに設けた点である。同図において、２５はディスク９と磁気ヘッド５の相対位置関係に対応して電気的特性あるいは出力が変化するセンサ、２６はセンサ出力によりディスク９と磁気ヘッド５の接触を検出するセンサ出力検出である。

【００４５】図１０は、センサ２５とセンサ出力検出２６の具体的な回路ブロック図の一例である。同図において、センサ２５は例えば、磁気ヘッド５上あるいは磁気ヘッド５近傍のディスク９に接触する位置に設置された一組の並行平板で、ディスク９とセンサ２５の距離に応じて図１１に示すように静電容量ＣｄがＣｏからＣｗまで変化する。また、３０１は外部に接続されたセンサ２５の静電容量Ｃｄが

【００４６】

【数４】Ｃｄ＝Ｃｗ

のときに、共振周波数ｆｗで発振する発振回路である。センサ出力検出２６内部のその他のブロックは、図８におけるスピンドル電流検出２１内部のブロックと同一機能であるので、同一符号を付し、説明を省略する。以下、両図を用いて本実施例による光磁気ディスク記録再生装置の、データ記録開始時の動作を説明する。

【００４７】システムコントロールから、例えばデータの記録期間中だけＨｉｇｈレベルとなるような記録命令信号が、アナログ信号処理１、センサ出力検出２６およびアームドライバ２２に入力される。アームドライバ２２は、記録命令信号がＨｉｇｈレベルとなると、第１の方向の駆動電流をアーム上下移動手段２３に出力し、これによりアーム２４はディスク９に近づく方向に移動する。センサ出力検出２６に入力された記録命令信号は、センサ出力検出２６内のフリップフロップ２０４のリセット端子に入力され、記録命令信号がＬｏｗレベルのときには非動作状態で、記録命令信号がＨｉｇｈレベルとなるとリセットが解除され、動作状態となる。一方、センサ２５の静電容量Ｃｄは、磁気ヘッド５とディスク９の距離が近くなるに従って増加し、磁気ヘッド５とディスク９が接触するとＣｗとなる。このとき、発振回路３０１は共振周波数ｆｗにて発振し、この発振周波数ｆｗを検波回路２０１にて検波する。検波出力が基準電圧Ｖｒｅｆよりも高いレベルになると電圧比較器２０３出力はＬｏｗレベルからＨｉｇｈレベルに変わり、この信号を受けて、フリップフロップ２０４出力はＨｉｇｈレベルとなる。アームドライバ２２は、このフリップフロップ２０４出力を受けて、それまで出力していた第１の方向の駆動電流を停止する。

【００４８】図１２（ａ）～（ｃ）は、センサ２５の具体的な構成例である。それぞれ上側の図は磁気ヘッド５をディスク９と垂直な面でカットした断面図で、下側の図は磁気ヘッド５およびセンサ２５をディスク９に面した方向から見た図である。（ａ）は、磁気ヘッド５の横に一組の並行平板４０１ａ、４０１ｂを配置したものである。（ｂ）は、磁気ヘッド５のサイドコア上に２組の並行平板４０２ａ、４０２ｂおよび４０２ｃ、４０２ｄを配置したものである。（ｃ）は、磁気ヘッド５のサイドコアから中央部のコアにかけて並行平板を支持するための部材４０３を設け、支持部材４０３上に一組の並行平板４０４ａ、４０４ｂを配置したものである。なお（ｂ）、（ｃ）において、ディスク９との接触面が磁気ヘッド５の中央部のコアと並行平板とで同一平面となるように磁気ヘッド中央部のコアの長さをサイドコアに対して長くしてある。また、磁気ヘッド中央部のコアをさらに長くして並行平板の位置よりもディスク９に接近させても特に問題はなく、その場合には、図１１のＣｗの設定値を変更すればよい。

【００４９】また、第３の実施例においては、磁気ヘッド５とディスク９との接触を検出する方法について、磁気ヘッド５とディスク９の距離に対応して変化する発振周波数の検波を行うことにより検出したが、次のような方法により検出を行うことも可能である。ディスク９の磁気ヘッド５が接触する側の表面に、導電体の膜を形成する。磁気ヘッド５とディスク９が非接触のときには、センサ２５は少なくとも並行平板の面積と空気の誘電率で定まる所定の静電容量をもつので発振回路３０１は、

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この静電容量により発振する。磁気ヘッド５とディスク９が接触したときには、センサ２５の並行平板がディスク９の表面に形成された導電体により電気的に同電位となるため、静電容量はゼロとなる。この結果、発振回路３０１は発振条件を満たさなくなり発振を停止する。以上の動作において、検波回路２０１では、発振回路３０１が発振しているか否かを検出することにより、磁気ヘッド５とディスク９の接触を検出することができる。

【００５０】なお、磁気ヘッド５とディスク９の相対位置関係において、磁気ヘッド５が所定の位置に到達したか否かを検出する方法として、第１、第２の実施例ではスピンドル電流から検出する方法を、第３の実施例では静電容量センサから検出する方法を述べたが、この他にもセンサ２５としてＬＥＤとフォトダイオードを用いた距離検出等を行ってもよく、本発明はこれらの磁気ヘッド５とディスク９の相対位置検出方法に限定されるものではない。

【００５１】図１３（ａ）～（ｃ）は、アーム２４をディスク９に接近させる際、およびディスク９から遠ざける際の速度パターンの一例で、速度のプラス方向は磁気ヘッド５をディスク９に近づける方向、速度のマイナス方向は磁気ヘッド５をディスク９から遠ざける方向の速度を示している。同図において、時刻ｔ６１、ｔ６３は、それぞれ図３における時刻ｔ１１、ｔ１３に、時刻ｔ６５、ｔ６６は、それぞれ図７における時刻ｔ５３、ｔ５４に対応している。時刻ｔ６２は、時刻ｔ６１からの経過時間により設定を行うか、あるいはアーム２４が略所定の位置に達したことをマイクロスイッチやフォトインタラプタ等により検出し、この検出信号により設定を行ってもよい。時刻ｔ６４は、時刻ｔ６３からの経過時間により設定を行う。（ａ）の例では、時刻ｔ６１からｔ６２までは速度ｖ１で、時刻ｔ６２からｔ６３までは速度ｖ１よりも低速の速度ｖ２としている。時刻ｔ６５からｔ６６までは速度ｖ１と絶対値が等しく方向が逆の速度ｖ３としている。これにより、磁気ヘッド５をディスク９に近づけるときには、速い速度でなるべく早くディスク９の近傍に移動させ、その後はディスク９に衝突による損傷を与えないように低速で接触させることができる。また磁気ヘッド５をディスク９から遠ざけるときには、速い速度でディスク９から離れた位置へ移動させることができる。（ｂ）の例では、時刻ｔ６１からｔ６２までは速度ｖ１で、時刻ｔ６２からｔ６３までは速度ｖ１から徐々に速度を減少させていき、時刻ｔ６３で速度が略ゼロとなるようにしている。時刻ｔ６５からｔ６６までは速度ｖ１よりも絶対値が大きく方向が逆の速度ｖ４としている。これにより、（ａ）と同様に磁気ヘッド５をディスク９に近づけるときには、速い速度でなるべく早くディスク９の近傍に移動させ、その後はディスク９に衝突による損傷を与えないように低速で接触させることができる。また磁気ヘッド５をディスク９から遠ざけるときには、近づけるときの速度よりもさらに速い速度でディスク９から離れた位置へ移動させることができる。（ｃ）の例では、時刻ｔ６１からｔ６３までは速度ｖ１で、時刻ｔ６３からｔ６４までは速度ｖ１よりも低速でかつ方向が逆である速度ｖ５としている。時刻ｔ６５からｔ６６までは（ａ）と同様に速度ｖ１と絶対値が等しく方向が逆の速度ｖ３としている。これにより、磁気ヘッド５をディスク９に近づけるときには、速い速度でなるべく早くディスク９の近傍に移動させ、そのままの速度でディスク９に接触させるので、短い時間で磁気ヘッド５を所定の位置に移動させることができる。また、速い速度のままディスク９に接触させるので、磁気ヘッド５とディスク９が接触する寸前においてディスク面振れ等により起こる複数回の衝突を避けることができる。なお、以上のような速度パターンを実現する方法については、よく知られているのでここでは省略する。

【００５２】

【発明の効果】本発明によれば、記録開始後にディジタルデータ列が一旦半導体メモリに書き込まれ、この間に磁気ヘッドをディスクに接触するまで移動させる。半導体メモリにデータが所定値以上蓄えられ、かつ磁気ヘッドがディスクに接触した後、光スポットがトレース中の絶対アドレスとアドレスレジスタに記憶されているアドレス値が一致したときに、半導体メモリからデータを読み出してディスクへの記録が行われる。また、記録終了時には半導体メモリ内のデータを全て読み出してから、磁気ヘッドをディスクから遠ざける。以上により、ディスクへのデータ記録時にのみ磁気ヘッドをディスクに接触させ、記録時以外においては、磁気ヘッドをディスクから遠ざかった位置に退避させておけるので、磁気ヘッドおよびディスクの摩耗と、磁気ヘッドがディスクに接触することによるスピンドルモータの負荷増とこれに伴う消費電力増を、ディスクへのデータ記録期間のみに限定でき、ディスク再生時においては、これらの不具合が全く生じない。さらに、ディスクカートリッジの誤挿入に対しても、磁気ヘッドおよびアームを破損から保護することができる。

【００５３】

【図面の簡単な説明】

【図１】本発明の第１の実施例を示す回路ブロック図である。

【図２】図１におけるデータ記憶部の内部回路ブロック図である。

【図３】図１および図２の各部動作波形図である。

【図４】図１および図２の各部動作波形図である。

【図５】図１および図２の各部動作波形図である。

【図６】図１および図２の各部動作波形図である。

【図７】図１および図２の各部動作波形図である。

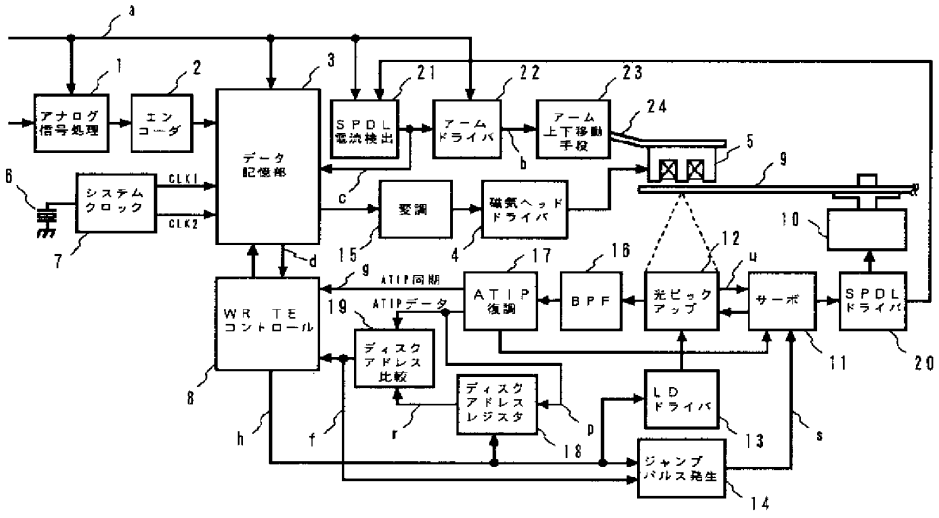
【図８】本発明の第２の実施例を示す回路ブロック図で

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ある。
【図９】本発明の第３の実施例を示す回路ブロック図である。
【図１０】図９の一部を具体的に示す回路ブロック図である。
【図１１】センサの特性を示す特性図である。
【図１２】センサと磁気ヘッドの取付位置関係を示す構成図である。
【図１３】磁気ヘッドを移動させる際の速度パターン図である。
【符号の説明】
２…エンコーダ、３…データ記憶部、４…磁気ヘッドドライバ、５…磁気ヘッド、７…システムクロック、８…ＷＲＩＴＥコントロール、１１…サーボ、１２…光ピックアップ、１４…ジャンプパルス発生、１７…ＡＴＩＰ復調、１８…ディスクアドレスレジスタ、１９…ディスクアドレス比較、２０…スピンドルドライバ、２１…スピンドル電流検出、２２…アームドライバ、２３…アーム上下移動手段、２４…アーム、２５…センサ、２６…センサ出力検出、１０２…ＲＡＭ、１０４…書き込みアドレス発生、１０５…アドレスセレクタ、１０６…読み出しアドレス発生、１０７…ＲＡＭアドレス比較、２０１…検波回路、２０５…交流電流発生、２０６…直流電流発生、３０１…発振回路

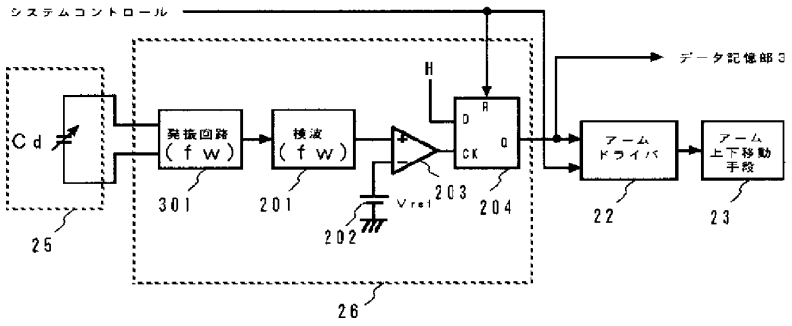
【図１】

図１



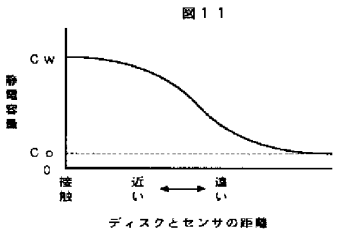
【図１０】

図１０



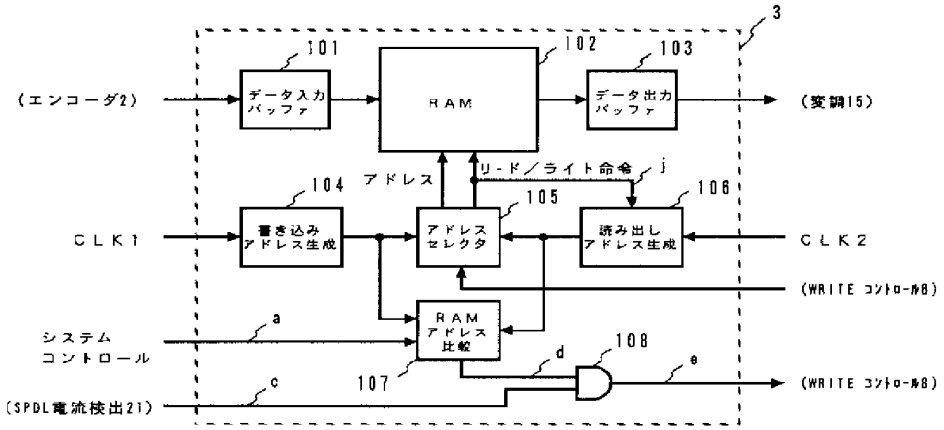
【図１１】

図１１



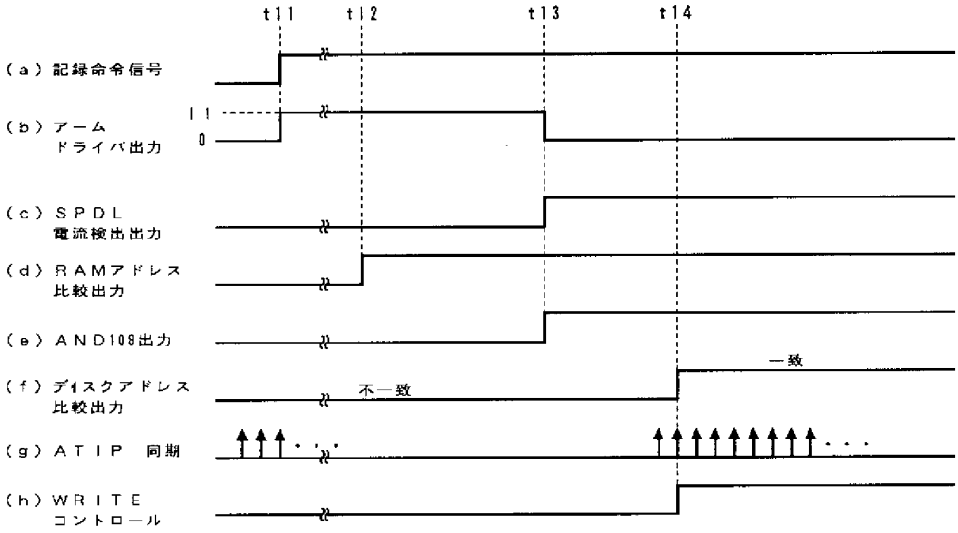
【図２】

図２


3
101
102
103
（エンコーダ2）
データ入力バッファ
RAM
データ出力バッファ
（変調15）
アドレス
リード／ライト命令
j
104
105
106
CLK1
書き込みアドレス生成
アドレスセレクタ
読み出しアドレス生成
CLK2
（WRITE コントロール8）
RAMアドレス比較
a
システムコントロール
108
d
e
107
c
（SPDL電流検出21）
（WRITE コントロール8）

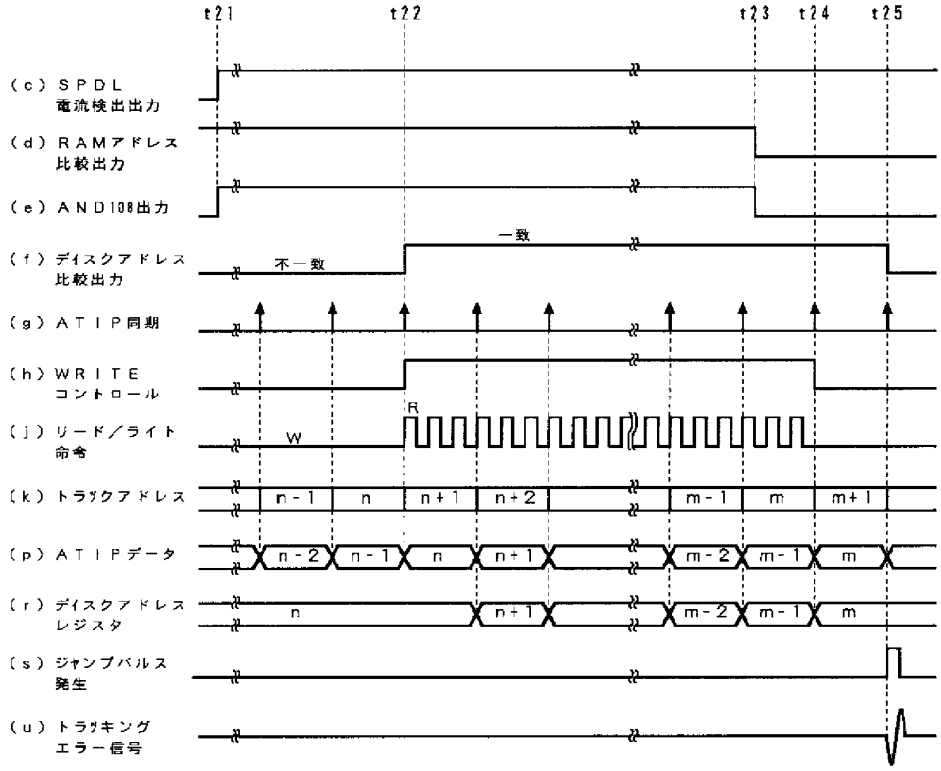
【図３】

図３


t11
t12
t13
t14
（a）記録命令信号
（b）アームドライバ出力
1
0
（c）SPDL電流検出出力
（d）RAMアドレス比較出力
（e）AND108出力
（f）ディスクアドレス比較出力
不一致
一致
（g）ATIP　同期
（h）WRITEコントロール

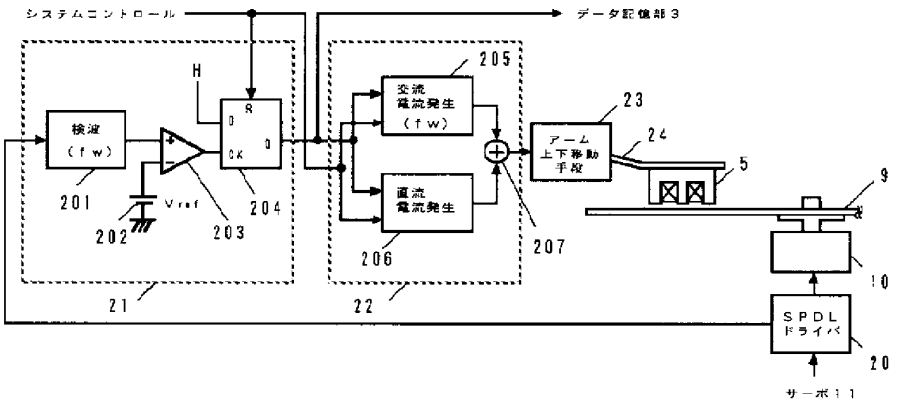
【図４】

図４


t21
t22
t23
t24
t25
(c) SPDL 電流検出出力
(d) RAMアドレス 比較出力
(e) AND108出力
(f) ディスクアドレス 比較出力
不一致
一致
(g) ATIP同期
(h) WRITE コントロール
(j) リード／ライト 命令
R
W
(k) トラックアドレス
n-1
n
n+1
n+2
m-1
m
m+1
(p) ATIPデータ
n-2
n-1
n
n+1
m-2
m-1
m
(r) ディスクアドレス レジスタ
n
n+1
m-2
m-1
m
(s) ジャンプパルス 発生
(u) トラッキング エラー信号

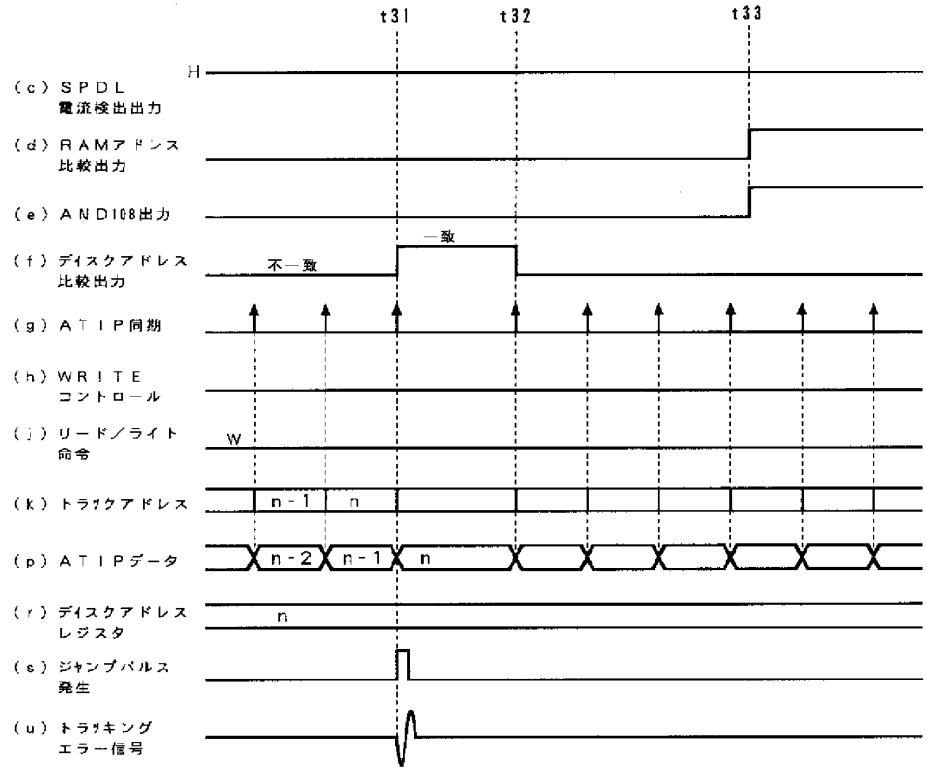
【図８】

図８

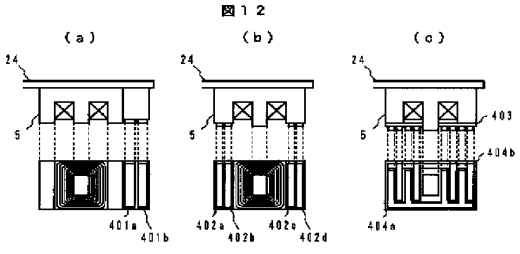

システムコントロール
データ記憶部３
検波
(fw)
201
202
Vref
203
H
R
D
CK
Q
204
205
交流
電流発生
(fw)
直流
電流発生
206
207
21
22
23
アーム
上下移動
手段
24
5
9
10
SPDL
ドライバ
20
サーボ１１

【図５】

図５

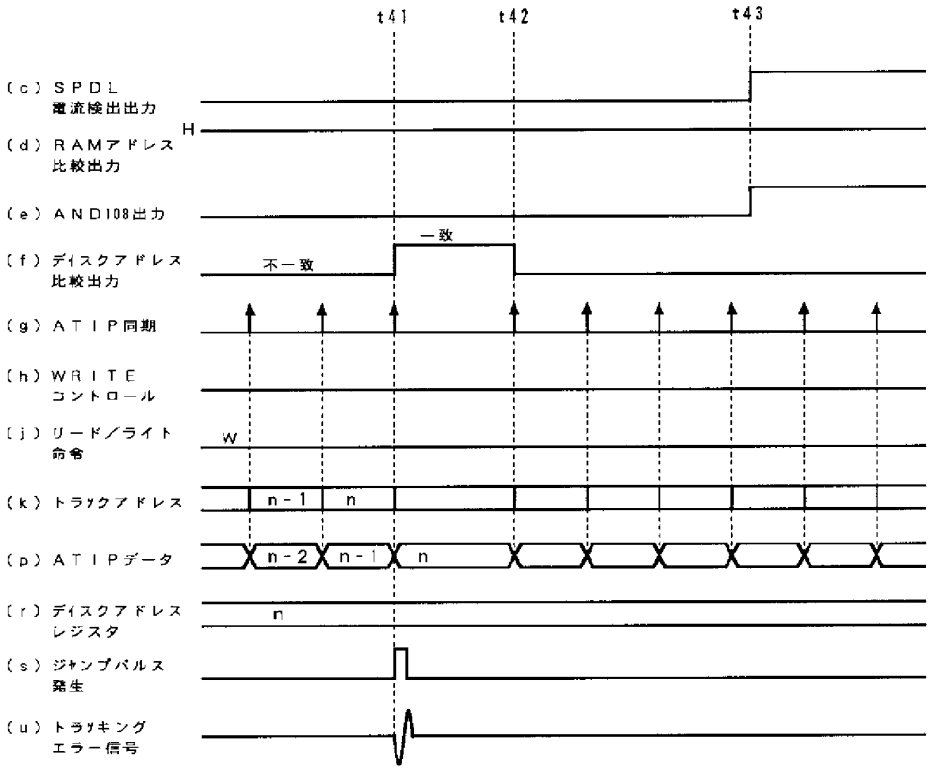

t31
t32
t33
H
(c) SPDL
電流検出出力
(d) RAMアドレス
比較出力
(e) AND108出力
(f) ディスクアドレス
比較出力
一致
不一致
(g) ATIP同期
(h) WRITE
コントロール
(j) リード／ライト
命令
W
(k) トラックアドレス
n-1
n
(p) ATIPデータ
n-2
n-1
n
(r) ディスクアドレス
レジスタ
n
(s) ジャンプパルス
発生
(u) トラッキング
エラー信号

【図１２】


図１２
(a)
(b)
(c)
24
5
401a
401b
402a
402b
402c
402d
403
404a
404b

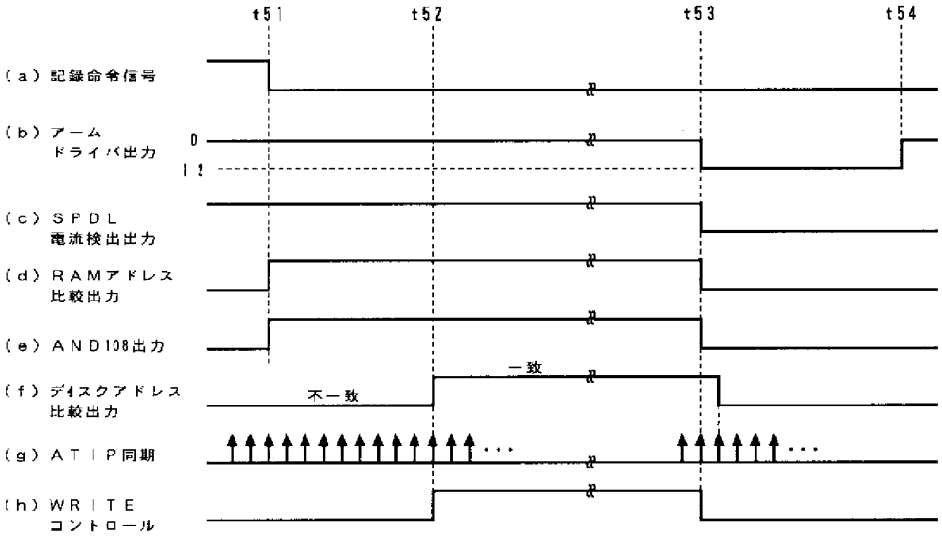
【図６】

図６


t41
t42
t43
(c) SPDL 電流検出出力
H
(d) RAMアドレス 比較出力
(e) AND108出力
一致
(f) ディスクアドレス 比較出力
不一致
(g) ATIP同期
(h) WRITE コントロール
(j) リード/ライト 命令
W
(k) トラックアドレス
n-1
n
(p) ATIPデータ
n-2
n-1
n
(r) ディスクアドレス レジスタ
n
(s) ジャンプパルス 発生
(u) トラッキング エラー信号

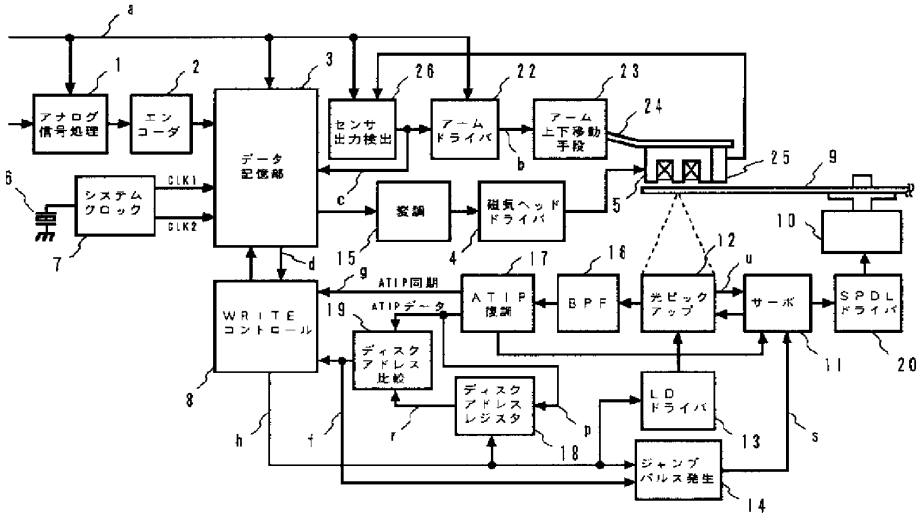
【図７】

図７


t51
t52
t53
t54
（ａ）記録命令信号
（ｂ）アーム
ドライバ出力
0
1
（ｃ）ＳＰＤＬ
電流検出出力
（ｄ）ＲＡＭアドレス
比較出力
（ｅ）ＡＮＤ108出力
（ｆ）ディスクアドレス
比較出力
不一致
一致
（ｇ）ＡＴＩＰ同期
（ｈ）ＷＲＩＴＥ
コントロール

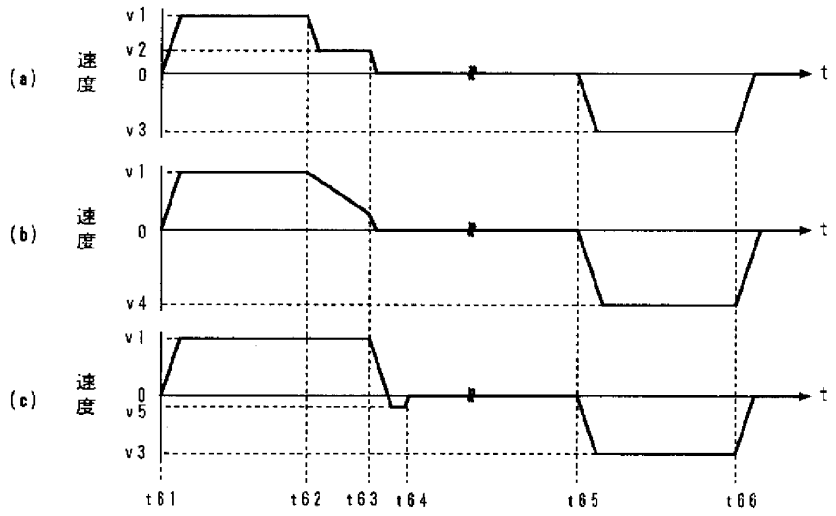
【図９】

図９


アナログ
信号処理
エン
コーダ
データ
記憶部
センサ
出力検出
アーム
ドライバ
アーム
上下移動
手段
システム
クロック
CLK1
CLK2
変調
磁気ヘッド
ドライバ
WRITE
コントロール
ATIP同期
ATIPデータ
ＡＴＩＰ
復調
ＢＰＦ
光ピック
アップ
サーボ
ＳＰＤＬ
ドライバ
ディスク
アドレス
比較
ディスク
アドレス
レジスタ
ＬＤ
ドライバ
ジャンプ
パルス発生

【図１３】

図１３



Bibliographic data

Title:	MULTILAYER VESSEL
Pub/Pat no:	JPH07156349A
Pub/Issue Date:	1995-06-20
Inventor(s):	YOSHII JUNJI|YOSHII JUNJI
Applicant(s):	KUREHA CHEMICAL IND CO LTD| KUREHA PLAST KK
Classification:	B65D1/00AI; B29C49/04AI; B29C49/22AI; B32B1/02AI; B32B27/00AI; B32B27/08AI; B32B27/32AI; B32B27/36AI; B29K23/00AN; B29K67/00AN; B29L9/00AN; B29L22/00AN; B65D1/09AN
Application number:	JP19930341735 1993-12-10
Priority number:	JP19930341735 1993-12-10;

Abstract of JPH07156349A

PURPOSE:To obtain a multilayer vessel which has excellent heat resistance, surface gloss, transparency, gas barrier properties, etc., and dropping strength by extrusion blow molding. CONSTITUTION:This multilayer vessel comprises an outer layer formed of a polyethylene terephthalate copolymer (a) having inherent viscosity (I.V.) of 1.0-1.5dl/g, a core layer formed of a gas barrier resin (b), and an inner layer formed of the copolymer (a) or polypropylene resin (c) obtained with a metallocene compound as a polymerization catalyst, and is obtained by extrusion blow molding.

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号

特開平7－156349

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(51)Int.Cl.[6]		識別記号	庁内整理番号	ＦＩ	技術表示箇所
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Ｂ２９Ｃ	49/04		7619－4Ｆ		
	49/22		7619－4Ｆ		
Ｂ３２Ｂ	1/02		7415－4Ｆ		
				Ｂ６５Ｄ　1/ 00　Ｂ	

審査請求　未請求　請求項の数２　ＦＤ　（全　５　頁）　最終頁に続く

(21)出願番号　特願平5－341735

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(74)代理人　弁理士　西川　繁明

(54)【発明の名称】　多層容器

(57)【要約】
【目的】　耐熱性、表面光沢、透明性、ガスバリヤー性などが良好で、しかも落下強度に優れた多層容器を、押出ブロー成形により得ること。
【構成】　固有粘度（Ｉ．Ｖ．）が１．０～１．５ｄｌ／ｇのポリエチレンテレフタレート共重合体（ａ）からなる外層、ガスバリヤー性樹脂（ｂ）からなる芯層、及び前記ポリエチレンテレフタレート共重合体（ａ）またはメタロセン化合物を重合触媒として得られたポリプロピレン系樹脂（ｃ）からなる内層を含有し、押出ブロー成形されてなることを特徴とする多層容器。

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【特許請求の範囲】
【請求項１】　固有粘度（Ｉ．Ｖ．）が１．０～１．５ｄｌ／ｇのポリエチレンテレフタレート共重合体（ａ）からなる外層、ガスバリヤー性樹脂（ｂ）からなる芯層、及び前記ポリエチレンテレフタレート共重合体（ａ）またはメタロセン化合物を重合触媒として得られたポリプロピレン系樹脂（ｃ）からなる内層を含有し、押出ブロー成形されてなることを特徴とする多層容器。
【請求項２】　ポリエチレンテレフタレート共重合体（ａ）が、１，４－シクロヘキサンジメタノールまたはイソフタル酸を共重合成分として１～５モル％含有するものである請求項１記載の多層容器。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明は、押出ブロー成形されてなるボトル状の多層容器に関し、さらに詳しくは、耐熱性、表面光沢、透明性、ガスバリヤー性などが良好で、しかも落下強度に優れた多層容器に関する。
【０００２】
【従来の技術】ブロー成形（中空成形）によるプラスチック成形容器は、多層化することにより、ガスバリヤー性などの単層では得られない性質が得られる。従来、例えば、ガスバリヤー性に優れたエチレン・ビニルアルコール共重合体（ＥＶＯＨ）を芯層とし、ポリプロピレン（ＰＰ）またはポリエチレンテレフタレート（ＰＥＴ）を内外層に配した多層ブロー成形容器が知られている。しかし、ＰＰやＰＥＴは、溶融押出成形時に結晶化し易いため、押出ブロー成形（ダイレクトブロー成形）すると、白濁して透明性や表面光沢が損なわれる。そこで、これらの多層ブロー成形容器は、一般に、共押出延伸ブロー成形により製造されている。また、ＰＥＴ／ナイロンＭＸＤ６／ＰＥＴの積層構造を有する多層容器を、共射出延伸ブロー成形により製造することも知られている。
【０００３】ところが、このような延伸ブロー成形では、熱可塑性材料を押出または射出によって、プリフォームをつくり、このプリフォームを所定の金型内に移動し、ガラス転移点以上、融点以下で圧縮空気を吹き込み、膨張延伸して成形するため、工程が煩雑で、しかも成型機などの設備費がかさむという問題がある。これに対して、ダイレクトブロー成形では、押出機にて熱可塑性材料を加熱溶融し、円形ダイより円筒状にパリソンを押出したものを、直接に割り金型で挟み、溶融状態のまま圧縮空気を吹き込み、冷却した金型壁までブローし、冷却して成形するため、工程数が少なく、設備費も比較的安価である。
【０００４】最近、ダイレクトブロー成形により、前記のような多層ブロー成形容器を製造する方法が提案されている。例えば、特公平４－６０８３０号には、ダイレクトブロー成形により、シクロヘキシレンジメチレンテレフタレート／エチレンテレフタレート共重合ポリエステルを外層、プロピレン共重合樹脂を内層、ＥＶＯＨを中間層とする多層容器を製造する方法が開示されている。しかし、該公報に記載の発明で使用されている共重合ポリエステルは、実際には、共重合成分としてシクロヘキサンジメタノールをグリコール成分の約１８モル％と高い割合で含有するものである。ところが、このようなシクロヘキサンジメタノールの共重合割合が大きい共重合ポリエステルを使用した多層押出ブロー成形容器は、透明性や表面光沢が良好であるものの、落下強度に劣るものであった。
【０００５】
【発明が解決しようとする課題】本発明の目的は、耐熱性、表面光沢、透明性、ガスバリヤー性などが良好で、しかも落下強度に優れた多層容器を、押出ブロー成形により得ることにある。本発明者らは、前記従来技術の問題点を克服するために鋭意研究した結果、ガスバリヤー性樹脂からなる層を芯層とする多層容器において、少なくとも外層に超高分子量のポリエチレンテレフタレート共重合体（ＰＥＴ共重合体）を用いることにより、多層押出ブロー成形によって、落下強度が顕著に優れた多層容器の得られることを見出した。
【０００６】この超高分子量のＰＥＴ共重合体は、例えば、共重合成分として１，４－シクロヘキサンジメタノールまたはイソフタル酸を数モル％程度までの少割合で使用して重合し、さらに、固相重合によって重合度を上げて、超高分子材料として設計されたものである。また、内層としては、外層に用いたのと同じ超高分子量のＰＥＴ共重合体を用いるか、あるいはメタロセン化合物を重合触媒として得られたポリプロピレン系樹脂を用いると、落下強度が優れていると共に、透明性が良好な多層容器を得ることができる。本発明の多層容器は、耐熱性、表面光沢、ガスバリヤー性なども良好である。本発明は、これらの知見に基づいて完成するに到ったものである。
【０００７】
【課題を解決するための手段】かくして、本発明によれば、固有粘度（Ｉ．Ｖ．）が１．０～１．５ｄｌ／ｇのポリエチレンテレフタレート共重合体（ａ）からなる外層、ガスバリヤー性樹脂（ｂ）からなる芯層、及び前記ポリエチレンテレフタレート共重合体（ａ）またはメタロセン化合物を重合触媒として得られたポリプロピレン系樹脂（ｃ）からなる内層を含有し、押出ブロー成形されてなることを特徴とする多層容器が提供される。
【０００８】以下、本発明について詳述する。本発明で使用するＰＥＴ共重合体は、重合度を上げて、超高分子量としたものであり、その固有粘度（Ｉ．Ｖ．値）は、１．０～１．５ｄｌ／ｇ、好ましくは１．０５～１．５ｄｌ／ｇの範囲内にある高粘性ＰＥＴである。ここで、Ｉ．Ｖ．値は、ＡＳＴＭ　Ｄ－２８５７に従って、ｐ－

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クロロフェノール／テトラクロロエタン（１／１重量％）混合溶媒を使用し、３０℃で測定した値である。通常のＰＥＴ樹脂は、Ｉ．Ｖ．値が０．８０前後であるのに対して、本発明で使用する超高分子量ＰＥＴ共重合体は、共重合成分の種類と共重合割合を選択し、かつ、重合度を上げることにより、Ｉ．Ｖ．値を１．０ｄｌ／ｇ以上に高めたものである。

【０００９】このようなＰＥＴ共重合体は、テレフタル酸及びエチレングリコールの他に、共重合成分として１，４－シクロヘキサンジメタノールまたはイソフタル酸を１～５モル％、好ましくは１～４モル％、より好ましくは２～４モル％使用して共重合し、さらに、後重合（ｐｏｓｔ　ｐｏｌｙｍｅｒｉｚａｔｉｏｎ）工程で固相重合するなどしてＩ．Ｖ．値を高めることにより得ることができる。その他の共重合成分として、例えば、ジエチレングリコールなどを数モル％以下の割合で併用してもよい。

【００１０】共重合成分のモル％は、１，４－シクロヘキサンジメタノールの場合、グリコール成分中のモル％を意味する。ただし、１，４－シクロヘキサンジメタノールをグリコール成分中に１～５モル％の割合で使用すると、得られたＰＥＴ共重合体中の１，４－シクロヘキサンジメチレンテレフタレート単位の割合も、エチレンテレフタレート単位との合計中の１～５モル％となる。イソフタル酸の場合には、テレフタル酸とイソフタル酸の合計中のモル％を意味する。このモル％は、ＰＥＴ共重合体中におけるエチレンイソフタレート単位のエチレンテレフタレート単位との合計中のモル％と一致する。

【００１１】このような超高分子量のＰＥＴ共重合体としては、例えば、米国のイーストマンケミカル社のコダパック（Ｋｏｄｐａｋ）ＰＥＴ　１３３３９〔Ｉ．Ｖ．＝１．０８；１，４－シクロヘキサンジメタノール使用品〕、日本ユニペット社のＲＤ－３８３〔Ｉ．Ｖ．＝１．１；１，４－シクロヘキサンジメタノール使用品〕やＲＮ－２８３〔Ｉ．Ｖ．＝１．１；イソフタル酸使用品〕、アクゾ社のＡｒｎｉｔｅ　Ｄｏ６－３００〔Ｉ．Ｖ．＝１．１；イソフタル酸使用品〕、ヘキスト社のＴ－８８〔Ｉ．Ｖ．＝１．１；イソフタル酸使用品〕、ＩＣＩ社のＭｅｌｉｎａｒ　５９２２ｃ〔Ｉ．Ｖ．＝１．１；イソフタル酸使用品〕などを挙げることができる。これらの中でも、コダパックＰＥＴ　１３３３９（１，４－シクロヘキサンジメタノール含有量＝３．６モル％）、ＲＤ－３８３（１，４－シクロヘキサンジメタノール含有量＝３．６モル％）などが特に好ましい。

【００１２】超高分子量のＰＥＴ共重合体を多層容器の外層または外層及び内層に使用することにより、耐熱性、透明性、表面光沢などが良好であると共に、落下強度が顕著に優れた多層押出ブロー成形容器を得ることができる。押出ブロー成形された場合、超高分子量ＰＥＴ共重合体からなる層は、透明で非晶状態である。これに対して、１，４－シクロヘキサンジメタノールまたはイソフタル酸を共重合成分として用いたＰＥＴ共重合体であっても、その共重合割合が大きく、低重合度のＰＥＴ共重合体を用いると、落下強度が低下する。例えば、イーストマンケミカル社の非晶性のＰＥＴ共重合体であるコダール（Ｋｏｄａｒ）ＰＥＴ－Ｇ６７６３（コモノマー含有量＝３１モル％、Ｉ．Ｖ．＝０．７５ｄｌ／ｇ）を用いた場合には、落下強度が劣悪な多層押出ブロー容器しか得ることができない。

【００１３】芯層に使用するガスバリヤー性樹脂としては、エチレン含有量が２８～５０モル％、好ましくは３０～４３モル％で、ケン化度が９６％以上、好ましくは９９％以上のエチレン・酢酸ビニル共重合体ケン化物、即ち、エチレン・ビニルアルコール共重合体（ＥＶＯＨ）、あるいはナイロンＭＸＤ６などのポリアミド、ＥＶＯＨとポリアミドとの混合物などを挙げることができるが、これらの中でも、特に、ＥＶＯＨが好ましい。

【００１４】内層としては、前記超高分子量のＰＥＴ共重合体またはメタロセン化合物を重合触媒として得られたポリプロピレン系樹脂を使用する。前記した通り、内外層に超高分子量のＰＥＴ共重合体を配置すると、耐熱性、透明性、表面光沢などが良好で、かつ、落下強度に優れた多層押出ブロー成形容器を得ることができる。メタロセン化合物を重合触媒として得られたポリプロピレン系樹脂を内層に使用すると、前記と同様の諸特性を有し、特に、落下強度及び透明性に優れた多層押出ブロー成形容器を得ることができる。

【００１５】メタロセン化合物は、例えば、チタン（Ｔｉ）、ジルコニウム（Ｚｒ）、ニッケル（Ｎｉ）、パラジウム（Ｐｄ）、ハフニウム（Ｈｆ）、白金（Ｐｔ）などの４価の遷移金属に、１つまたはそれ以上のシクロペンタジエニル環あるいはその類縁体が配位子として存在する化合物であり、発見者の名前をとって、カミンスキー（Ｋａｍｉｎｓｋｙ）触媒またはカミンスキー・シン（Ｋａｍｉｎｓｋｙ－Ｓｉｎｎ）触媒とも呼ばれている。また、活性点の性質が同じであるという特徴から、シングルサイト触媒または均一系触媒とも呼ばれている。

【００１６】メタロセン化合物を触媒として重合したポリプロピレンは、分子量分布（多分散度）、即ち、重量平均分子量／数平均分子量（Ｍｗ／Ｍｎ）が、通常、１．５～２．５程度であり、従来の触媒で重合すると４～１０であるのに比べて、多分散度が非常に小さい。Ｍｗ／Ｍｎは、ゲルパーミエーションクロマトグラフィー（ＧＰＣ）を用い、分子量既知のポリスチレンを標準物質として測定し、ユニバーサルキャリブレーション法により、算出することができる。このポリプロピレンは、低重合度のポリマーやオリゴマーの含有量が小さく、不純物の溶出量が少ないため、内層として好適である。また、メタロセン化合物を触媒として重合したポリプロピ

レンは、一般に、シンジオタクチック・ポリプロピレン（ｓ－ポリプロピレン）である。

【００１７】ポリプロピレン系樹脂は、ポリプロピレン単独重合体だけではなく、ポリプロピレンとエチレン、あるいはブテン－１、４－メチルペンテン－１、ヘキセン－１、オクテン－１などのα－オレフィンとの共重合体であってもよい。また、２種以上のメタロセン化合物を、それぞれ触媒として使用して製造された分子量やメルトフローレイト（ＭＦＲ）の異なる２種以上のポリプロピレン系樹脂をブレンドした、バイモーダルまたは多モーダル的な分子量分布を示すブレンド物を使用することもできる。ポリプロピレン系樹脂のＭＦＲは、通常、２ｇ／１０分以上である。

【００１８】外層と芯層、及び芯層と内層の間には、層間接着性がないか、極めて不十分であるため、通常、これらの間に接着性樹脂層（接着層）を設ける。接着性樹脂としては、汎用のものが使用でき、例えば、無水マレイン酸、アクリル酸、メタクリル酸、無水イタコン酸等のエチレン系不飽和カルボン酸またはその無水物でグラフト変性された酸変性ポリオレフィン、あるいはコポリエステル、コポリアミド等が挙げられる。

【００１９】本発明の多層容器の層構成は、接着層をも含めると、（１）ＰＥＴ共重合体層／接着層／ガスバリヤー性樹脂層／接着層／ＰＥＴ共重合体層、（２）ＰＥＴ共重合体層／接着層／ガスバリヤー性樹脂層／接着層／ポリプロピレン系樹脂層となる。各層の厚みは、使用目的に応じて適宜定めることができるが、一般に、外層の厚みを全層の厚みの５～４０％とし、芯層の厚みを全層の厚みの２～１５％とすることが好ましい。また、リグラインド樹脂を用いた中間層を適宜配置してもよい。

【００２０】本発明の多層容器は、複数の押出機と多層ダイを備えた公知の多層押出ブロー成形機を用いて、押出ブロー成形（ダイレクトブロー成形）することにより得ることができる。本発明の多層容器は、耐熱性、表面光沢、透明性、ガスバリヤー性などが良好で、しかも落下強度が顕著に優れている。

【００２１】

【実施例】以下に実施例及び比較例を挙げて、本発明についてより具体的に説明するが、本発明は、これらの実施例のみに限定されるものではない。

【００２２】［実施例１］複数の押出機と多層ダイを用いて、下記構成（外層／接着層／芯層／接着層／内層）のパリソンを押出し、ダイレクトブロー方式のロータリー成型機により、内容積が５００ｍｌの多層押出ブローボトルを成形した。多層容器の目付けは、２４ｇであった。なお、超高分子量のＰＥＴ共重合体は、除湿型ドライヤーを用いて予備乾燥を充分に行った。

【００２３】（１）外層：イーストマンケミカル製コダパックＰＥＴ　１３３３９、Ｉ．Ｖ．＝１．０８ｄｌ／ｇ、コモノマー（１，４－シクロヘキサンジメタノール）含有量＝３．６モル％、結晶密度＝１．４ｇ／ｃｍ^3、結晶融点＝２４５℃、ガラス転移点＝約８０℃。

（２）芯層：（株）クラレ製、エバール－ＥＰ－Ｆ（エチレン含有量＝３２モル％、ケン化度＝９９％）。

（３）内層：外層と同じ樹脂。

（４）上記各層間の接着層：三井石油化学（株）製、アドマーＳＦ－７１０（ＡＴ－４６９）層の厚み比は、外層より、２０：１：２：１：２０であった。

【００２４】［実施例２］Ｍｗ／Ｍｎ＝２．３、固有粘度〔η〕＝１．４０ｄｌ／ｇ、ＭＦＲ（ＪＩＳＫ－６７５８）＝３．４ｇ／１０分で、メタロセン化合物を触媒として用いて製造されたシンジオタクチック・ポリプロピレンを内層に使用したこと以外は、実施例１と同様にして、多層押出ブローボトルを作成した。

【００２５】［比較例１］内外層に、非晶性ＰＥＴ共重合体であるイーストマンケミカル社のＫｏｄａｒＰＥＴ－Ｇ６７６３〔Ｉ．Ｖ．＝０．７５ｄｌ／ｇ、コモノマー（１，４－シクロヘキサンジメタノール）含有量＝３１モル％〕を用いたこと以外は、実施例１と同様にして、多層押出ブローボトルを作成した。これらの多層押出ブローボトルの物性を表１に示した。

【００２６】

【表１】

	光沢度（%）	曇価（%）	落下強度（破損率）			
			20℃		1℃	
			縦	横	縦	横
実施例１	85	23	0／10	0／10	0／10	1／10
実施例２	84	23	0／10	0／10	0／10	1／10
比較例１	84	24	3／10	6／10	6／10	8／10

【００２７】物性の測定方法は、次の通りである。

（１）光沢度（グロス）及び曇価（ヘーズ）：ＪＩＳＫ－７１０５に準拠して測定した。

（２）落下強度：ＪＩＳ　Ｚ－１７０３に準じ、以下の方法によって測定した。ボトル１０個に、水を充填して、キャッピングし、所定の温度にコントロールした後、１２０ｃｍの高さからコンクリートの床面上にボトルの底面（縦）及び側面（横）が当たるように１回ずつ落下させ、破損の有無を調べた。

【００２８】

【発明の効果】本発明によれば、少なくとも外層に、高粘性で超高分子量の結晶性ポリエステル（ＰＥＴ共重合

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体）を用いることにより、押出ブロー成形によって、耐熱性、表面光沢、透明性、ガスバリヤー性などが良好で、しかも落下強度に優れた多層容器を得ることができる。本発明の多層容器は、ケチャップ、マヨネーズなどの食品用の容器として好適である。

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	27/08		8413－4Ｆ		
	27/36		7421－4Ｆ		
// Ｂ６５Ｄ	1/09				
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	22:00				

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Pub/Issue Date:	1999-10-12
Inventor(s):	CHISHOLM BRET JA|CHISHOLM BRET JA
Applicant(s):	GEN ELECTRIC
Classification:	C08K3/00AI; C08G63/64AI; C08K3/32AI; C08L67/00AI; C08L67/02AI; C08L69/00AI; C08L51/04AN
Application number:	JP19990016457 1999-01-26
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Abstract of JPH11279389A

PROBLEM TO BE SOLVED: To obtain a thermoplastic resin composition having an increased glass transition temperature, a relatively high heat distortion temperature, homogenous appearance and a good melt stability by mixing a specified alkylene naphthanoate polyester with a specified amorphous PEC resin and a quencher. SOLUTION: This composition comprises the following components A to C: [A] about 90 to about 10 wt.% alkylene naphthanoate polyester containing recurring units of formula I (wherein each R<1> is a divalent aliphatic hydrocarbon, alicyclic hydrocarbon, polyoxyalkylene group or a mixture thereof; each A<1> is a divalent naphthalene group or a mixture thereof), [B] about 10 to about 90 wt.% essentially amorphous polymer containing recurring units of formula II (wherein Ar is a divalent aromatic residue of a dicarboxylic acid or of a mixture thereof; and Ar' is a divalent aromatic residue of a dihydric phenol or of a mixture thereof), and [C] a quencher such as a phosphite having an acidic OH group, an acid phosphate, a phosphorus oxo acid, or a phosphate of a IB or IIB metal in the periodic table.

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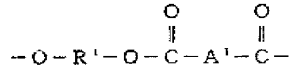
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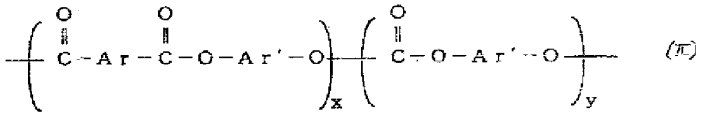
(54)【発明の名称】　ポリエステル成形組成物

(57)【要約】　（修正有）
【課題】増加されたガラス転位温度、比較的高い熱変形温度（ＨＤＴ）均質な外観を含めた向上された諸特性の熱可塑性樹脂組成物
【解決手段】（ａ）下式Ｉ



(I)

の反復単位（各R^1は２価の脂肪族炭化水素、脂環式炭化水素、ポリオキシアルキレン、各A^1は二価のナフタリン）を含有するナフタノエートポリエステル約９０乃至約１０重量％（ｂ）下式II

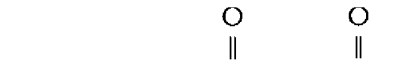


(II)

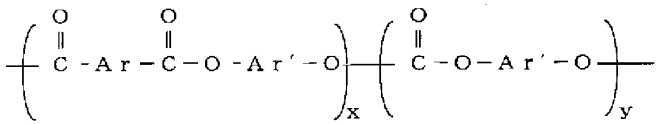
の反復単位（Ａｒはジカルボン酸二価の芳香族残基であり、Ａｒ′は二価フェノールまたは二価フェノールの混合物の二価の芳香族残基である）を含有する非晶質のポリマー約１０乃至約９０重量％、（ｃ）酸性ＯＨ基を有するホスファイト、酸性燐酸塩、ポリ酸ピロ燐酸塩およびその酸性塩、周期律表第ＩＢおよびＩＩＢ族金属の燐酸塩並びに燐オクソ酸からなる群から選ばれる抑制剤を含む熱可塑性樹脂組成物、

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【特許請求の範囲】
【請求項１】　（ａ）下記の式Ｉ
【化１】



の反復単位（但し上記式中、各R^1は個々に２価の脂肪族炭化水素、脂環式炭化水素、ポリオキシアルキレンまたはこれらの基の混合物であり、各A^1は個々に二価のナフタリンまたはそれらの基の混合物である）を含有するアルキレンナフタノエートポリエステル約９０乃至約１０重量％（ｂ）下記の式II
【化２】



の反復単位（但し上記式中、Ａｒはジカルボン酸またはジカルボン酸の混合物の二価の芳香族残基であり、Ａｒ′は二価フェノールまたは二価フェノールの混合物の二価の芳香族残基である）を含有する本質的に非晶質のポリマー約１０乃至約９０重量％、および（ｃ）酸性ＯＨ基を有するホスファイト、酸性燐酸塩、ポリ酸ピロ燐酸塩およびその酸性塩、周期律表第ＩＢおよびIIＢ族金属の燐酸塩並びに燐オクソ酸からなる群から選ばれる抑制剤、を含む熱可塑性樹脂組成物。
【請求項２】　式IIにおいてｘ＝０である反復単位を有するポリカーボネート樹脂を更に含む請求項１記載の熱可塑性樹脂組成物。
【請求項３】　式IIのＡｒ′が二価フェノール成分としてのビスフェノールＡの芳香族残基から誘導される請求項１記載の熱可塑性樹脂組成物。
【請求項４】　式IIのＡｒがイソフタル酸、テレフタル酸またはこれらの混合物の芳香族残基から誘導される請求項１記載の熱可塑性樹脂組成物。
【請求項５】　式Ｉのナフタノエートポリエステルが、A^1がジ酸成分の２，６－ナフタン酸またはその誘導体からの残基であり、そしてR^1がエチレングリコール、プロパンジオール、ブタンジオール、シクロヘキサンジメタノールおよびこれらの誘導体から本質的になる群から選ばれるジオール成分からの残基である、ポリアルキレンナフタノエートである請求項１記載の熱可塑性樹脂組成物。
【請求項６】　更にゴム質の耐衝撃性改良剤を含んでおり、この耐衝撃性改良剤がゴム質の幹部と硬質ポリマー性の枝部またはシェルを含むグラフトコポリマーである請求項１記載の熱可塑性樹脂組成物。
【請求項７】　グラフトコポリマーがメチルメタクリレート－ブタジエン－スチレングラフトコポリマーおよびアクリロニトリル－ブタジエン－スチレングラフトコポリマーから選ばれる請求項６記載の熱可塑性樹脂組成物。
【請求項８】　式Ｉのナフタノエートポリエステルが約１０乃至約９０重量％、式IIの非晶質ＰＥＣ樹脂が約９０乃至約１０重量％（但し、この非晶質のＰＥＣ熱可塑性樹脂は０乃至約６０重量％のポリカーボネートを含む）、ゴム質の耐衝撃性改良剤が０乃至約２５重量％、ガラスまたは鉱物質充填剤が０乃至約６０重量％、そして抑制剤が約０．００５乃至約２．０重量％含まれている請求項１記載の熱可塑性樹脂組成物。
【請求項９】　式Ｉのナフタノエートポリエステルが約２０乃至約６０重量％そして式IIの非晶質ＰＥＣ樹脂が約２０乃至約６０重量％含まれ、前記重量％が前記熱可塑性樹脂の合計重量に基づいている請求項１記載の熱可塑性樹脂組成物。
【請求項１０】　式IIにおいてｘ＝０である反復単位を有するポリカーボネート樹脂を約１０乃至約４０重量％含む請求項３記載の熱可塑性樹脂組成物。
【発明の詳細な説明】
【０００１】
【発明の分野】本発明はポリエステル樹脂のブレンドに係わる。
【０００２】
【発明の背景】ポリカーボネート（ＰＣ）と芳香族結晶性ポリエステルとのブレンド類は周知であり、それらの加工性、耐溶剤性および衝撃強さの組合せのために有用である。殆どの場合、これらのブレンドはまた良好で均質な表面外観をも提供する。これらのブレンドの特に負荷の下での熱的特性はそのポリカーボネートに富んだ相のガラス転位温度（Ｔｇ）の関数である。ポリカーボネートがポリエステルに部分的に混和性である限度において、このブレンドのＰＣのＴｇは純粋なＰＣに対して低下される。［J. Applied Polymer Sci.48,2249(1993)を参照されたい］これは負荷の下での熱変形温度（ＨＤＴ）のような熱的特性の低下を引き起こす。
【０００３】もしも比較的に高いＴｇのポリカーボネート樹脂を使用してブレンドのＴｇの低下に対処しようと試みたとしても、なお問題があろう。ポリアリーレートおよびこれに関連するポリエステルカーボネート（ＰＥＣ）樹脂は比較的に高いＴｇを持ったポリカーボネートの諸特性の幾つかを持っていることが知られている。（米国特許４，４３０，４８４参照）しかし、これらのポリアリーレートまたはポリエステルカーボネートをポリブチレンテレフタレート（ＰＢＴ）のような標準のアルキルテレフタレートをベースとするポリエステルと混

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合すると、標準の比較的に低いＴｇのＰＣのブレンドに比べてＨＤＴの上昇はあっても極僅かである。比較的に高いＴｇのポリエステルカーボネートおよびポリアリーレートはアルキルテレフタレート樹脂に対しより混和性であり、得られたこのブレンドのＴｇは類似のＰＣ－アルキルテレフタレートブレンドとほぼ同じかあるいはそれより低い。

【０００４】ポリエステル－ポリカーボネートブレンドにおける熱的特性の喪失に取り組んだ別の方法は標準のポリアルキレンテレフタレート、ポリエチレンテレフタレート（ＰＥＴ）およびＰＢＴ　ＰＣ　よりも高いＴｇを持っている結晶性のポリエステルを使用することであった。［Research Disclosure, Nov.1987,p667-669参照］比較的に高いＴｇの結晶性ポリエステルはポリエチレンナフタノエート（ＰＥＮ）あるいはポリブチレンナフタノエート（ＰＢＮ）のようなアルキルナフタノエートポリエステル樹脂として最近市販されている。残念ながら、これらのナフタノエートポリエステル樹脂は、ポリカーボネートとブレンドされると、貧弱に分散された、非均質の、真珠層の表面を示す外観に乏しい成形部品を与える。

【０００５】このように、比較的に高い熱能力、良好な外観および良好な機械的諸特性を有するＰＣ－ポリエステルブレンドを得ることは難しい。それ故に、上昇されたＴｇ、高い衝撃強さ、比較的に高い熱変形温度（ＨＤＴ）並びに均質な外観を含めた諸特性を組み合わせて有するポリカーボネート／ポリエステルブレンドを入手することが望ましい。

【０００６】

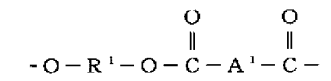
【発明の要約】或るポリマーに種々の添加剤または他のポリマーを添加してその物理的特性を改良する分野は予測可能な化学というよりはむしろ大分経験による技術分野であって、特定の添加剤が特定のポリマーに与える影響の予測性はあっても極僅かであることが当業者に良く知られている。しかし、驚くべきことに、アルキルナフタノエートポリエステルをポリエステルカーボネートとブレンドすると、外観および低いＴｇの問題を解決するブレンドを与えることが分かった。ポリアルキレンナフタノエートをポリエステルカーボネート樹脂とブレンドすれば、予想される低いＴｇの外観の乏しいブレンドが得られる代わりに、微細に分散されそして優れた外観のブレンドを与える。加えて、このブレンドは標準のアルキルテレフタレートポリエステル－ポリエステルカーボネートブレンドに比べて減少された混和性を示しそしてＨＤＴのような改善された熱的特性と共に比較的高いＴｇを有する。

【０００７】ポリエステルカーボネートまたはポリアリーレート樹脂とポリアルキレンナフタノエートポリエステルとのこの特定の組合せは外観と熱的特性の問題を両方とも解決しながらも、溶剤抵抗性、加工性、剛性および衝撃強さの利益をなお維持している。また、ポリナフタノエートとポリエステルカーボネート／ポリアリーレートとの間の溶融加工中の反応はコポリマーの生成や熱的特性の劣化並びに色の形成やガス発生のような加工上望ましくない効果をもたらすので、かかる反応を防ぐことが重要である。配合されたポリマー類の溶融反応を防止するには特定の酸性燐化学種の使用が望ましい。

【０００８】本発明によれば、（ａ）下記の式Ｉ

【０００９】

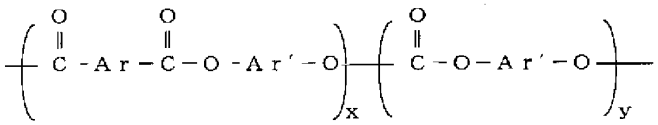
【化３】



【００１０】の反復単位（但し上記式中、各R^1は個々に２価の脂肪族炭化水素、脂環式炭化水素、ポリオキシアルキレンまたはこれらの基の混合物であり、各A^1は個々に二価のナフタリンまたはそれらの基の混合物である）を含有するナフタノエートポリエステル約９０乃至約１０重量％（ｂ）下記の式II

【００１１】

【化４】



【００１２】の反復単位（但し上記式中、Ａｒはジカルボン酸またはジカルボン酸の混合物の二価の芳香族残基であり、Ａｒ′は二価フェノールまたは二価フェノールの混合物の二価の芳香族残基である）を含有する本質的に非晶質のポリマー約１０乃至約９０重量％、および（ｃ）少なくとも１つの酸性水素を有するホスファイト、酸性燐酸塩、ポリ酸ピロ燐酸塩およびその酸性塩、周期律表第ＩＢおよびIIＢ族金属の燐酸塩並びに燐オクソ酸からなる群から選ばれる抑制剤、を含み、上昇されたガラス転位温度、比較的高い熱変形温度（ＨＤＴ）並びに均質な外観および良好な溶融安定性を含めた向上された諸特性の組合せを有する熱可塑性樹脂組成物が提供される。

【００１３】更に、ポリエステルカーボネート－アルキルナフタノエートポリエステルブレンドに標準の芳香族ポリカーボネート（式IIにおいてｘ＝０）を一部添加すると熱特性はナフタノエートポリエステルに添加されるいずれの非晶質樹脂自体の熱的特性を超えて向上されることが分かった。加えて、光反応してＵＶ安定性の物質を生成するポリエステルカーボネート／ポリアリーレー

ト樹脂のおかげで（J.Polymer Sci.Part A-1,9,3263,1971参照）、これらのブレンドは標準のポリカーボネートアルキルテレフタレートブレンドに比べて屋外での時効に際する諸特性の維持が改善されていることも予測される。

【００１４】

【好適な実施の態様の詳細な記述】通常コポリエステル－ポリカーボネート樹脂とも呼ばれるポリ（エステル－カーボネート）樹脂は、芳香族ジオールをジカルボン酸および炭酸またはその誘導体と反応させて生成されるコポリマーである。これに密接した関連のある種族の樹脂は普通ポリアリーレート樹脂と呼ばれ、これにはカーボネート結合が存在せず、ジフェノールと芳香族ジ酸またはその誘導体から誘導された非晶質の芳香族ポリエステルとして生成される。これらの種族の樹脂の両者を以後本発明のブレンド中に使用される”ＰＥＣ”と呼ぶこととする。これらのポリマーは例えば溶融重合あるいは界面重合のような種々の方法で調製できる。ポリアリーレート樹脂およびその合成についての論議はJames M.Margolisによって編集されMarcel Dekker Inc.によって1985年に発行された"Engineering Thermoplastics Properties and Applications", chapter 10 p255-281に載せられている。

【００１５】ＰＥＣ樹脂類を製造する溶融重合法は例えば二価フェノールと例えばイソ－およびテレ－フタレートのジフェニル誘導体あるいはこれらの混合物のようなエステル前駆体との種々の混合物を共重合させることを含むことができる。ポリエステルカーボネートコポリマーを調製するには炭酸ジフェニルを導入することができる。この重合反応を促進するため例えば水酸化リチウムおよびステアリン酸リチウムのような種々の触媒または触媒混合物を使用することもできる。

【００１６】一般に、この界面重合の方法は、二相系において、触媒と、ジカルボン酸およびカーボネート前駆体がジ酸ハロゲン化物であるときにはしばしば酸受容体とを使用して、二価フェノールをジ酸またはその誘導体のエステル前駆体および随意にカーボネート前駆体と反応させることを含む。界面重合技術の例は米国特許3169121および4487896に見ることができ、これらの記載を参考文献としてこの明細書の記載の一部とする。

【００１７】これら調製法の反応条件は変動しうるが、好ましい方法の幾つかでは、苛性水溶液に二価フェノール反応物質を溶解または分散し、こうして得られた混合物を適当な水に非混和性の溶媒媒質と組合せ、それから適当な触媒の存在下における制御されたｐＨ条件下でこの反応物質を例えばホスゲンのようなカーボネート前駆体およびジ酸塩化物のようなジ酸またはその誘導体と接触させることを伴うのが典型的である。最も普通に使用される水に非混和性の溶媒にはメチレンクロライド、１，２－ジクロロエタン、クロロベンゼン、トルエン等が含まれる。

【００１８】反応を促進するために反応混合物に触媒を添加することが有利なことがある。触媒は典型的には二価フェノール反応物質とカーボネート／エステル前駆体との重合速度を促進する。限定はされないが、代表的な触媒には例えばトリエチルアミンのような第三アミン、第四ホスホニウム化合物、第四アンモニウム化合物、等が含まれる。

【００１９】ポリエステルカーボネートコポリマーを調製する好ましい方法はホスゲン化反応を含む。ホスゲン化反応が進行する温度は約０℃以下から約１００℃で変動しうる。ホスゲン化反応は好ましくはほぼ室温（約２３℃）乃至約５０℃の温度で進行する。この反応は発熱反応なので、ホスゲンの添加速度を加減してこの反応温度を制御できる。

【００２０】使用される二価フェノールは知られており、その反応性基はフェノール性ヒドロキシル基であると考えられる。使用される二価フェノールの幾つかの代表的なものはビス－フェノール例えば（４－ヒドロキシフェニル）メタン、２，２－ビス（４－ヒドロキシフェニル）プロパン（ビスフェノールＡとしても知られている）、２，２－ビス（４－ヒドロキシ－３，５－ジブロモ－フェニル）プロパン；二価フェノールエーテル例えばビス（４－ヒドロキシフェニル）エーテル、ビス（３，５－ジクロロ－４－ヒドロキシフェニル）エーテル；ｐ，ｐ′－ジヒドロキシジフェニルおよび３，３′－ジクロロ－４，４′－ジヒドロキシジフェニル；ジヒドロキシアリールスルホン例えばビス（４－ヒドロキシフェニル）スルホン、ビス（３，５－ジメチル－４－ヒドロキシフェニル）スルホン；ジヒドロキシベンゼン例えばレゾルシノール、ヒドロキノン；ハロ－およびアルキル－置換ジヒドロキシベンゼン例えば１，４－ジヒドロキシ－２，５－ジクロロベンゼン、１，４－ジヒドロキシ－３－メチルベンゼン；並びにジヒドロキシジフェニルスルフィドおよびスルホキシド例えばビス（４－ヒドロキシフェニル）スルフィド、ビス（４－ヒドロキシフェニル）スルホキシドおよびビス（３，５－ジブロモ－４－ヒドロキシフェニル）スルホキシドである。各種の追加の二価フェノールが入手できそして米国特許2999835;3028365;3153008 に開示されており、これら米国特許の全ての記載を参考文献としてこの明細書の記載の一部とする。勿論、２種以上の異なる二価フェノールあるいは二価フェノールとグリコールの組合せを使用することもできる。

【００２１】カーボネート前駆体は典型的にはハロゲン化カルボニル、炭酸ジアリールまたはビスハロホーメートである。ハロゲン化カルボニルには例えば臭化カルボニル、塩化カルボニルおよびこれらの混合物が含まれる。ビスハロホーメートには二価フェノールのビスハロホーメート例えば２，２－ビス（４－ヒドロキシ－３，

５－ジクロロ－フェニル）プロパン、ヒドロキノン等のビスクロロホーメートあるいはグリコールのビスハロホーメート等が含まれる。上記のカーボネート前駆体の全てが有用であるが、ホスゲンとしても知られる塩化カルボニルが好ましい。

【００２２】一般に、ポリエステルの調製に慣用されているいずれのジカルボン酸をポリ（エステル－カーボネート）樹脂の調製に使用できる。しかしながら、本発明に使用されるＰＥＣは芳香族ジカルボン酸、特にテレフタル酸およびこれとイソフタル酸との混合物を使用して調製される。ジカルボン酸自体を利用するよりはむしろこの酸成分の種々の誘導体を使用することができるし、ときには好ましくすらある。こうした反応性誘導体の例は酸ハロゲン化物である。好ましい酸ハロゲン化物は酸ジ塩化物および酸ジ臭化物である。従って、例えばテレフタル酸またはこれとイソフタル酸との混合物を使用する代わりに、テレフタロイルジクロライドおよびこれとイソフタロイルジクロライドとの混合物を使用することができる。

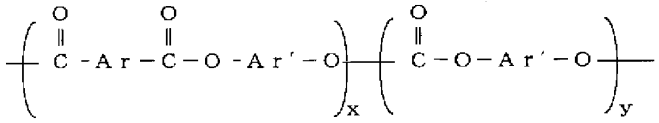
【００２３】ＰＥＣ、ポリカーボネートおよびポリアリーレートを調製する慣用的な界面重合法では、カーボネートおよび／またはエステル前駆体による重合反応の前あるいはその間に、反応混合物に分子量調節剤（連鎖停止剤）を添加するのが一般的である。有用な分子量調節剤には例えばフェノール、クロマン－１、パラ－ｔ－ブチルフェノール、ｐ－クミルフェノール等の１価のフェノールが含まれる。

【００２４】このＰＥＣを調製するのに使用される反応物質の割合はこの生成物樹脂を含有する本発明のブレンドの提示された用途次第で変動されよう。一般に、結合されたエステル単位の量はカーボネート単位に対して約２０重量％乃至約１００重量％、好ましくはカーボネート単位に対して約４０重量％乃至約９０重量％でよい。

【００２５】本発明のブレンド中に成分として使用される好ましい”ＰＥＣ”は好ましくは次式II

【００２６】

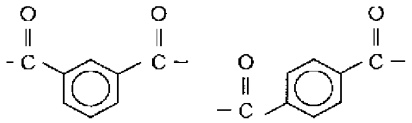
【化５】



【００２７】のエステル／カーボネート単位を有する。ここに、上記式中、Ａｒはジカルボン酸またはジカルボン酸の混合物の二価の芳香族残基であり、Ａｒ′は二価フェノールまたは二価フェノールの混合物の二価の芳香族残基である。Ａｒはアリール基であり、最も好ましくはイソ－およびテレ－フタレートまたはこれらの混合物からの残基であって次式

【００２８】

【化６】

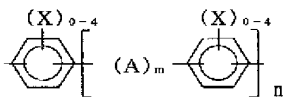


および

【００２９】を有する。二価フェノールの二価の残基Ａｒ′は次の一般式

【００３０】

【化７】



【００３１】によって表すことができ、上記式中、Ａは１乃至約１５個の炭素原子を含有する二価の炭化水素基、１乃至約１５個の炭素原子およびハロゲンのような置換基を含有する置換された二価の炭化水素基、－Ｓ－、－Ｓ（Ｏ）$_2$－または－Ｏ－であり、各Ｘは水素、ハロゲン、並びに１価の炭化水素基例えば１乃至約８個の炭素原子を含有するアルキル基、６乃至約１８個の炭素原子を含有するアリール基、７乃至約１４個の炭素原子を含有するアルアルキル基、１乃至約８個の炭素原子を含有するアルコキシ基からなる群から個々に選ばれ、ｍは０または１であり、そしてｎは０乃至約５の整数である。Ａｒ′はヒドロキノンやレゾルシノールのような単一の芳香族環あるいはビフェノールまたはビスフェノールＡのような多数の芳香族環でよい。

【００３２】式IIの好ましい”ＰＥＣ”樹脂においては、カーボネート含有量ｙは０乃至約８０、好ましくは５乃至約７０であり、芳香族エステル含有量ｘは約２０乃至約１００、好ましくは約３０乃至約９５である。より好ましくはｘは５０乃至約９５である。式IIにおいて、ｘおよびｙは合計重量１００部に基づいてそれぞれ芳香族エステル単位およびカーボネート単位の重量を表している。ｙが０のときは、カーボネート結合は存在せず、このポリエステル樹脂はポリアリーレートとして知られている。

【００３３】一般に、ポリエステルの調製に慣用されるいずれのジカルボン酸もポリ（エステルカーボネート）樹脂の調製に使用しうる。しかしながら、本発明に使用されるＰＥＣは芳香族ジカルボン酸、特にテレフタル酸およびこれとイソフタル酸との混合物を使って調製され、ここにテレフタル酸とイソフタル酸の重量比は約５：９５乃至約９５：５の範囲である。

【００３４】本発明のブレンドにおいて成分（ｂ）として使用するのに好ましいＰＥＣはビスフェノール－Ａお

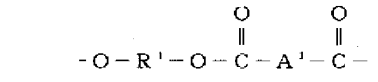
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よびホスゲンとイソーおよびテレーフタロイルクロライドとの反応から誘導され、約０．５乃至約０．６５デシリットル／グラム（メチレンクロライド中２５℃の温度で測定）の固有粘度を有するものである。異なるポリアリーレート類およびポリエステルカーボネート類のブレンドもこれらの組成物中に使用することができる。

【００３５】本発明の組成物を調製するのに使用されるナフタノエートポリエステルには次式Ｉ

【００３６】

【化８】



【００３７】の構造単位を含むものが包含される。ここに、上記式中、各R^1は個々に２価の脂肪族炭化水素、脂環式炭化水素、ポリオキシアルキレンまたはこれらの基の混合物であり、各A^1は個々に二価のナフタリンまたはそれらの基の混合物である。式Ｉの構造を含有する適当なポリエステルの例はポリ（アルキレンナフタノエート）、エラストマー性ポリエステル、液晶ポリエステルおよびポリエステルコポリマーである。例えば３つあるいはそれ以上のヒドロキシル基を有するグリコールあるいは三官能性または多官能性カルボン酸のような分岐剤が導入された分岐ポリエステルを使用することもできる。分岐ポリエステルを製造するにはポリエステルを三官能性または多官能性エポキシ化合物例えばトリグリシジルイソシアヌレートで処理することもできる。更に、組成物の究極の最終用途次第では、ポリエステルに種々の濃度の酸およびヒドロキシル末端基を有することがときとして望ましい。

【００３８】或る場合には、酸反応性化学種の使用によって、酸末端基の数を典型的には約３０マイクロ当量／グラム未満に減少することが望ましい。他の場合には、このポリエステルが比較的に高いカルボキシル末端基濃度例えば約５－２５０マイクロ当量／グラムあるいはより好ましくは約２０－７０マイクロ当量／グラム有することが望ましい。

【００３９】R^1基は例えばC_{2-10}アルキレン基、C_{6-10}脂環式基、あるいはアルキレン基が約２乃至６最も頻繁には２または４個の炭素原子を含有するポリオキシアルキレン基であることができる。上記式中のA^1基は最も頻繁には１，４－または２，６－ナフチレンである。ポリ（アルキレンナフタノエート）例えばポリ（エチレンナフタノエート）、ポリ（シクロヘキシルジメチレンナフタノエート）、ポリ（プロピレンナフタノエート）およびポリ（ブチレンナフタノエート）が本発明にとって好ましいポリエステルであり、ポリ（エチレンナフタノエート）およびポリ（ブチレンナフタノエート）が最も好ましいものである。上記のポリ（アルキレンナフタノエート）の種々の混合物も適当であり得る。

【００４０】本発明の組成物が遭遇する高い押出および成形温度においてポリエステルが加水分解による劣化を受ける傾向があるため、このポリエステルが実質的に水を含まないことが好ましい。従って、他の成分との混合前にこのポリエステルを予備乾燥することができる。より普通には、このポリエステルを予備乾燥せずに使用し、押出機に真空ベントを使用することにより揮発性物質を除去する。

【００４１】これらのポリエステルはゲル透過クロマトグラフィーで測定して約２０，０００－１００，０００の範囲の数平均分子量を一般に有している。既述したとおり、標準の芳香族ポリカーボネートの一部をポリエステルカーボネート－アルキルナフタノエートポリエステルブレンドに加えると、熱的特性が更に向上することが更に分かった。

【００４２】好適な実施の態様によれば、ポリ（エステルカーボネート）およびナフタノエートポリエステルの上述したブレンドと共に追加の成分としてポリカーボネートを含めることが好ましい。本発明のブレンドを調製するのに有用なポリカーボネート樹脂は一般に芳香族ポリカーボネート樹脂である。典型的には、これらは二価フェノールをホスゲン、ハロホーメートまたは炭酸エステルのようなカーボネート前駆体と反応させることによって調製される。一般的に述べれば、このようなカーボネートポリマーは式IIでエステル含有量ｘが０である反復構造単位を有するものとして特徴付けることができる。Ａｒ′はポリマー生成反応に使用される既述した如き二価フェノールの二価の芳香族残基である。

【００４３】これらの芳香族ポリカーボネートは、例えば上述したように、上記に引用した文献および米国特許4123436 に明らかにされている方法に従って二価フェノールをホスゲンのようなカーボネート前駆体と反応させたり、あるいは米国特許3153008 に開示されているようなエステル交換法によったり、並びに当業者に周知の他の方法によるなどして、既知の方法によって製造できる。

【００４４】本発明のポリカーボネートを含む混合物の調製に使用するのにホモポリマーよりもカーボネートコポリマーまたはインターポリマーが望まれる場合には、２種以上の異なる二価フェノールを使用したりあるいは二価フェノールとグリコールとのあるいはヒドロキシ－または酸－終端ポリエステルとのあるいは２塩基酸またはヒドロキシ酸とのコポリマーとして使用することも可能である。米国特許4001184 に記載されているような分岐ポリカーボネートも有用である。また、線状ポリカーボネートと分岐ポリカーボネートとのブレンドも利用できる。更に、芳香族ポリカーボネートを与えるために本発明の実施においては上記材料のいずれかの混合物を使用することもできる。

【００４５】いずれにしても、本発明における実施に使

用するのに好ましい芳香族カーボネートはホモポリマー、例えばGeneral Electric CompanyからLEXAN という登録商標の商品表記で市販されている２，２－ビス（４－ヒドロキシフェニル）プロパン（ビスフェノール－Ａ）およびホスゲンから誘導されたホモポリマーである。本発明に使用されるポリカーボネートは好ましくは２５℃のクロロホルム中で測定して約０．３乃至約１．５ｄｌ／ｇ、好ましくは約０．４５乃至約１．０ｄｌ／ｇの固有粘度を有する高分子量芳香族カーボネートポリマーである。これらのポリカーボネートは分岐されていても分岐されていなくてもよく、ゲル透過クロマトグラフィーで測定して約１０，０００乃至約２００，０００、好ましくは約２０，０００乃至約１００，０００の重量平均分子量を一般に有するであろう。

【００４６】あらゆるタイプのポリカーボネート末端基が本発明の範囲内にあると考えられる。本発明の組成物は既述した望ましい性質に干渉しない追加の成分を含むことができる。組成物はゴム質の耐衝撃性改良剤のような耐衝撃性改良剤を随意に含むことができる。好ましくはこのような耐衝撃性改良剤は組成物の合計重量に基づいて約３０重量％未満、好ましくは約２０重量％未満、より好ましくは約１５重量％未満の量で利用される。代表的な耐衝撃性改良剤はオレフィン、ビニル芳香族モノマー、アクリルおよびアルキルアクリル酸およびこれらのエステル誘導体並びに共役ジエンからなる群から選ばれる１種またはそれ以上のモノマーから誘導される。特に好ましい耐衝撃性改良剤は室温で弾性を示す天然および合成ポリマー物質を含むゴム質の高分子量物質である。これらにはホモポリマーと、ランダム、ブロック、ラジアルブロック、グラフトおよびコア－シェルコポリマーを含むコポリマーとの両者並びにこれらの組合せが含まれる。適当な改質剤はゴム－様コアの上に１つまたはそれ以上のシェルがグラフトされるように形成されたコア－シェルポリマーが含まれる。このコアは典型的にはアクリレートゴムまたはブタジエンゴムから実質的になる。１つまたはそれ以上のシェルがこのコアの上にグラフトされるのが典型的である。このシェルは好ましくはビニル芳香族化合物および／またはシアン化ビニルおよび／またはアルキル（メタ）アクリレートを含んでいる。これらのコアおよび／またはシェル（１つまたはそれ以上）は架橋剤および／またはグラフト剤として働くことのできる多官能性化合物をしばしば含んでいる。これらのポリマーは通常幾つかの段階によって調製される。

【００４７】本発明の組成物にはオレフィンアクリレートおよびオレフィンジエンターポリマーのようなオレフィン含有コポリマーも耐衝撃性改良剤として使用できる。オレフィンアクリレートコポリマーの耐衝撃性改良剤の例はエチレンエチルアクリレートである。例えば、プロピレンとｎ－ブチルアクリレートのように、アルキルアクリレートとのコポリマーには他のより高級なオレフィンモノマーも使用することができる。オレフィンジエンターポリマーは当業界で周知されており、一般にＥＰＤＭ（エチレン・プロピレン・ジエン）種のターポリマーの類に入る。これらの組成物にはポリエチレン、アルファ－オレフィンとポリエチレンのコポリマーのようなポリオレフィンも使用される。ポリエステルを含有するブレンドの耐衝撃性の改良にはポリオレフィンとグリシジルアクリレートまたはメタクリレートとのコポリマーが特に有効である。

【００４８】スチレン含有ポリマーも耐衝撃性改良剤として使用することができる。このようなポリマーの例はアクリロニトリル－ブタジエン－スチレン（ＡＢＳ）、アクリロニトリル－ブタジエン－α－メチルスチレン、スチレン－ブタジエン、スチレン－ブタジエン－スチレン（ＳＢＳ）、スチレン－エチレン－ブチレン－スチレン（ＳＥＢＳ）、メタクリレート－ブタジエン－スチレン（ＭＢＳ）およびその他のハイインパクトスチレン含有ポリマーである。

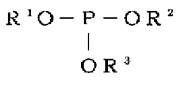
【００４９】更に、熱安定性、増大された密度、剛性およびテクスチャーのような追加の有益な特性を付与するために熱可塑性樹脂に無機充填剤を使用することも望まれることがある。代表的な無機の充填剤にはアルミナ、非晶質シリカ、アルミノ珪酸塩、マイカ、長石、粘土、タルク、ガラスフレーク、ガラス繊維、ガラスマイクロスフェアー、二酸化チタンのような金属酸化物、硫化亜鉛、粉砕石英、等が含まれる。好ましい無機充填剤は樹脂組成物から成形された物品にセラミック－様の感じを提供しうる。本発明の熱可塑性樹脂組成物に使用される好ましい無機充填剤には硫酸バリウムおよびガラス繊維が含まれる。

【００５０】本発明の成形組成物は組成物全体の重量に基づいて０乃至約６５重量％、好ましくは約１０乃至約５０重量％、最も好ましくは約１０乃至約４０重量％の無機充填剤成分を含むことができる。ガラス繊維が好ましい充填剤である。ポリエステル樹脂およびＰＥＣまたはポリカーボネート樹脂を含有する熱可塑性樹脂組成物においては、安定剤即ち抑制剤物質を使用することが好ましい。典型的には、このような安定剤は０．００１－１０重量％、好ましくは０．００５－２重量％の添加水準で使用される。好ましいこの安定剤には、有効量の、酸性燐酸塩、少なくとも１つの酸性水素を有する酸、アルキル、アリールまたは混成ホスファイト、周期律表第ＩＢおよびIIＢ族金属の燐酸塩、燐オクソ酸、金属酸ピロ燐酸塩またはこれらの混合物が含まれる。或る特定の化合物の安定剤として使用する適性および安定剤としてどの程度の量使用すべきかの決定は、ポリエステル樹脂成分、ＰＥＣおよび随意にはポリカーボネートにこの特定の化合物を添加するかあるいは添加せずに混合物を調製しそれから溶融粘度、ガスの発生、色の安定性または

インターポリマーの生成に対する効果を見ることによって容易に決めることができる。酸性燐酸塩には燐酸二水素ナトリウム、燐酸一亜鉛、燐酸水素カリウム、燐酸二水素カルシウム、等が含まれる。ホスファイトは次式

【００５１】

【化９】



【００５２】からなり得る。ここに、上記式中、R^1、R^2 およびR^3 は水素、アルキルおよびアリールからなる群から個々に選ばれ、但しR^1、R^2 およびR^3 の少なくとも１つは水素である。周期律表第ＩＢおよびＩＩＢ族金属の燐酸塩には燐酸亜鉛、燐酸銅等が含まれる。燐オクソ酸には亜燐酸、燐酸、ポリ燐酸または次亜燐酸が含まれる。

【００５３】ポリ酸ピロ燐酸塩は式

$M^z_x H_y P_n O_{3n+1}$

で表すことができ、ここに、上記式中、Ｍは金属であり、ｘは１－１２の範囲の数であり、ｙは１－１２の範囲の数であり、ｎは２－１０の数であり、ｚは１－５の数であり、そして（ｘｚ）＋ｙの和はｎ＋２に等しい。好ましいＭはアルカリ金属またはアルカリ土類金属である。

【００５４】好ましいブレンドの範囲は：

ポリアルキレンナフタノエート	１０－９０重量％
ＰＥＣ	９０－１０重量％
ＢＰＡ－ＰＣ	０－６０重量％
ゴム	０－２５重量％
ガラスまたは鉱物質	０－６０重量％
抑制剤即ち安定剤	０．００５－２．０重量％

【００５５】

【実施例】以下の実施例は本発明を例示しているが、本発明の範囲を限定するような意味はない。ＰＥＣおよびナフタノエートポリエステルからなり、或る実施例ではポリカーボネートも添加されているポリマーブレンドを１００ｒｐｍおよび略２５０－２６５℃の素材温度で動作されている３０ｍｍ二軸スクリュー押出機の使用により溶融混合して調製した。試験供試体の射出成形は２６０℃の溶融温度で完了され、金型温度は６５℃であった。成形前にペレットを１２５℃で２－４時間乾燥した。

【００５６】以下の表Ｉには本発明の実施例および参照材料を生成するために使用された原材料が記載されている。機械的諸特性の測定には、ＡＳＴＭ試験のＤ２５６（アイゾット衝撃強さ）、Ｄ６３８（引張強さおよび引張伸び）、Ｄ７９０（曲げ強さおよび曲げ弾性率）、Ｄ３７６３（Dynatup ブランドの計器を使用して試験した二軸またはインスツルメンテッド衝撃強さ）およびＤ６４８（熱変形温度）を使用した。延性－脆性変位温度（Ｄ／Ｂ温度）の測定は、異なる温度でノッチ付きアイゾット衝撃強さを測定しどの温度で破壊挙動が延性から脆性へ変化したかを測定して行った。Ｄ／Ｂ温度より低い温度では、破壊挙動は脆性で亀裂の伝播が比較的に小さなエネルギー吸収で起こるのに対して、Ｄ／Ｂ温度より高い温度では、材料は延性で亀裂の伝播が比較的に大きなエネルギー吸収で起こる。ガラス転位温度（Ｔｇ）を測定し、そしてし或る実験例においてはTakemori[Polym.Eng.Sci.,19(15),1104(1979)]の方法を使用してＨＤＴを推定するために１／８インチ厚の射出成形供試体に対して動的機械分析（ＤＭＡ）を行った。

【００５７】以下の表中への各記入は単一の実験を表すものである。従って、掲載された表中の各実施例に対し、押出条件、成形条件、試験条件等は同一であった。”Ｒ１”、”Ｒ２”等と表示された材料は参照材料であり、”Ｅ１”、”Ｅ２”等と表示された材料は本発明の実施例である。

表Ｉ：原材料の記述

原材料名		記述
ＰＢＴ	ポリブチレンテレフタレート	Ｍｗ＝１１０，０００*
		GE PlasticsからのVALOX 315
ＰＥＴ	ポリエチレンテレフタレート	ＩＶ＝１．００
		ICI Inc.からのMELINAR 5922C
ＰＢＮ	ポリブチレン－２，６－ナフタレート	ＩＶ＝１．００
ＰＥＮ	ポリエチレン－２，６－ナフタレート	ＩＶ＝１．６８
		ICI Inc.からのMELINAR X-61
ＰＣ－１	ビスフェノール－Ａポリカーボネート	Ｍｗ＝２３，３００
ＰＣ－２	ビスフェノール－Ａポリカーボネート	Ｍｗ＝３０，４００
ＰＣ－３	ビスフェノール－Ａポリカーボネート	Ｍｗ＝３６，０００
ＰＥＣ－１	ポリエステルカーボネート	Ｍｗ＝２８，０００

エステル８０％；イソ／テレ＝９３／７

ＰＥＣ－２　ポリエステルカーボネート　Ｍｗ＝２８，０００
エステル６０％；イソ／テレ＝５０／５０

ＭＢＳ　メチルメタクリレートーブタジエンースチレンコアーシェル耐衝撃性改良剤　Rohm and Haasからの商標名EXL2691

ＰＥＴＳ　ペンタエリトリットテトラステアレート

Irganox 1076　ヒンダードフェノール酸化防止剤　Cibaから市販のIrganox 1076

Seenox 412S　チオエステル酸化防止剤　Witcoにより市販のSeenox 412S

H_3PO_3　亜燐酸（H_3PO_3）の４５％水溶液

［脚註］＊＝ポリスチレン標準を使用してＧＰＣで計算された分子量。

【００５８】以下の表IIは耐衝撃性を改良されたＰＢＴ／ＰＣブレンド中のＢＰＡ－ＰＣをＴｇのより高いＰＥＣで置き換えると、ブレンドのＰＣまたはＰＥＣに富む相のＴｇ並びにＨＤＴを測定することによって示されるように熱的特性の実質的な低下が生ずることを示している（Ｒ１とＲ２およびＲ３を比較されたい）。対照的に、耐衝撃性を改良されたＰＢＮ／ＰＣブレンド中のＰＣをＰＥＣで置き換えると、ブレンドのＴｇ（ＰＣ／ＰＥＣに富む相のＴｇ）の上昇および６６ｐｓｉでのより高いＨＤＴが得られる。加えて、ＰＢＮ／ＰＣブレンド（Ｒ４）が望ましくない真珠層外観を呈しているのに対して、ＰＢＮ／ＰＥＣブレンド（Ｅ１およびＥ２）は驚くべきことに均質な外観を示した。それ故に、ＰＢＮ／ＰＥＣブレンドは類似のＰＢＴ／ＰＥＣブレンドに比較して著しく良好な熱的特性と、ＰＢＮ／ＰＣブレンドより著しく良好な外観を持つ。

【００５９】

表II：ＰＢＮ／ＰＥＣブレンドの特性

	Ｒ１	Ｒ２	Ｒ３	Ｒ４	Ｅ１	Ｅ２
原材料						
ＰＢＴ	42.40	42.40	42.40	----	----	----
ＰＢＮ	----	----	----	42.40	42.40	42.40
ＰＣ－１	45.87	----	----	45.87	----	----
ＰＥＣ－１	----	45.87	----	----	45.87	----
ＰＥＣ－２	----	----	45.87	----	----	45.87
ＭＢＳ	11.00	11.00	11.00	11.00	11.00	11.00
諸妄定剤*	0.73	0.73	0.73	0.73	0.73	0.73
諸特性						
Ｔｇ**（℃）	124	101	96	141	161	157
ＨＤＴ；264psi（℃）	83	63	62	106	101	100
ＨＤＴ；66psi（℃）	102	73	68	125	133	131
Ｄ／Ｂ温度（℃）	-40	-47	<-47	-40	-35	-43
降伏応力（psi）	7300	7200	7100	7400	8000	7900
破断時応力（psi）	7500	7500	7800	6900	9000	9100
引張伸び（％）	178	154	146	84	115	108

［脚註］＊＝ＰＥＴＳ：０．３０重量％；Irganox 1076：０．３０重量％；Seenox 412S：０．０５重量％；亜燐酸：０．０８重量％

＊＊＝ＰＣまたはＰＥＣに富む相のＴｇ。

【００６０】表III はＰＣをＰＢＮとブレンドすると（Ｒ６）良好な熱機械的特性（高いＨＤＴ）を有する物質が得られるが、この物質は望ましくない真珠層外観を呈している。ブレンドＥ３－Ｅ６のブレンドに対しては、ＰＣのＰＥＣによる置換量を増していくと、物質の外観が益々改善され、一方良好な熱機械的特性および衝撃特性が維持される。驚くべきことに、Ｅ３－Ｅ６の熱機械的特性はＲ６とＥ７の特性の間でＰＥＣ含有分と共に線形的に変化することはなかった。Ｅ３－Ｅ６はＥ７より顕著に良好な熱機械的特性を持っていた。加えて、Ｅ３－Ｅ６の外観はＲ６より良く、その改善の度合いはＰＥＣ含有分の増加に伴って増大している。Ｅ４およびＥ５に対しては真珠層外観は辛うじて検出できる程度であるが、Ｅ６およびＥ７に対しては真珠層外観は観察されなかった。

【００６１】

表III：ＰＢＮ／ＰＣ／ＰＥＣ三元ブレンド

Ｒ５	Ｒ６	Ｅ３	Ｅ４	Ｅ５	Ｅ６	Ｅ７

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原材料							
ＰＢＴ	39.30	----	----	----	----	----	----
ＰＢＮ	----	39.30	39.30	39.30	39.30	39.30	39.30
ＰＣ－２	46.20	46.20	34.65	23.10	23.10	11.55	----
ＰＥＣ－２	----	----	11.55	23.10	----	34.65	46.2
ＰＥＣ－１	----	----	----	----	23.10	----	----
ＭＢＳ	14.00	14.00	14.00	14.00	14.00	14.00	14.00
諸安定剤*	0.50	0.50	0.50	0.50	0.50	0.50	0.50
諸特性							
Ｔｇ**（℃）	142	150	154	157	163	162	157
推定HDT;264psi(℃)*	94	118	111	109	109	108	104
推定HDT;66psi(℃)**	136	150	152	155	157	154	141
Ｄ／Ｂ温度（℃）	-60	-60	<-60	-60	-55	-55	-50
Dynatup -50℃最大負荷(ft.lb)	42	47	44	42	49	38	40
Dynatup -50℃合計(ft.lb.)	52	50	46	44	51	41	42
引張強さ（psi）	6300	6400	6100	6500	6200	6200	6500
引張伸び（％）	96	72	54	71	62	62	63
曲げ強さ(psi)	10300	9700	9700	10000	9900	10000	10200
曲げ弾性率(psi)	230300	211100	207300	212100	204800	190000	182600

［脚註］＊＝３℃／分の加熱速度を使用して動的機械分析から測定された貯蔵弾性率が$10^{8.9}$パスカルであるときの温度。

【００６２】

＊＊＝３℃／分の加熱速度を使用して動的機械分析から測定された貯蔵弾性率が$10^{8.3}$パスカルであるときの温度。

表IVはＰＥＮ／ＰＥＣ－１ブレンド（Ｅ８）がＰＥＮ／ＰＣブレンド（Ｒ７）より高いＨＤＴを有することを示している。加えて、ＰＥＮ／ＰＥＣ－１ブレンドの外観はＰＥＮ／ＰＣブレンドよりづっと良い。ＰＥＮ／ＰＣブレンドは真珠層外観を有しているが、ＰＥＮ／ＰＥＣ－１ブレンドは均質な非真珠層外観を有している。

【００６３】

表IV：ＰＥＮ／ＰＥＣ－１ブレンド

	Ｒ７	Ｅ８
原材料		
ＰＥＮ	42.40	42.40
ＰＣ－２	45.87	---
ＰＥＣ－１	---	45.87
ＭＢＳ	11.00	11.00
諸安定剤*	0.73	0.73
諸特性		
HDT;66psi(℃)	128	141
HDT;264psi(℃)	107	123
引張強さ（psi）	6800	6800
引張伸び（％）	40	16
曲げ弾性率(psi)	257000	248500
曲げ強さ(psi)	11600	11900

［脚註］＊＝表IIにおけると同じ。

【００６４】表ＶはＥ９がＲ８より高いＨＤＴ、引張強さ、曲げ弾性率および曲げ強さを有することを示している。

表Ｖ：ＰＥＮ／ＰＣ／ＰＥＣ－１三元ブレンド

	Ｒ８	Ｅ９

原材料		
ＰＥＴ	48.40	---
ＰＥＮ	---	48.40
ＰＣ－３	22.94	22.94
ＰＥＣ－１	22.94	22.94
ＭＢＳ	11.00	11.00
諸安定剤*	0.73	0.73
諸特性		
HDT;66psi(℃)	122	133
HDT;264psi(℃)	77	109
引張強さ（psi）	5400	6700
引張伸び（％）	32	24
曲げ弾性率(psi)	246100	258300
曲げ強さ(psi)	10400	11700

［脚註］＊＝表IIにおけると同じ。

フロントページの続き

(51)Int.Cl.[6]	識別記号	ＦＩ
（Ｃ０８Ｌ　67/02 51:04）		
（Ｃ０８Ｌ　67/02 69:00）		

【外国語明細書】

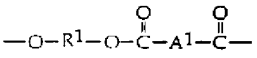
1. Title of Invention

Polyester Molding Composition

2. Claims

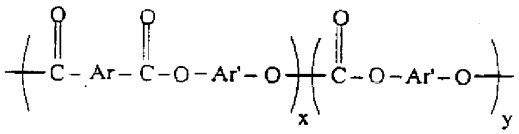
1. A thermoplastic resin composition comprising:

a) about 90 to about 10 weight percent of an alkylene polyester napthanoate containing recurring units of the formula I:



wherein each R^1 is independently a divalent aliphatic hydrocarbon, alicyclic hydrocarbon, , polyoxyalkylene radical, or mixtures thereof and each A^1 is independently a divalent napthalene radical, or mixtures thereof;

b) about 10 to about 90 weight percent of an essentially amorphous polymer containing recurring units of the formula II:



wherein Ar is divalent aromatic residue of a dicarboxylic acid or mixture of dicarboxylic acids and Ar' is the divalent aromatic residue of a dihydric phenol or mixture of dihydric phenols; and

c) a quencher selected from the group consisting of phosphites having an acidic OH group, acidic phosphate salts, polyacid pyrophosphates and acidic salts thereof, phosphates of Group IB and Group IIB metals, and phosphorus oxo-acids.

2. A thermoplastic resin composition of claim 1 wherein said composition further comprises a polycarbonate resin having recurring units of formula II where x = 0.

3. A thermoplastic resin composition of claim 1 wherein Ar' of formula II is derived from the aromatic residue of bisphenol A as the dihydric phenol component.

4. A thermoplastic resin composition of claim 1 wherein Ar of formula II is derived from the aromatic residue of isophthalic acid , terephthalic acid or a mixture thereof.

5. A thermoplastic resin composition of claim 1 wherein the polyester napthanoate of formula I is a polyalkylene napthanoate wherein A^1 is the residue from a diacid component 2,6-napthanoic acid and derivatives thereof and R^1 is the residue from a diol component selected from the group consisting essentially of ethylene glycol, propanediol, butanediol, or cyclohexanedimethanol, and derivatives thereof.

6. A thermoplastic resin composition of claim 1 wherein said composition further comprises a rubbery impact modifier and wherein said impact modifier is a graft copolymer comprising a rubbery substrate and a rigid polymeric graft or shell.

7. A thermoplastic resin composition of claim 6 wherein said graft copolymer is selected from methylmethacrylate-butadiene-styrene graft copolymers and acrylonitrile-butadiene-stryene graft copolymers.

8. A thermoplastic resin composition of claim 1 wherein polyester naphthanoate of formula I comprises from about 10 to about 90 percent, the amorphous PEC resin of formula II comprises from about 90 to about 10 percent by weight, said amorphous PEC thermoplastic resin including from 0 to about 60 percent by weight polycarbonate, from 0 to about 25 percent by weight of a rubbery impact modifier, from 0 to about 60 percent by weight of a glass or mineral filler material, and from about 0.005 to about 2.0 weight percent of a quencher.

9. A thermoplastic resin composition of claim 1 wherein polyester naphthanoate of formula I comprises from about 20 to about 60 percent and the amorphous PEC resin of formula II comprises from about 20 to about 60 percent by weight wherein said weight percent is based on the total weight of said thermoplastic resin.

10. A thermoplastic resin composition of claim 3 wherein said composition comprises from about 10 to about 40 percent by weight of a polycarbonate resin having recurring units of formula II where x = 0.

3. Detailed Description of Invention

Field of the Invention

The invention relates to blends of polyester resin.

BACKGROUND OF THE INVENTION

Polycarbonate (PC) blends with aromatic crystalline polyesters are well known and are useful for their combination of processability, solvent resistance and impact strength. In most cases these blends also give good, uniform surface appearance. The thermal properties of these blends, especially under load, is a function of the glass transition temperature (Tg) of the polycarbonate-rich phase. To the extent that the polycarbonate is partially miscible with the polyester, the PC Tg of the blend will be reduced relative to pure PC [ref. *J. Applied Polymer Sci.* 48, 2249 (1993)]. This will cause a drop in thermal properties like Heat Distortion Under Load (HDT).

If one tries to address the drop in blend Tg by use of a higher Tg polycarbonate resin there may still be problems. Polyarylates and the related polyester carbonate (PEC) resins are known to have some of the properties of polycarbonate with higher Tgs (see US 4,430,484). However, when these polyarylates or polyester carbonates are mixed with standard alkyl terephthalate base polyesters, like polybutylene terephthalate (PBT), there is little if any gain in HDT vs. the standard, lower Tg PC blends. The higher Tg polyester carbonates and polyarylates are more miscible with the alkyl terephthalate resins and the resultant Tg of the blend is about the same or lower than an analogous PC-alkyl terephthalate blend.

Another way to try to address the loss of thermal properties in polyester-polycarbonate blends is to use a crystalline polyester that has a higher Tg than the standard polyalkylene terephthalates, polyethylene terephthalate (PET) and PBT PC [ref. Research Disclosure, Nov. 1987, p667-669]. Higher Tg crystalline polyesters have recently become commercially available as alkyl naphthanoate polyester resins like polyethylene naphthanoate (PEN) or polybutylene naphthanoate (PBN). Unfortunately, these naphthanoate polyester resins when blended with polycarbonate give molded parts with poor appearance showing a poorly dispersed, non uniform, pearlescent surface.

Thus, PC-polyester blends with higher heat capability and good appearance and good mechanical properties are difficult to achieve. Hence, it is desired to have a polycarbonate/polyester blend with a combination of properties including increased Tg, high impact strength, higher Heat Distortion Temperature (HDT) as well as uniform appearance .

SUMMARY OF THE INVENTION

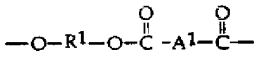
It is well known to those skilled in the art, that the area of modification of the physical properties of a polymer by the addition of various additives or other polymers thereto is largely an empirical art rather than a predictable science with little, if any, predictability on the effects a particular additive will have in a particular polymer. Surprisingly, we have found that blending the alkyl naphthanoate polyesters with polyester carbonates give blends which solve the issues of appearance and lower Tg. Instead of getting the expected low Tg blend with poor appearance, the polyalkylene naphthanoate with polyester carbonate resin gives blends with a fine dispersion and excellent appearance. In addition, the blends show reduced miscibility compared to a standard alkyl terephthalate polyester-polyester carbonate blends and have higher Tgs with improved thermal properties, such as HDT.

This specific combination of polyester carbonate or polyarylate resins with polyalkylene naphthanoate polyesters solves both the problems of appearance and thermal properties while still maintaining the benefits of solvent resistance, processability, stiffness and impact strength.

It is also important to prevent reaction between the polynaphthanoates and polyester carbonates/ polyarylates during melt processing, since such reaction will lead to copolymer formation and a degradation of thermal properties, as well as the creation of color and undesirable processing effects such as gas generation. Use of specific acidic phosphorus species is desirable to prevent melt reaction of the blended polymers.

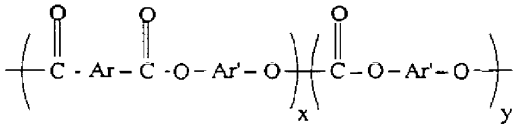
In accordance with the present invention, there is provided a thermoplastic resin having enhanced combination of properties including increased glass transition, higher Heat Distortion Temperature (HDT) as well as uniform appearance and good melt stability compromising:

a) about 90 to about 10 weight percent of a polyester napthanoate containing recurring units of the formula I:



wherein each R^1 is independently a divalent aliphatic hydrocarbon, alicyclic hydrocarbon, polyoxyalkylene radical, or mixtures thereof and each A^1 is independently a divalent napthalene radical, or mixtures thereof;

b) about 10 to about 90 weight percent of an essentially amorphous polymer containing recurring units of the formula II:



wherein Ar is divalent aromatic residue of a dicarboxylic acid or mixture of dicarboxylic acids and Ar' is the divalent aromatic residue of a dihydric phenol or mixture of dihydric phenols; and

c) a quencher selected from the group consisting of phosphites having at least one acidic hydrogen, acidic phosphate salts, polyacid pyrophosphates and acidic salts thereof, phosphates of Group IB and Group IIB metals, and phosphorus oxo-acids.

It has further been found that when a portion of standard aromatic polycarbonate (Formula II where x = 0) is added to the polyester carbonate-alkyl naphthanoate polyester blends that thermal properties are enhanced beyond that of either amorphous resin added to the naphthanoate polyester by itself.

In addition, by virtue of the polyester carbonate/polyarylate resins, which photo react to produce a UV stable material (ref. *J Polymer Sci. Part A-1*, 9, 3263, 1971) these blends will also be expected to have improved retention of properties on outdoor aging vs. standard polycarbonate alkyl terephthalate blends.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The poly(ester-carbonate) resins, also commonly referred to as copolyester-polycarbonate resins, are copolymers of aromatic diphenols reacted with dicarboxylic acids and carbonic acid or their derivatives. A closely related resin family are commonly referred to as polyarylate resins where the carbonate linkages are absent producing an amorphous aromatic polyester derived from diphenols and aromatic diacids, or derivatives thereof. Both of these resin families will hereinafter be referred to as "PEC" used in the blends of the present invention. These polymers may be prepared by a variety of methods, for example by either melt polymerization or by interfacial polymerization. A discussion of Polyarylate resins and their

synthesis is contained in chapter 10 p255-281 of *"Engineering Thermoplastics Properties and Applications"* edited by James M. Margolis, published by Marcel Dekker Inc. 1985

Melt polymerization methods to make PEC resins may involve co-reacting, for example, various mixtures of dihydric phenols and ester precursors such as, for example, diphenyl derivatives of iso- and terephthalates, and their mixtures. Diphenyl carbonate may be introduced to prepare polyester carbonate copolymers. Various catalysts or mixtures of catalysts such as, for example, lithium hydroxide and lithium stearate can also be used to accelerate the polymerization reactions.

In general, the method of interfacial polymerization comprises the reaction of a dihydric phenol with diacid or derivative ester precursor and optionally a carbonate precursor, in a two phase system with catalyst and often an acid acceptor when the dicarboxylic acid and carbonate precursors are diacid halides. Examples of interfacial polymerization techniques can be found in U.S. Patent Nos. 3,169,121 and 4,487,896 which are incorporated herein by reference.

Although the reaction conditions of the preparative processes may vary, several of the preferred processes typically involve dissolving or dispersing dihydric phenol reactants in aqueous caustic, combining the resulting mixture with a suitable water immiscible solvent medium and contacting the reactants with the carbonate precursor, such as, for example, phosgene, and diacids or derivatives, such as diacid chlorides, in the presence of a suitable catalyst and under controlled pH conditions. The most commonly used water immiscible solvents include methylene chloride, 1,2-dichloroethane, chlorobenzene, toluene, and the like.

Advantageously a catalyst may be added to the reaction mixture to promote the reaction. The catalyst typically accelerates the rate of

polymerization of the dihydric phenol reactants with the carbonate/ester precursors. Representative catalysts include but are not limited to, for example, tertiary amines such as triethylamine, quaternary phosphonium compounds, quaternary ammonium compounds, and the like.

The preferred process for preparing polyester carbonate copolymers comprises a phosgenation reaction. The temperature at which the phosgenation reaction proceeds may vary from below about 0°C to about 100°C. The phosgenation reaction preferably proceeds at temperatures of from about room temperatures (about 23°C) to about 50°C. Since the reaction is exothermic, the rate of phosgene addition may be used to control the reaction temperature.

The dihydric phenols employed are known, and the reactive groups are thought to be the phenolic hydroxyl groups. Typical of some of the dihydric phenols employed are bis-phenols such as (4-hydroxy-phenyl)methane, 2,2-bis(4-hydroxyphenyl)propane (also known as bisphenol-A), 2,2-bis(4-hydroxy-3,5-dibromo-phenyl)propane; dihydric phenol ethers such as bis(4-hydroxyphenyl)ether, bis(3,5-dichloro-4-hydroxyphenyl)ether; p,p'-dihydroxydiphenyl and 3,3'-dichloro-4,4'-dihydroxydiphenyl; dihydroxyaryl sulfones such as bis(4-hydroxyphenyl)sulfone, bis(3,5-dimethyl-4-hydroxyphenyl)sulfone, dihydroxy benzenes such as resorcinol, hydroquinone, halo- and alkyl-substituted dihydroxybenzenes such as 1,4-dihydroxy-2,5-dichlorobenzene, 1,4-dihydroxy-3-methylbenzene; and dihydroxydiphenyl sulfides and sulfoxides such as bis(4-hydroxyphenyl)sulfide, bis(4-hydroxy-phenyl)sulfoxide and bis(3,5-dibromo-4-hydroxy-phenyl)sulfoxide. A variety of additional dihydric phenols are available and are disclosed in U. S. Patent Nos. 2,999,835, 3,028,365 and 3,153,008; all of which are incorporated herein by reference. It is, of course,

possible to employ two or more different dihydric phenols or a combination of a dihydric phenol with a glycol.

The carbonate precursors are typically a carbonyl halide, a diarylcarbonate, or a bishaloformate. The carbonyl halides include, for example, carbonyl bromide, carbonyl chloride, and mixtures thereof. The bishaloformates include the bishaloformates of dihydric phenols such as bischloroformates of 2,2-bis(4-hydroxy-3,5-dichlorophenyl)-propane, hydroquinone, and the like, or bishaloformates of glycol, and the like. While all of the above carbonate precursors are useful, carbonyl chloride, also known as phosgene, is preferred.

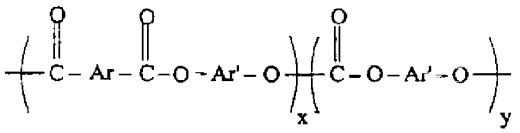
In general, any dicarboxylic acid conventionally used in the preparation of polyesters may be utilized in the preparation of poly(ester-carbonate) resins. However, the PEC used in the present invention are prepared with aromatic dicarboxylic acids, and in particular terephthalic acid, and mixtures thereof with isophthalic acid.

Rather than utilizing the dicarboxylic acid per se, it is possible, and sometimes even preferred, to employ various derivatives of the acid moiety. Illustrative of these reactive derivatives are the acid halides. The preferred acid halides are the acid dichlorides and the acid dibromides. Thus, for example instead of using terephthalic acid or mixtures thereof with isophthalic acid, it is possible to employ terephthaloyl dichloride, and mixtures thereof with isophthaloyl dichloride

In the conventional interfacial polymerization methods of preparing PEC, polycarbonates and polyarylates, a molecular weight regulator (a chain stopper) is generally added to the reaction mixture prior to or during the polymerization reactions with carbonate and/or ester precursors. Useful molecular weight regulators include, for example, monohydric phenols such as phenol, chroman-I, para-t-butylphenol, p-cumylphenol and the like.

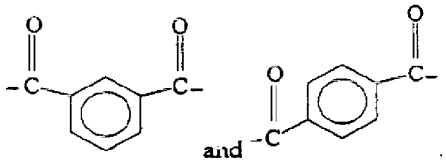
The proportions of reactants employed to prepare the PEC will vary in accordance with the proposed use of the blends of the invention containing this product resin. In general, the amount of the combined ester units may be from about 20% by weight to about 100% by weight, relative to the carbonate units, preferably about 40% to about 90% by weight relative to the carbonate units.

The preferred "PEC" used as an ingredient in the blends of the present invention preferably has a ester/carbonate units of formula II :

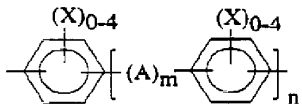


wherein Ar is divalent aromatic residue of a dicarboxylic acid or dicarboxylic acid mixture and Ar' is the divalent aromatic residue of a dihydric phenol or mixture of dihydric phenols.

Ar is an aryl group and most preferably the residue from iso- and terephthalate or mixtures thereof and has the formula



The divalent residue of dihydric phenols, Ar ' may be represented by the general formula:



wherein A is a divalent hydrocarbon radical containing from 1 to about 15 carbon atoms or a substituted divalent hydrocarbon radical containing

from 1 to about 15 carbon atoms and substituent groups such as halogen; -S- ; -$S(O)_2$- or -O-; each X is independently selected from the group consisting of hydrogen, halogen, and a monovalent hydrocarbon radical such as an alkyl group of from 1 to about 8 carbon atoms, an aryl group of from 6 to about 18 carbon atoms, an aralkyl group of from 7 to about 14 carbon atoms, an alkoxy group of from 1 to about 8 carbon atoms; and m is 0 or 1 and n is an integer of from 0 to about 5. Ar' may be a single aromatic ring like hydroquinone or resorcinol, or a multiple aromatic ring like biphenol or bisphenol A.

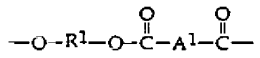
In the preferred "PEC" resin of formula II, y, the carbonate content, is from 0 to about 80 and preferably from 5 to about 70 and x, the aromatic esters content, is about 20 to about 100 and preferably from about 30 to about 95. More preferably x is from 50 to about 95. In formula II x and y represent the respective weights of carbonate units and aromatic ester units based on 100 parts total weight. When y is 0, the carbonate linkages are absent and the polyester resin is known as a polyarylate.

In general, any dicarboxylic acid conventionally used in the preparation of polyesters may be utilized in the preparation of poly(estercarbonate) resins. However, the PEC used in the present invention are prepared with aromatic dicarboxylic acids, and in particular terephthalic acid, and mixtures thereof with isophthalic acid wherein the weight ratio of terephthalic acid to isophthalic acid is in the range of from about 5:95 to about 95:5

The preferred PEC for use as the ingredient (b) in the blends of the present invention are those derived from reaction of bisphenol-A and phosgene with iso- and terephthaloyl chloride and having an intrinsic viscosity of about 0.5 to about 0.65 deciliters per gram (measured in methylene chloride at a temperature of 25°C).

Blends of different polyarylates and polyestercarbonates may also be used in these compositions.

Polyester naphthanoates used for preparing the present compositions include those comprising structural units of the formula I:



wherein each R^1 is independently a divalent aliphatic hydrocarbon, alicyclic hydrocarbon, polyoxyalkylene radical, or mixtures thereof and each A^1 is independently a divalent napthalene radical, or mixtures thereof. Examples of suitable polyesters containing the structure of formula I are poly(alkylene naphthanoates), elastomeric polyesters, liquid crystalline polyesters, and polyester copolymers. It is also possible to use a branched polyester in which a branching agent, for example, a glycol having three or more hydroxyl groups or a trifunctional or multifunctional carboxylic acid has been incorporated. Treatment of the polyester with a trifunctional or multifunctional epoxy compound, for example, triglycidyl isocyanurate can also be used to make a branched polyester. Furthermore, it is sometimes desirable to have various concentrations of acid and hydroxyl end groups on the polyester, depending on the ultimate end-use of the composition.

In some instances, it is desirable to reduce the number of acid end groups, typically to less than about 30 micro equivalents per gram, with the use of acid reactive species. In other instances, it is desirable that the polyester has a relatively high carboxylic end group concentration, e.g., about 5-250 micro equivalents per gram or, more preferable, about 20-70 micro equivalents per gram

The R^1 radical may be, for example, a C_{2-10} alkylene radical, a C_{6-10} alicyclic radical, or a polyoxyalkylene radical in which the alkylene groups

contain about 2-6 and most often 2 or 4 carbon atoms. The A^1 radical in the above formula is most often a 1,4- or 2,6-naphthylene.

The poly(alkylene naphthanoates), for example, poly(ethylene naphthanoate), poly(cyclohexyldimethylene naphthanoate), poly(propylene naphthanoate) and poly(butylene naphthanoate) are the preferred polyesters for the present invention, with poly(ethylene naphthanoate) and poly (butylene naphthanoate) being the most preferred members. Various mixtures of the above poly(alkylene naphthanoates) may also be suitable.

Because of the tendency of polyesters to undergo hydrolytic degradation at the high extrusion and molding temperatures encountered by the compositions of this invention, it is preferred that the polyester be substantially free of water. The polyester may be predried before admixing with the other ingredients. More commonly, the polyester is used without predrying and the volatile materials are removed through the use of vacuum venting the extruder.

The polyesters generally have number average molecular weights in the range of about 20,000-100,000, as determined by gel permeation chromatography.

As previously mentioned, it has further been found that when a portion of standard aromatic polycarbonate is added to the polyester carbonate-alkyl naphthanoate polyester blends that thermal properties are further enhanced.

According to a preferred embodiment, it is desirable to include polycarbonate as an additional component with the above mentioned blend of poly(ester carbonate) and polyester naphthanoate. Polycarbonate resins useful in preparing the blends of the present invention are generally aromatic polycarbonate resins.

Typically these are prepared by reacting a dihydric phenol with a carbonate precursor, such as phosgene, a haloformate or a carbonate ester. Generally speaking, such carbonate polymers may be typified as possessing recurring structural units of formula II where the ester content, x, is zero. Ar' is a divalent aromatic radical of the dihydric phenol as previously discussed which is employed in the polymer producing reaction.

These aromatic polycarbonates can be manufactured by known processes, such as, for example and as mentioned above, by reacting a dihydric phenol with a carbonate precursor, such as phosgene, in accordance with methods set forth in the above-cited literature and in U.S. Pat. No. 4,123,436, or by transesterification processes such as are disclosed in U.S. Pat. No. 3,153,008, as well as other processes known to those skilled in the art.

It is also possible to employ two or more different dihydric phenols or a copolymer of a dihydric phenol with a glycol or with a hydroxy- or acid-terminated polyester or with a dibasic acid or hydroxy acid in the event a carbonate copolymer or interpolymer rather than a homopolymer is desired for use in the preparation of the polycarbonate mixtures of the invention. Branched polycarbonates are also useful, such as are described in U.S. Pat. No. 4,001,184. Also, there can be utilized blends of linear polycarbonate and branched polycarbonate. Moreover, blends of any of the above materials may be employed in the practice of this invention to provide the aromatic polycarbonate.

In any event, the preferred aromatic carbonate for use in the practice in the present invention is a homopolymer, e.g., a homopolymer derived from 2,2-bis(4-hydroxyphenyl)propane (bisphenol-A) and phosgene, commercially available under the trade designation LEXAN Registered TM from General Electric Company.

The instant polycarbonates are preferably high molecular weight aromatic carbonate polymers having an intrinsic viscosity, as determined in chloroform at 25° C of from about 0.3 to about 1.5 dl/gm, preferably from about 0.45 to about 1.0 dl/gm. These polycarbonates may be branched or unbranched and generally will have a weight average molecular weight of from about 10,000 to about 200,000, preferably from about 20,000 to about 100,000 as measured by gel permeation chromatography.

All types of polycarbonate end groups are contemplated as being within the scope of the present invention.

The composition of the present invention may include additional components which do not interfere with the previously mentioned desirable properties. The composition may optionally contain impact modifiers such as a rubbery impact modifier. Preferably such impact modifiers are utilized in an amount less than about 30, and preferably less than about 20 percent, more preferably less than about 15 percent by weight based on the total weight of the composition. Typical impact modifiers are derived from one or more monomers selected from the group consisting of olefins, vinyl aromatic monomers, acrylic and alkylacrylic acids and their ester derivatives as well as conjugated dienes. Especially preferred impact modifiers are the rubbery high-molecular weight materials including natural and synthetic polymeric materials showing elasticity at room temperature. They include both homopolymers and copolymers, including random, block, radial block, graft and core-shell copolymers as well as combinations thereof. Suitable modifiers include core-shell polymers built up from a rubber-like core on which one or more shells have been grafted. The core typically consists substantially of an acrylate rubber or a butadiene rubber. One or more shells typically are grafted on the core. The shell preferably comprises a vinylaromatic compound and/or a vinylcyanide and/or an alkyl(meth)acrylate. The core

and/or the shell(s) often comprise multi-functional compounds which may act as a cross-linking agent and/or as a grafting agent. These polymers are usually prepared in several stages.

Olefin containing copolymers such as olefin acrylates and olefin diene terpolymers can also be used as impact modifiers in the present compositions. An example of an olefin acrylate copolymer impact modifier is ethylene ethylacrylate. Other higher olefin monomers can be employed in copolymers with alkyl acrylates, for example, propylene and n-butyl acrylate. The olefin diene terpolymers are well known in the art and generally fall into the EPDM (ethylene propylene diene) family of terpolymers. Polyolefins such as polyethylene, polyethylene copolymers with alpha olefins are also of use in these compositions. Polyolefin copolymers with gylcidyl acrylates or methacrylates may be especially effective in the impact modification of polyester containing blends.

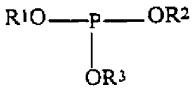
Styrene-containing polymers can also be used as impact modifiers. Examples of such polymers are acrylonitrile-butadiene-styrene (ABS), acrylonitrile-butadiene-alpha-methylstyrene, styrene butadiene, styrene butadiene styrene (SBS), styrene ethylene butylene styrene (SEBS), methacrylate-butadiene-styrene (MBS), and other high impact styrene-containing polymers.

Additionally, it may be desired to employ an inorganic filler to the thermoplastic resin to impart additional beneficial properties such as thermal stability, increased density, stiffness and texture. Typical inorganic fillers include: alumina, amorphous silica, alumino silicates, mica, feldspar, clays, talc, glass flake, glass fibers, glass microspheres, metal oxides such as titanium dioxide, zinc sulfide, ground quartz, and the like. Preferred inorganic fillers may provide a ceramic-like feel to articles formed from the resin composition.

Preferred inorganic fillers which are employed in the present thermoplastic compositions include: barium sulfate and fiberglass.

The molding compositions may include from 0 to about 65% by weight, preferably from about 10 to about 50% by weight or most preferably from about 10 to about 40% by weight of total composition of an inorganic filler component. Fiber glass is the preferred filler.

In the thermoplastic compositions which contain a polyester resin and a PEC or polycarbonate resin, it is preferable to use a stabilizer or quencher material. Typically, such stabilizers are used at a level of 0.001-10 weight percent and preferably at a level of from 0.005-2 weight percent. The preferred stabilizers include an effective amount of an acidic phosphate salt; an acid, alkyl, aryl or mixed phosphite having at least one acidic hydrogen; a Group IB or Group IIB metal phosphate salt; a phosphorus oxo acid, a metal acid pyrophosphate or a mixture thereof. The suitability of a particular compound for use as a stabilizer and the determination of how much is to be used as a stabilizer may be readily determined by preparing a mixture of the polyester resin component, the PEC and optionally polycarbonate with and without the particular compound and determining the effect on melt viscosity, gas generation or color stability or the formation of interpolymer. The acidic phosphate salts include sodium dihydrogen phosphate, mono zinc phosphate, potassium hydrogen phosphate, calcium dihydrogen phosphate and the like. The phosphites may be of the formula:



where R1, R2 and R3 are independently selected from the group consisting of hydrogen, alkyl and aryl with the proviso that at least one of R1, R2 and R3 is hydrogen.

The phosphate salts of a Group IB or Group IIB metal include zinc phosphate, copper phosphate and the like. The phosphorus oxo acids include phosphorous acid, phosphoric acid, polyphosphoric acid or hypophosphorous acid.

The polyacid pyrophosphates may be of the formula:

$M^z_xH_yP_nO_{3n+1}$

wherein M is a metal, x is a number ranging from 1 to 12 and y is a number ranging 1 to 12, n is a number from 2 to 10, z is a number from 1 to 5 and the sum of (xz) + y is equal to n + 2. The preferred M is an alkaline or alkaline earth metal.

The preferred blend range is:

Polyalkylene Naphthanoate	10-90 wt. %
PEC	90-10 wt. %
BPA-PC	0-60 wt. %
Rubber	0-25 wt. %
Glass or Mineral	0-60 wt. %
Quencher/Stabilizer	0.005-2.0 wt. %

EXAMPLES

The following examples illustrate the present invention, but are not meant to be limitations to the scope thereof.

Polymer blends constituting PEC and polyester napthanoate, and in some examples additions of polycarbonate were included, were prepared by melt mixing using a 30 mm twin screw extruder operating at 100 rpm and stock temperature of approximately 250° C. to 265° C. Injection molding of test specimens was completed at 260°C. melt temperature and mold temperature was 65° C. Pellets were dried for 2-4 h at 125 °C prior to molding.

Table I describes the raw materials used to produce the examples of the invention and reference materials.

Mechanical properties were measured using ASTM tests D256 (Izod impact), D638 (Tensile strength and elongation), D790 (Flexural strength and modulus), D3763 (biaxial or instrumented impact run using a Dynatup brand instrument) and D648 (heat distortion temperature). Ductile-brittle transition temperature (D/B temperature) was determined by measuring notched-Izod impact at different temperatures and determining at which temperature the fracture behavior changes from ductile to brittle. At temperatures below the D/B temperature, fracture behavior is brittle and crack propagation occurs with relatively little energy absorption, while at temperatures above the D/B temperature, the material is ductile and crack propagation occurs with relatively large energy absorption. Dynamic mechanical analysis (DMA) on 1/8 in. thick injection molded specimens was used to determine glass transition temperatures (Tgs) and, for some examples, to estimate HDT using the method of Takemori [*Polym. Eng. Sci.*, 19(15), 1104 (1979)]

Each entry in the tables to follow represents a single experiment. Thus, for each example in a given table, the extrusion conditions, molding conditions, testing conditions, etc. were identical. The materials designated "R1", "R2", etc. are reference materials while materials designated "E1", "E2", etc. are examples of the invention.

Table I. Description of raw materials

Raw Material ID	Description
PBT	polybutylene terephthalate Mw=110,000*, VALOX 315 from GE Plastics
PET	polyethylene terephthalate IV=1.00, MELINAR 5922C from ICI Inc.
PBN	polybutylene-2,6-napthalate IV=1.00
PEN	polyethylene-2,6-napthalate IV=1.68, MELINAR X-61 from ICI Inc.
PC-1	bisphenol-A polycarbonate Mw=23,300
PC-2	bisphenol-A polycarbonate Mw=30,400
PC-3	bisphenol-A polycarbonate Mw=36,000
PEC-1	polyestercarbonate Mw=28,000, 80% ester, iso/tere 93/7
PEC-2	polyestercarbonate Mw=28,000, 60% ester, iso/tere 50/50
MBS	methylmethacrylate-butadiene-styrene core shell impact modifier sold by Rohm and Haas under the tradename EXL2691
PETS	pentaerythritol tetrastearate
Irganox 1076	Hindered phenol antioxidant sold by Ciba as Irganox 1076
Seenox 412S	Thioester antioxidant sold by Witco as Seenox 412S
H3PO3	45% aqueous solution of phosphorous acid (H3PO3)

* Molecular weight by GPC Calculated using polystyrene standards.

Table II shows that replacement of BPA-PC in an impact modified PBT/PC blend by a higher Tg PEC results in a substantial drop in thermal properties as indicating by measuring the Tg of the PC or PEC-rich phase of the blends and the HDT (compare R1 to R2 and R3). In contrast, replacement of PC in an impact modified PBN/PC blend by PEC results in an increase in the blend Tg (Tg of the PC/PEC-rich phase) and a higher HDT at 66 psi. In addition, while the PBN/PC blend (R4) possesses an undesirable, pearlescent appearance, the PBN/PEC blends (E1 and E2), surprisingly, show a uniform appearance. Thus, PBN/PEC blends possess significantly better thermal properties as compared to analogous PBT/PEC blends and significantly better appearance than PBN/PC blends.

Table II. PBN/PEC blend properties.

Raw Mtrls	R1	R2	R3	R4	E1	E2
PBT	42.40	42.40	42.40	----	----	----
PBN	----	----	----	42.40	42.40	42.40
PC-1	45.87	----	----	45.87	----	----
PEC-1	----	45.87	----	----	45.87	----
PEC-2	----	----	45.87	----	----	45.87
MBS	11.00	11.00	11.00	11.00	11.00	11.00
Stabilizers*	0.73	0.73	0.73	0.73	0.73	0.73
Properties						
Tg**(°C)	124	101	96	141	161	157
HDT @ 264 psi (°C)	83	63	62	106	101	100
HDT @ 66 psi (°C)	102	73	68	125	133	131
D/B temperature (°C)	-40	-47	< -47	-40	-35	-43
Stress @ yield (psi)	7300	7200	7100	7400	8000	7900
Stress @ break (psi)	7500	7500	7800	6900	9000	9100
Tensile Elongation (%)	178	154	146	84	115	108

*0.30 wt. % PETS, 0.30 wt. % Irganox 1076, 0.05 wt. % Seenox 412S, 0.08 wt. % phosphorous acid **Tg of PC or PEC-rich phase.

Table III shows that blending PC with PBN (R6) results in a material with good thermo-mechanical properties (high HDT), but the material has an undesirable pearlescent appearance. For blends E3 - E6, displacing an increasing amount of PC by PEC results in an increasing improvement in the appearance of the material while with the good thermo-mechanical properties and impact properties being maintained. It is surprising that the thermo-mechanical properties of E3 - E6 do not vary linearly with PEC content between that of R6 and E7. E3 - E6 possess thermo-mechanical properties significantly better than E7. In addition, the appearance of E3 - E6 is better than R6 with the magnitude of improvement increasing with increasing PEC

content. For E4 and E5, pearlescence was barely detectable, and for E6 and E7 no pearlescence was observed.

Table III. PBN/PC/PEC ternary blends

Raw Materials	R5	R6	E3	E4	E5	E6	E7
PBT	39.30	—	—	—	—	—	—
PBN	—	39.30	39.30	39.30	39.30	39.30	39.30
PC-2	46.20	46.20	34.65	23.10	23.10	11.55	—
PEC-2	—	—	11.55	23.10	—	34.65	46.2
PEC-1	—	—	—	—	23.10	—	—
MBS	14.00	14.00	14.00	14.00	14.00	14.00	14.00
Stabilizers etc.*	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Properties							
Tg** (°C)	142	150	154	157	163	162	157
Estimated HDT @ 264 psi (°C)*	94	118	111	109	109	108	104
Estimated HDT @ 66 psi (°C)**	136	150	152	155	157	154	141
D/B temperature (°C)	-60	-60	< -60	-60	-55	-55	-50
Dynatup @ -50°C max. load (ft.lb.)	42	47	44	42	49	38	40
Dynatup @ -50°C total energy (ft.lb.)	52	50	46	44	51	41	42
Tensile Strength (psi)	6,300	6,400	6,100	6,500	6,200	6,200	6,500
Tensile Elongation (%)	96	72	54	71	62	62	63
Flexural Strength (psi)	10,300	9,700	9,700	10,000	9,900	10,000	10,200
Flexural Modulus (psi)	230,300	211,100	207,300	212,100	204,800	190,000	182,600

*Temperature at which the storage modulus determined from dynamic mechanical analysis using a heating rate of 3°C/minute was $10^{8.9}$ Pascals. **Temperature at which the storage modulus determined from dynamic mechanical analysis using a heating rate of 3°C/minute was $10^{8.3}$ Pascals.

Table IV shows that the PEN/PEC-1 blend (E8) possesses higher HDT than the PEN/PC blend (R7). In addition, the appearance of the PEN/PEC-1 blend is much better than the PEN/PC blend. The PEN/PC blend has a pearlescent appearance; while the PEN/PEC-1 blend has a uniform, nonpearlescent appearance.

Table IV. PEN/PEC-1 blends.

Raw Materials	R7	E8
PEN	42.40	42.40
PC-2	45.87	—
PEC-1	—	45.87
MBS	11.00	11.00
Stabilizers etc.*	0.73	0.73
Properties		
HDT @ 66 psi °C)	128	141
HDT @ 264 psi (°C)	107	123
Tensile Strength (psi)	6800	6800
Tensile Elongation (%)	40	16
Flexural Modulus (psi)	257,000	248,500
Flexural Strength (psi)	11,600	11,900

* as in Table II

Table V shows that E9 has higher HDT, tensile strength, flexural modulus, and flexural strength than R8.

Table V. PEN/PC/PEC-1 ternary blends.

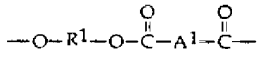
Raw Materials	R8	E9
PET	48.40	—
PEN	—	48.40
PC-3	22.94	22.94
PEC-1	22.94	22.94
MBS	11.00	11.00
Stabilizers*	0.73	0.73
Properties		
HDT @ 66 psi (°C)	122	133
HDT @ 264 psi (°C)	77	109
Tensile Strength (psi)	5,400	6,700
Tensile Elongation (%)	32	24
Flexural Modulus (psi)	246,100	258,300
Flexural Strength (psi)	10,400	11,700

* as in Table II

1. Abstract

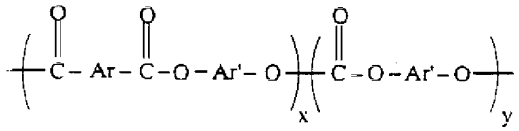
A thermoplastic resin having enhanced combination of properties including increased glass transition temperature, higher Heat Distortion Tempertaure (HDT) as well as uniform appearance comprises:

a) about 90 to about 10 weight percent of a polyester napthanoate containing recurring units of the formula I:



wherein each R^1 is independently a divalent aliphatic hydrocarbon, alicyclic hydrocarbon, polyoxyalkylene radical, or mixtures thereof and each A^1 is independently a divalent napthalene radical, or mixtures thereof;

b) about 10 to about 90 weight percent of an essentially amorphous polymer containing recurring units of the formula II:



wherein Ar is divalent aromatic residue of a dicarboxylic acid or a mixture of dicarboxylic acids and Ar' is the divalent aromatic residue of a dihydric phenol; or a mixture of dihydric phenols and

c) a quencher selected from the group consisting of phosphites having an acidic OH group, acidic phosphate salts, polyacid pyrophosphates and acidic salts thereof, phosphates of Group IB and Group IIB metals, and phosphorus oxo acids

Electronic Acknowledgement Receipt	
EFS ID:	46471312
Application Number:	17858825
International Application Number:	
Confirmation Number:	1348
Title of Invention:	MULTILAYER POLYMER SHEETS
First Named Inventor/Applicant Name:	Chunhua LI
Customer Number:	107046
Filer:	Garrett T Potter/James Brady
Filer Authorized By:	Garrett T Potter
Attorney Docket Number:	22773-826.310
Receipt Date:	23-AUG-2022
Filing Date:	06-JUL-2022
Time Stamp:	19:00:29
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		IDS22773-826-310-08-23-2022.pdf	283290 7b231fc38263b8ddd89292ab61e985480b7dca88	yes	8

	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Transmittal Letter		1	4	
	Information Disclosure Statement (IDS) Form (SB08)		5	8	
Warnings:					
Information:					
2	Foreign Reference	CN108394152A_EFS.pdf	605235 3a7d0dc8e164e3008baf4f3158a15ecd9f5dcb62	no	10
Warnings:					
Information:					
3	Foreign Reference	JPH0696486A_EFS.pdf	698046 089dadbc54fd896843e49d7a02b7c1070af2cb57	no	17
Warnings:					
Information:					
4	Foreign Reference	JPH07156349A_EFS.pdf	230170 b33a980c92aad03303d8386436d4ff514d80d4fc	no	6
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5	Foreign Reference	JPH11279389A_EFS.pdf	1117838 1a662d1eacbb8f2dbaed0d7ede58257e89e73823	no	36
Warnings:					
Information:					
		Total Files Size (in bytes):	2934579		

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New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor:	LI; Chunhua et al.	Group Art Unit:	1787
Serial Number:	17/858,825	Examiner:	CHEN, VIVIAN
Filing or 371 (c) Date:	2022-07-06	**CONFIRMATION NO:**	**1348**
Title:	MULTILAYER POLYMER SHEETS		

FILED ELECTRONICALLY ON: August 23, 2022

Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

INFORMATION DISCLOSURE STATEMENT UNDER 37 CFR § 1.97

Commissioner for Patents:

An Information Disclosure Statement along with attached PTO/SB/08 is hereby submitted. A copy of each listed publication is submitted, if required, pursuant to 37 CFR §§1.97-1.98, as indicated below.

The Examiner is requested to review the information provided and to make the information of record in the above-identified application. The Examiner is further requested to initial and return the attached PTO/SB/08 in accordance with MPEP § 609.

The right to establish the patentability of the claimed invention over any of the information provided herewith, and/or to prove that this information may not be prior art, and/or to prove that this information may not be enabling for the teachings purportedly offered, is hereby reserved.

This statement is not intended to represent that a search has been made or that the information cited in the statement is, or is considered to be, prior art or material to patentability as defined in § 1.56.

ClearCorrect Exhibit 1137, Page 169 of 337
ClearCorrect v. Align - IPR2025-00819

A. ☒ *37 CFR § 1.97 (b).* This Information Disclosure Statement should be considered by the Office because:

☐ (1) It is being filed within 3 months of the filing date of a national application and is other than a continued prosecution application under § 1.53 (d);

-- OR --

☐ (2) It is being filed within 3 months of entry of the national stage as set forth in § 1.491 in an international application;

-- OR --

☒ (3) It is being filed before the mailing of a first Office action on the merits;

-- OR --

☐ (4) It is being filed before the mailing of a first Office action after the filing of a request for continued examination under § 1.114.

B. ☐ *37 CFR § 1.97(c).* Although this Information Disclosure Statement is being filed after the period specified in *37 CFR § 1.97(b),* above, it is filed before the mailing date of the earlier of (1) a final office action under § 1.113, (2) a notice of allowance under § 1.311, or (3) an action that otherwise closes prosecution in the application, this Information Disclosure Statement should be considered because it is accompanied by one of:

☐ a statement as specified in §1.97 (e) provided concurrently herewith;

-- OR --

☐ a fee of $260.00 as set forth in § 1.17 (p) authorized below, enclosed, or included with the payment of other papers filed together with this statement.

C. ☐ *37 CFR § 1.97 (d).* Although this Information Disclosure Statement is being filed after the mailing date of the earlier of (1) a final office action under § 1.113, (2) a notice of allowance under § 1.311, or (3) an action that otherwise closes prosecution in the application, it is being filed before payment of the issue fee and should be considered because it is accompanied by:

i. a statement as specified in § 1.97 (e);

-- AND --

ii. a fee of $260.00 as set forth in §1.17(p) is authorized below, enclosed, or included with the payment of other papers filed together with this Statement.

D. ☐ *37 CFR §1.97 (e).* Statement.

☐ A statement is provided herewith to satisfy the requirement under 37 CFR §§ 1.97 (c);

-- AND/OR --

☐ A statement is provided herewith to satisfy the requirement under 37 CFR §§ 1.97 (d);

-- AND/OR --

☐ A copy of a dated communication from a foreign patent office clearly showing that the information disclosure statement is being submitted within 3 months of the filing date on the communication is provided in lieu of a statement under 37 C.F.R. § 1.97(e) (1) as provided for under MPEP 609.04(b) V.

E. ☐ *Statement Under 37 C.F.R. §1.704(d).* Each item of information contained in the information disclosure statement was first cited in any communication from a patent office in a counterpart foreign or international application or from the Office or is a communication that was issued by a patent office in a counterpart foreign or international application or by the Office that was received by an individual designated in § 1.56(c) not more than thirty (30) days prior to the filing of this information disclosure statement. This statement is made pursuant to the requirements of 37 C.F.R. §1.704(d) to avoid reduction of the period of adjustment of the patent term for Applicant(s) delay.

F. ☒ *37 CFR §1.98 (a) (2).* The content of the Information Disclosure Statement is as follows:

☐ Copies of each of the references listed on the attached Form PTO/SB/08 are enclosed herewith.

-- OR --

☐ Copies of U.S. Patent Documents (issued patents and patent publications) listed on the attached Form PTO/SB/08 are not enclosed.

-- AND/OR --

☒ Copies of Foreign Patent Documents and/or Non Patent Literature Documents listed on the attached Form PTO/SB/08 are enclosed in accordance with 37 CFR §1.98 (a)(2).

-- AND/OR --

☐ Copies of pending unpublished U.S. patent applications are enclosed in accordance with 37 CFR §1.98 (a) (2) (iii).

G. ☒ *37 CFR §1.98(a)(3).* The Information Disclosure Statement includes non-English patents and/or references.

☐ Pursuant to 37 CFR §1.98(a)(3)(i), a concise explanation of the relevance of each patent, publication or other information provided that is not in English is provided herewith.

☐ Pursuant to MPEP 609(B), an English language copy of a foreign search report is submitted herewith to satisfy the requirement for a concise explanation where non-English language information is cited in the search report.

-- OR --

☐ A concise explanation of the relevance of each patent, publication or other information provided that is not in English is as follows: _____

☒ Pursuant to 37 CFR §1.98(a) (3) (ii), a copy of a translation, or a portion thereof, of the non-English language reference(s) is provided herewith.

H. ☐ *37 CFR §1.98(d).* Copies of patents, publications and pending U.S. patent applications, or other information specified in 37 C.F.R. § 1.98(a) are not provided herewith because:

☐ Pursuant to 37 CFR §1.98(d)(1) the information was previously submitted in an Information Disclosure Statement, or cited by examiner for another application under which this application claims priority for an earlier effective filing date under 35 U.S.C. 120.

Application in which the information was submitted: _____

Information Disclosure Statement(s) filed on: _____

AND

☐ The information disclosure statement submitted in the earlier application complied with paragraphs (a) through (c) of 37 CFR §1.98.

I. ☒ *Fee Authorization*. The Commissioner is hereby authorized to charge the above-referenced fees of $0.00 and charge any additional fees or credit any overpayment associated with this communication to Deposit Account No. 23-2415 (Docket No. 22773-826.310).

Respectfully submitted,

WILSON SONSINI GOODRICH & ROSATI

Dated: August 23, 2022

By: /Garrett T. Potter/
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/858,825	07/06/2022	Chunhua LI	22773-826.310	1348

107046 7590 08/26/2022

Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304

EXAMINER	
CHEN, VIVIAN	

ART UNIT	PAPER NUMBER
1787	

NOTIFICATION DATE	DELIVERY MODE
08/26/2022	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentdocket@wsgr.com

Office Action Summary	**Application No.** 17/858,825	**Applicant(s)** LI et al.	
	Examiner VIVIAN CHEN	**Art Unit** 1787	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-30 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-30 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date 07/08/2022.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

ClearCorrect Exhibit 1137, Page 174 of 337
ClearCorrect v. Align - IPR2025-00819

DETAILED ACTION

Status of Claims

1. Claims 1-30 is/are pending.

2. Claims 1-30 is/are rejected.

Notice of Pre-AIA or AIA Status

3. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

4. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

Claim Rejections - 35 USC § 112

5. The following is a quotation of 35 U.S.C. 112(b):
(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 1-30 is rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

Claims 1, 8, 18 are vague and indefinite because it is unclear whether it is the first layer (as a whole) which has the recited properties, or whether it is the co-polyester which has the recited properties.

Claim 1, 18 are vague and indefinite because it is unclear whether the second layer (as a whole) which has the recited properties, or whether it is the thermoplastic polyurethane elastomer which has the recited properties.

Claims 2-7, 9-17, 19-30 are dependent on one or more of the above claims and therefore incorporate the above-described indefinite subject matter.

Double Patenting

7. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van*

Ornum, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP §§ 706.02(l)(1) - 706.02(l)(3) for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

8. Claims 1-30 is/are rejected on the ground of nonstatutory double patenting as being unpatentable over:

- claims 1-31 of U.S. Patent No. 9,655,691 (LI ET AL); or
- claims 1-20 of U.S. Patent No. 9,655,693 (LI ET AL); or

• claims 1-27 of U.S. Patent No. 10,052,176 (LI ET AL); or

• claims 1-22 of U.S. Patent No. 10,973,613 (LI ET AL).

in view of TADROS ET AL (US 2005/0100853).

The above U.S. Patents each claim a dental appliance for repositioning a patient's teeth, wherein the appliance comprises a multilayer film, or methods related to said multilayer film, wherein the multilayer film comprises:

• a first soft outer layer comprising a thermoplastic polyurethane (TPU) elastomer (corresponding to the recited "second layer"), wherein the first soft outer layer has physical properties (e.g., flexural modulus, ultimate tensile strength, elongation at break, hardness, light transmission, etc.) as recited in present application claims 1, 8-9, 18, 28-29, etc.;

• a hard inner layer comprising a copolyester, wherein the hard inner layer has physical properties (e.g., flexural modulus, elongation at yield, tensile modulus, tensile strength at yield, elongation at break, light transmission, etc.) as recited in present application claims 1-2, 8-11, 18, 24-27, etc., wherein the hard inner layer is optionally formed from:
  • a first hard sub-layer comprising a copolyester (corresponding to the recited "first layer");
  • a second hard sub-layer comprising a copolyester (corresponding to the recited "third layer");

• a second soft outer layer comprising thermoplastic polyurethane (TPU) elastomer (corresponding to the recited "fourth layer");

Features not explicitly claimed in the above U.S. Patents are known in the prior art.

TADROS ET AL '853 discloses that it is well known in the art to form dental appliances for adjusting the alignment of a patent's teeth, wherein the appliance is formed from a multilayer sheet comprising:

• a first elastomer layer (e.g., containing polyurethane elastomer);

• a copolyester layer (e.g., containing polyethylene terephthalate copolymerized with cyclohexanedimethanol (PETG), etc.);

- a second elastomer layer (e.g., containing polyurethane elastomer).

The dental appliance is formed by:

- providing the above multilayer sheet;
- providing a mold;
- thermoforming the multilayer sheet over the mold to form a plurality of cavities designed to receive and reposition the patient's teeth from a first position to a second position.

(paragraph 0015, 0019, 0022-0023, 0067, 0073, 0087-0088, etc.)

Regarding claims 1-30, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to utilize a multilayer sheet comprising a soft outer layer containing TPU elastomer on one or both sides of a hard inner layer containing copolyester as claimed in U.S. Patent Nos. 9,655,691 and 9,655,693 and 10,052,176 and 10,973,613 in a known dental appliance production method as disclosed in TADROS ET AL '853 in order to produce useful dental aligning appliances with compliant teeth-containing surfaces (to provide uniform repositioning force across teeth surfaces) and optionally compliant mouth-contacting surfaces (to provide enhanced comfort during usage).

Further regarding claims 3-7, 12-16, 19-23, one of ordinary skill in the art would have used two copolyester sub-layers to form the hard inner layer in the multilayer material claimed in U.S. Patent Nos. 9,655,691 and 9,655,693 and 10,052,176 and 10,973,613 in order to produce a 4-layer multilayer material which allows for convenient optimization of various performance properties (strength, thermoforming properties, rigidity, flexibility, etc.) in the hard inner layer and the dental appliance for specific applications and/or usage conditions.

Further regarding claims 1-2, 8-11, 18, 24-29, one of ordinary skill in the art would have utilized: (i) TPU elastomers having physical properties which are substantially similar to the desired physical properties of the soft outer layer(s); and (ii) copolyesters having physical properties which are substantially similar to the desired physical properties of the hard inner layer(s); in the multilayer materials as claimed in U.S. Patent Nos. 9,655,691 and 9,655,693 and 10,052,176 and 10,973,613 in order to simplify the production of dental appliances with specific overall physical mechanical properties.

Further regarding claims 1, 17, 30, since the elastic modulus is a measure of the rigidity or stiffness of a material, one of ordinary skill in the art would have utilized a relatively lower elastic modulus material to form soft outer layer(s) in the multilayer materials claimed in U.S. Patent Nos. 9,655,691 and 9,655,693 and 10,052,176 and 10,973,613 in order to provide desirably compliant or resilient outer layer(s) which conform well to a patient's teeth (thereby avoiding localized force which might damage teeth) and optionally to provide comfortable mouth-containing surfaces.

Further regarding claims 1, 17, 30, since the elastic modulus is a measure of the rigidity or stiffness of a material, one of ordinary skill in the art would have utilized a relatively higher elastic modulus material to form hard inner layer(s) in the multilayer materials claimed in U.S. Patent Nos. 9,655,691 and 9,655,693 and 10,052,176 and 10,973,613 in order to provide desirably "hard" or stiff inner layer(s) which provide the required structural strength, shape-retention, as well as the necessary tooth-repositioning force for specific applications.

Further regarding claims 1, 8, 18, it is conventional in the art to trim excess material from thermoformed articles after shaping in order to obtain the desired final product.

* * *

9. Claims 1-30 is/are rejected on the ground of nonstatutory double patenting as being unpatentable over:

• claims 1-30 of U.S. Patent No. 11,154,384 (LI ET AL);

in view of TADROS ET AL (US 2005/0100853),

and in view of DESIMONE ET AL (US 2006/0078841).

The above U.S. Patent claims a dental appliance for repositioning a patient's teeth, wherein the appliance comprises a multilayer film with three or more layers, wherein the multilayer film comprises:

• at least one soft layer comprising a thermoplastic polyurethane (TPU) elastomer (corresponding to the recited "second layer" and optionally the recited "fourth layer"), wherein the soft layer(s) has physical properties (e.g., flexural modulus, tensile strength at yield, elongation at break, hardness, light transmission, etc.) as recited in present application claims 1, 8-9, 18, 28-29, etc., wherein the soft layer(s) have an elastic modulus which is less than the elastic modulus of the hard layer;

• at least one hard layer comprising a copolyester (corresponding to the recited "second layer" and optionally the recited "third layer"), wherein the hard layer(s) have physical properties (e.g., flexural modulus, tensile modulus, tensile strength at yield, elongation at break, light transmission, etc.) as recited in present application claims 1-2, 8-11, 18, 24-27, etc., wherein the hard inner layer is optionally formed from:

Features not explicitly claimed in the above U.S. Patent are known in the prior art.

TADROS ET AL '853 discloses that it is well known in the art to form dental appliances for adjusting the alignment of a patent's teeth, wherein the appliance is formed from a multilayer sheet comprising:

• a first elastomer layer (e.g., containing polyurethane elastomer);

- a copolyester layer (e.g., containing polyethylene terephthalate copolymerized with cyclohexanedimethanol (PETG), etc.);

- a second elastomer layer (e.g., containing polyurethane elastomer).

The dental appliance is formed by:

- providing the above multilayer sheet;

- providing a mold;

- thermoforming the multilayer sheet over the mold to form a plurality of cavities designed to receive and reposition the patient's teeth from a first position to a second position.

(paragraph 0015, 0019, 0022-0023, 0067, 0073, 0087-0088, etc.)

DESIMONE ET AL '841 discloses that it is well known in the art to use copolyesters having physical properties (e.g., flexural modulus, elongation at yield, tensile modulus, tensile strength at yield, elongation at break, light transmission, etc.) as recited in present application claims 1-2, 8-11, 18, 24-27, etc., as components in dental appliances (e.g., appliances for repositioning a patient's teeth). (paragraph 0023, 0027, 0030, 0044, etc.)

Regarding claims 1-30, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to utilize a multilayer sheet comprising a soft layer containing TPU elastomer on at least one side of a hard layer containing copolyester as claimed in U.S. Patent No. 11,154,384 in a known dental appliance production method as disclosed in TADROS ET AL '853 in order to produce useful dental aligning appliances with compliant teeth-containing surfaces (to provide uniform repositioning force across teeth surfaces) and optionally compliant mouth-contacting surfaces (to provide enhanced comfort during usage).

Further regarding claims 3-7, 12-16, 19-23, one of ordinary skill in the art would have used two copolyester sub-layers to form the hard inner layer in the multilayer material claimed in U.S. Patent No. 11,154,384 in order to produce a 4-layer multilayer material which allows for convenient optimization of various performance properties (strength, thermoforming properties, rigidity, flexibility, etc.) in the hard inner layer and the dental appliance for specific applications and/or usage conditions.

Further regarding claims 1-2, 8-11, 18, 24-29, one of ordinary skill in the art would have utilized: (i) TPU elastomers having physical properties which are substantially similar to the desired physical properties of the soft outer layer(s); and (ii) copolyesters having physical properties which are substantially similar to the desired physical properties of the hard inner layer(s); in the multilayer materials as claimed in U.S. Patent No. 11,154,384 in order to simplify the production of dental appliances with specific overall physical mechanical properties.

Further regarding claim 1-2, 8-11, 18, 24-27, one of ordinary skill in the art would have utilize known, commercially available copolyester materials having physical properties as recited in application claims 1-2, 8-11, 18, 24-27 as disclosed in DESIMONE ET AL ‘841 in the hard layer(s) in the multilayer materials as claimed in U.S. Patent No. 11,154,384 in order to produce dental appliances with the required structural strength, shape-retention, as well as the necessary tooth-repositioning force for specific applications.

Further regarding claims 1, 8, 18, it is conventional in the art to trim excess material from thermoformed articles after shaping in order to obtain the desired final product.

Regarding claims 6-7, 12-16, 22-23, one of ordinary skill in the art would have positioned a soft layer on both sides of a single hard layer or a multilayer hard layer in order to provide useful dental aligning appliances with compliant teeth-containing surfaces (to provide

uniform repositioning force across teeth surfaces) and optionally compliant mouth-contacting surfaces (to provide enhanced comfort during usage).

* * *

10. Claims 1-30 is/are **provisionally** rejected on the ground of nonstatutory double patenting as being unpatentable over:

• claims 30-31, 36-37, 39-40, 48-49, 58, 62-63, 69, 71-88 of copending Application No. 16/043,065 (US 2019/0183611) (LI ET AL);

or

• claims 1-30 of copending Application No. 16/264,420 (U.S. 2019/0159870) (LI ET AL);

or

• claims 1, 5, 7, 9-13, 17, 19-25, 29-41 of copending Application No. 16/382,918 (US 2019/0231484) (LI ET AL);

in view of TADROS ET AL (US 2005/0100853),

and in view of DESIMONE ET AL (US 2006/0078841).

The above copending Applications each claim a dental appliance comprising a multilayer film, or methods related to said multilayer film, wherein the multilayer film comprises:

• a first soft outer polymer layer comprising thermoplastic polyurethane elastomer, wherein the first soft outer layer have physical properties (e.g., hardness, flexural modulus, elongation at break, tensile strength, etc.) as recited in present application claims 1, 8-9, 18, 28-29, etc.;

• a hard inner polymer layer comprising a copolyester, wherein the hard inner layers have various physical properties (e.g., flexural modulus, elongation at break, elongation at

yield, tensile strength, tensile modulus, light transmission, etc.) as recited in present application claim 1-2, 8-11, 18, 24-27, etc.,

• an optional second outer polymer layer optionally comprising thermoplastic polyurethane elastomer (e.g., thermoplastic polyurethane elastomer as used in the first soft outer layer; etc.);

Features not explicitly claimed in the above copending Applications are known in the prior art.

TADROS ET AL '853 discloses that it is well known in the art to form dental appliances for adjusting the alignment of a patent's teeth, wherein the appliance is formed from a multilayer sheet comprising:

• a first elastomer layer (e.g., containing polyurethane elastomer);

• a copolyester layer (e.g., containing polyethylene terephthalate copolymerized with cyclohexanedimethanol (PETG), etc.);

• a second elastomer layer (e.g., containing polyurethane elastomer).

The dental appliance is formed by:

• providing the above multilayer sheet;

• providing a mold;

• thermoforming the multilayer sheet over the mold to form a plurality of cavities designed to receive and reposition the patient's teeth from a first position to a second position.

(paragraph 0015, 0019, 0022-0023, 0067, 0073, 0087-0088, etc.)

DESIMONE ET AL '841 discloses that it is well known in the art to use copolyesters having physical properties (e.g., flexural modulus, elongation at yield, tensile modulus, tensile strength at yield, elongation at break, light transmission, etc.) as recited in present application

claims 1-2, 8-11, 18, 24-27, etc., as components in dental appliances (e.g., appliances for repositioning a patient's teeth). (paragraph 0023, 0027, 0030, 0044, etc.)

Regarding claims 1-30, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to utilize a multilayer sheet comprising soft outer layers containing TPU elastomer on both sides of a hard inner layer containing copolyester as claimed in copending Application Nos. 16/043,065 and 16/264,420 and 16/382,918 in a known dental appliance production method as disclosed in TADROS ET AL '853 in order to produce useful dental aligning appliances with compliant teeth-containing surfaces (to provide uniform repositioning force across teeth surfaces) and optionally compliant mouth-contacting surfaces (to provide enhanced comfort during usage).

Further regarding claims 1, 17, 30, since the elastic modulus is a measure of the rigidity or stiffness of a material, one of ordinary skill in the art would have utilized a relatively lower elastic modulus material to form soft outer layer(s) in the multilayer materials claimed in copending Application Nos. 16/043,065 and 16/264,420 and 16/382,918 in order to provide desirably compliant or resilient outer layer(s) which conform well to a patient's teeth (thereby avoiding localized force which might damage teeth) and optionally to provide comfortable mouth-containing surfaces.

Further regarding claims 1, 17, 30, since the elastic modulus is a measure of the rigidity or stiffness of a material, one of ordinary skill in the art would have utilized a relatively higher elastic modulus material to form hard inner layer(s) in the multilayer materials claimed in copending Application Nos. 16/043,065 and 16/264,420 and 16/382,918 in order to provide desirably "hard" or stiff inner layer(s) which provide the required structural strength, shape-retention, as well as the necessary tooth-repositioning force for specific applications.

Further regarding claims 3-7, 12-16, 18-23, one of ordinary skill in the art would have used two copolyester sub-layers to form the hard inner layer in the multilayer materials claimed in copending Application Nos. 16/043,065 and 16/264,420 and 16/382,918 in order to optimize the strength, thermoforming properties, and/or rigidity (or flexibility) of the dental appliance for specific applications and/or usage conditions.

Further regarding claims 1-2, 8-11, 18, 24-29, one of ordinary skill in the art would have utilized: (i) TPU elastomers having physical properties which are substantially similar to the desired physical properties of the soft outer layer(s); and (ii) copolyesters having physical properties which are substantially similar to the desired physical properties of the hard inner layer(s); in the multilayer materials as claimed in copending Application Nos. 16/043,065 and 16/264,420 and 16/382,918 in order to simplify the production of dental appliances with specific overall physical mechanical properties.

Further regarding claims 1-2, 8-11, 18, 24-27, one of ordinary skill in the art would have utilize known, commercially available copolyester materials having physical properties as recited in application claims 1-2, 8-10, 18, 24-27 as disclosed in DESIMONE ET AL '841 in the hard layer(s) in the multilayer materials as claimed in copending Application Nos. 16/043,065 and 16/264,420 and 16/382,918 in order to produce dental appliances with the required structural strength, shape-retention, as well as the necessary tooth-repositioning force for specific applications.

Further regarding claims 1, 8, 18, it is conventional in the art to trim excess material from thermoformed articles after shaping in order to obtain the desired final product.

This is a **provisional** nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

* * *

11. Claims 1-30 is/are **provisionally** rejected on the ground of nonstatutory double patenting as being unpatentable over:

• claims 2-33 of copending Application No. 17/553,590 (LI ET AL);

in view of TADROS ET AL (US 2005/0100853),

and in view of DESIMONE ET AL (US 2006/0078841).

The above copending Application claims a dental appliance comprising a multilayer film, or methods related to said multilayer film, wherein the multilayer film comprises:

• a second layer comprising a thermoplastic polyurethane (TPU) elastomer (corresponding to the recited "second layer"), wherein the first soft outer layer has physical properties (e.g., hardness, elongation at break, tensile strength, etc.) as recited in present application claims 1, 8-9, 18, 28-29, etc.;

• a first layer comprising a copolyester (corresponding to the recited "first layer"), wherein the first layer has physical properties (e.g., flexural modulus, elongation at yield, tensile modulus, tensile strength at yield, elongation at break, light transmission, etc.) as recited in present application claims 1-2, 8-11, 18, 24-27, etc.;

• a third layer comprising a copolyester (corresponding to the recited "third layer");

• a fourth layer comprising thermoplastic polyurethane (TPU) elastomer (corresponding to the recited "fourth layer");

wherein the copolyester of at least the first layer has an elastic modulus which is greater than the thermoplastic polyurethane elastomer in the soft outer polymer layers.

Features not explicitly claimed in the above U.S. copending Application are known in the prior art.

TADROS ET AL '853 discloses that it is well known in the art to form dental appliances for adjusting the alignment of a patent's teeth, wherein the appliance is formed from a multilayer sheet comprising:

- a first elastomer layer (e.g., containing polyurethane elastomer);
- a copolyester layer (e.g., containing polyethylene terephthalate copolymerized with cyclohexanedimethanol (PETG), etc.);
- a second elastomer layer (e.g., containing polyurethane elastomer).

The dental appliance is formed by:

- providing the above multilayer sheet;
- providing a mold;
- thermoforming the multilayer sheet over the mold to form a plurality of cavities designed to receive and reposition the patient's teeth from a first position to a second position.

(paragraph 0015, 0019, 0022-0023, 0067, 0073, 0087-0088, etc.)

DESIMONE ET AL '841 discloses that it is well known in the art to use copolyesters having physical properties (e.g., flexural modulus, elongation at yield, tensile modulus, tensile strength at yield, elongation at break, light transmission, etc.) as recited in present application claims 1-2, 8-11, 18, 24-27, etc., as components in dental appliances (e.g., appliances for repositioning a patient's teeth). (paragraph 0023, 0027, 0030, 0044, etc.)

Regarding claims 1-30, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to utilize a multilayer sheet comprising soft outer layers containing TPU elastomer on both sides of a hard inner layer containing copolyester as claimed in copending Application No. 17/553,590 in a known dental appliance production method as disclosed in TADROS ET AL '853 in order to produce useful dental

aligning appliances with compliant teeth-containing surfaces (to provide uniform repositioning force across teeth surfaces) and optionally compliant mouth-contacting surfaces (to provide enhanced comfort during usage).

Further regarding claims 3-7, 12-16, 18-23, one of ordinary skill in the art would have used two copolyester sub-layers to form the hard inner layer in the multilayer materials claimed in copending Application No. 17/553,590 in order to optimize the strength, thermoforming properties, and/or rigidity (or flexibility) of the dental appliance for specific applications and/or usage conditions.

Further regarding claims 1-2, 8-11, 18, 24-29, one of ordinary skill in the art would have utilized: (i) TPU elastomers having physical properties which are substantially similar to the desired physical properties of the soft outer layer(s); and (ii) copolyesters having physical properties which are substantially similar to the desired physical properties of the hard inner layer(s); in the multilayer materials as claimed in copending Application No. 17/553,590 in order to simplify the production of dental appliances with specific overall physical mechanical properties.

Further regarding claims 1-2, 8-11, 18, 24-27, one of ordinary skill in the art would have utilize known, commercially available copolyester materials having physical properties as recited in application claims 1-2, 8-10, 18, 24-27 as disclosed in DESIMONE ET AL ‘841 in the hard layer(s) in the multilayer materials as claimed in copending Application No. 17/553,590 in order to produce dental appliances with the required structural strength, shape-retention, as well as the necessary tooth-repositioning force for specific applications.

Further regarding claim 1, one of ordinary skill in the art would have selected the stiffness and/or flexibility (as reflected by the flexural modulus) of the thermoplastic

polyurethane elastomer in at least the first layer in the multilayer materials as claimed in copending Application No. 17/553,590 in order to obtain the desired comfort and/or repositioning force for specific applications.

Further regarding claims 1, 8, 18, it is conventional in the art to trim excess material from thermoformed articles after shaping in order to obtain the desired final product.

This is a **provisional** nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claim Rejections - 35 USC § 103 (AIA)

12. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

13. This application currently names joint inventors. In considering patentability of the claims the examiner presumes that the subject matter of the various claims was commonly owned as of the effective filing date of the claimed invention(s) absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and effective filing dates of each claim that was not commonly owned as of the effective filing date of the later invention in order for the examiner to consider the applicability of 35 U.S.C. 102(b)(2)(C) for any potential 35 U.S.C. 102(a)(2) prior art against the later invention.

14. Claims 1-30 is/are rejected under 35 U.S.C. 103 as being unpatentable over:

TADROS ET AL (US 2005/0100853),

in view of DESIMONE ET AL (US 2006/0078841);

and in view of WHEELER, deceased ET AL (US 5,335,675),

and in view of KALILI (US 2011/0020761).

TADROS ET AL '853 discloses dental appliances for adjusting the alignment of a patent's teeth, wherein the appliance is formed from a multilayer sheet comprising:

- a first outer layer (e.g., containing polyurethane elastomer);
- a copolyester layer (e.g., containing polyethylene terephthalate copolymerized with cyclohexanedimethanol (PETG), etc.);
- a second outer layer (e.g., containing polyurethane elastomer).

The dental appliance is formed by:

- providing the above multilayer sheet;
- providing a mold;
- thermoforming the multilayer sheet over the mold to form a plurality of cavities designed to receive and reposition the patient's teeth from a first position to a second position.

(entire document, e.g., paragraph 0015, 0019, 0022-0023, 0067, 0073, 0087-0088, etc.)

However, the reference does not specifically disclose copolyesters with the recited physical properties or polyurethane elastomer with the recited physical properties.

DESIMONE ET AL '841 discloses that it is well known in the art to use copolyesters having physical properties (e.g., flexural modulus, elongation at yield, tensile modulus, tensile strength at yield, elongation at break, light transmission, etc.) as recited in present application claims 1-2, 8-11, 18, 24-27, etc., as components in dental appliances (e.g., appliances for repositioning a patient's teeth). (paragraph 0023, 0027, 0030, 0044, etc.)

WHEELER, deceased ET AL '675 discloses that it is well known in the art to use thermoplastic polyurethane elastomers having physical properties (e.g., flexural modulus, elongation at break, ultimate tensile strength, hardness, etc.) as recited in present application claims 1, 8-9, 10, 28-29, etc., as components for medical articles. (line 3-16, col. 10; line 1-27, col. 22; etc.)

KALILI '761 discloses that it is well known in the art to position "soft" layers with relatively lower elastic modulus on the tooth-contacting side of multilayer sheets used in dental appliances for repositioning a patient's teeth, in order to improve patient comfort, and also prevent tooth and/or root damage due to excessive localized stress. (paragraph 0002, 0007-0009, 0069-0072, etc.)

Regarding claims 1-30, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to utilize known, commercially available copolyester materials having physical properties as recited in application claims 1-2, 8-10, 18, 24-27 as disclosed in DESIMONE ET AL '841 as the copolyester layer in the multilayer materials used to produce the dental appliances of TADROS ET AL '853 in order to produce dental appliances with the required structural strength, shape-retention, as well as the necessary tooth-repositioning force for specific applications.

Further regarding claims 1, 8-9, 18, 28-29, one of ordinary skill in the art would have utilized known relatively "soft" medically acceptable thermoplastic polyurethane elastomers as disclosed in WHEELER, deceased ET AL '675 as the first, tooth-contacting outer layer in the multilayer materials used to produce the dental appliances of TADROS ET AL '853 in order to produce repositioning dental appliances which minimize tooth and/or root damage associated with localized stress, as well as providing greater patient comfort.

Further regarding claims 1, 17, 30, since the elastic modulus is a measure of the rigidity or stiffness of a material, one of ordinary skill in the art would have utilized a relatively lower elastic modulus material to form soft outer layer(s) in the multilayer materials used to produce the dental appliances of TADROS ET AL '853 in order to provide desirably compliant or resilient outer layer(s) which conform well to a patient's teeth (thereby avoiding localized force which might damage teeth) and optionally to provide comfortable mouth-containing surfaces.

Further regarding claims 1, 17, 30, since the elastic modulus is a measure of the rigidity or stiffness of a material, one of ordinary skill in the art would have utilized a relatively higher elastic modulus material to form hard inner layer(s) in the multilayer materials used to produce the dental appliances of TADROS ET AL '853 in order to provide desirably "hard" or stiff inner layer(s) which provide the required structural strength, shape-retention, as well as the necessary tooth-repositioning force for specific applications.

Regarding claims 6-7, 12-16, 22-23, one of ordinary skill in the art would have utilized known relatively "soft" medically acceptable thermoplastic polyurethane elastomers as disclosed in WHEELER, deceased ET AL '675 as the second, mouth-contacting outer layer in the multilayer materials used to produce the dental appliances of TADROS ET AL '853 in order to provide useful dental aligning appliances with compliant mouth-contacting surfaces (to provide enhanced patient comfort during usage).

Regarding claims 3-7, 12-16, 18-23, one of ordinary skill in the art would have used two copolyester sub-layers to form the hard inner layer in the multilayer materials used to produce the dental appliances of TADROS ET AL '853 in order to optimize the strength, thermoforming properties, and/or rigidity (or flexibility) of the dental appliance for specific applications and/or usage conditions.

Further regarding claims 1-2, 8-11, 18, 24-29, one of ordinary skill in the art would have utilized: (i) TPU elastomers having physical properties which are substantially similar to the desired physical properties of the soft outer layer(s); and (ii) copolyesters having physical properties which are substantially similar to the desired physical properties of the hard inner layer(s); in the multilayer materials used to produce the dental appliances of TADROS ET AL '853 in order to simplify the production of dental appliances with specific overall physical mechanical properties.

Further regarding claims 1, 8, 18, it is conventional in the art to trim excess material from thermoformed articles after shaping in order to obtain the desired final product.

15. Claims 1-30 is/are rejected under 35 U.S.C. 103 as being unpatentable over:

TADROS ET AL (US 2005/0100853), in view of DESIMONE ET AL (US 2006/0078841), and in view of WHEELER, deceased ET AL (US 5,335,675), and in view of KALILI (US 2011/0020761),

as applied to claims 1-30 above,

and further in view of WROSZ (US 2005/0082703).

WROSZ '703 discloses that it is well known in the art to trim excess material from dental aligners after thermoforming. (paragraph 0006, 0009-0010, 0034, 0040, 0042, etc.)

Regarding claims 1-30, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to subject the dental appliances of TADROS ET AL '853 to conventional post-thermoforming processing (e.g., trimming of excess material) in order to produce dental appliances which conform comfortably to patients' mouths.

Conclusion

16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Vivian Chen (Vivian.chen@uspto.gov) whose telephone number is (571) 272-1506. The examiner can normally be reached on Monday through Thursday from 8:30 AM to 6 PM. The examiner can also be reached on alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Callie Shosho, can be reached on (571) 272-1123. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

The General Information telephone number for Technology Center 1700 is (571) 272-1700.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

August 22, 2022

/Vivian Chen/
Primary Examiner, Art Unit 1787

Notice of References Cited	Application/Control No. 17/858,825	Applicant(s)/Patent Under Reexamination LI et al.	
	Examiner VIVIAN CHEN	Art Unit 1787	Page 1 of 2

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*	B	US-20110020761-A1	01-2011	Kalili; Thomas	A61C7/08	433/214
*	C	US-20060078841-A1	04-2006	DeSimone; Joseph M.	A61C7/08	433/6
*	D	US-20050082703-A1	04-2005	Wrosz, Roman	B29C51/22	264/16
*	E	US-5335675-A	08-1994	Wheeler, deceased; Robert G.	B29C49/00	128/842
*	F	US-9655691-B2	05-2017	Li; Chunhua	B32B7/022	1/1
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*	H	US-10052176-B2	08-2018	Li; Chunhua	A61C7/08	1/1
*	I	US-10973613-B2	04-2021	Li; Chunhua	B32B27/34	1/1
*	J	US-11154384-B2	10-2021	Li; Chunhua	B32B7/022	1/1
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*	M	US-20190159870-A1	05-2019	LI; Chunhua	B32B27/40	1/1

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*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
*	U	"Overview of Materials for PETG Copolyester" (http://www.matweb.com/search/DataSheet.aspx?MatGUID= 4de1c85bb946406a86c52b688e3810d0&ckck=1) (webpage retrieved on 10/27/2020) (Year: 2020)
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	W	
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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Notice of References Cited	Application/Control No. 17/858,825	Applicant(s)/Patent Under Reexamination LI et al.	
	Examiner VIVIAN CHEN	Art Unit 1787	Page 2 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-7201575-B2	04-2007	Adell; Loren S.	A61C13/0001	433/80
*	B	US-20080248438-A1	10-2008	DeSimone; Joseph M.	A61C7/08	433/6
*	C	US-20060078688-A1	04-2006	DeSimone; Joseph M.	A61C7/08	264/494
*	D	US-7641828-B2	01-2010	DeSimone; Joseph M.	A61C7/08	264/16
*	E	US-20220249203-A1	08-2022	LI; Chunhua	B32B27/286	1/1
*	F	US-11213369-B2	01-2022	Li; Chunhua	B32B27/281	1/1
*	G	US-20210078357-A1	03-2021	VENKATASANTHANAM; Sriram	A61C7/08	1/1
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*	I	US-4253828-A	03-1981	Coles; Donna C.	A61C7/00	433/6
*	J	US-20150374464-A1	12-2015	STEWART; Ray F.	C09K11/06	264/16
*	K	US-20090298006-A1	12-2009	Schwartz; Dann	A61C7/08	433/34
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	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/858,825	LI et al.
	Examiner	**Art Unit**
	VIVIAN CHEN	1787

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	08/22/2022								
	1	✓								
	2	✓								
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	4	✓								
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	30	✓								

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/858,825	LI et al.
	Examiner	Art Unit
	VIVIAN CHEN	1787

CPC - Searched*		
Symbol	Date	Examiner
(see EAST text search history printout)	08/11/2022	/vc/

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
inventor / assignee / applicant search (PE2E, EAST)	08/11/2022	/vc/
EAST text search history printout	08/11/2022	/vc/
related applications - 13/470,681; 15/476,655; 16/835,101; 17/553,590	08/11/2022	/vc/

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/VIVIAN CHEN/ Primary Examiner, Art Unit 1787	

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BIB DATA SHEET

CONFIRMATION NO. 1348

SERIAL NUMBER	FILING or 371(c) DATE RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
17/858,825	07/06/2022	428	1787	22773-826.310

APPLICANTS
ALIGN TECHNOLOGY, INC., San Jose, CA;

INVENTORS
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Heinz PUDLEINER, Krefeld, GERMANY;
Klaus MEYER, Dormagen, GERMANY;
Joerg NICKEL, Dormagen, GERMANY;
Craig PEHLERT, Lenox, MA;

**** CONTINUING DATA ***************************
This application is a CON of 17/553,590 12/16/2021
which is a CON of 16/835,101 03/30/2020 PAT 11213369
which is a CON of 15/476,655 03/31/2017 PAT 10973613
which is a DIV of 13/470,681 05/14/2012 PAT 9655691

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****
07/14/2022

Foreign Priority claimed ☐ Yes ☑ No 35 USC 119(a-d) conditions met ☐ Yes ☑ No Verified and Acknowledged /VIVIAN CHEN/ Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		CA	8	30	3

ADDRESS
Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304
UNITED STATES

TITLE
MULTILAYER POLYMER SHEETS

FILING FEE RECEIVED		
2820	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

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Complete if Known	
Application Number	17/858,825
Filing Date	07-06-2022
First Named Inventor	LI; Chunhua
Art Unit	-
Examiner Name	-
Attorney Docket Number	22773-826.310

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Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	001	US-D865180	10-29-2019	BAUER; Laura et al.	
	002	US-5820368	10-13-1998	WOLK; Roger S.	
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	025	US-7854609	12-21-2010	CHEN; Jennifer C. et al.	

Examiner Signature	/VIVIAN CHEN/	Date Considered	08/11/2022

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 2 of 10

Complete if Known	
Application Number	17/858,825
Filing Date	07-06-2022
First Named Inventor	LI; Chunhua
Art Unit	-
Examiner Name	-
Attorney Docket Number	22773-826.310

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	026	US-7871269	01-18-2011	WU; KEN et al.	
	027	US-7878801	02-01-2011	ABOLFATHI; Amir et al.	
	028	US-7878805	02-01-2011	MOSS; Jon F. et al.	
	029	US-7914283	03-29-2011	KUO; Eric	
	030	US-7947508	05-24-2011	TRICCA; Robert E. et al.	
	031	US-8152518	04-10-2012	KUO; Eric E.	
	032	US-8172569	05-08-2012	MATTY; Rick M. et al.	
	033	US-8235715	08-07-2012	KUO; Eric	
	034	US-8292617	10-23-2012	BRANDT; Douglas et al.	
	035	US-8337199	12-25-2012	WEN; Huafeng	
	036	US-8401686	03-19-2013	MOSS; Jon et al.	
	037	US-8517726	08-27-2013	KAKAVAND; Ali et al.	
	038	US-8562337	10-22-2013	KUO; Eric et al.	
	039	US-8641414	02-04-2014	BOROVINSKIH; Artem et al.	
	040	US-8684729	04-01-2014	WEN; Huafeng	
	041	US-8708697	04-29-2014	LI; Chunhua et al.	
	042	US-8771149	07-08-2014	RAHMAN; Tariq et al.	
	043	US-8899976	12-02-2014	CHEN; Jennifer C. et al.	
	044	US-8899977	12-02-2014	CAO; Heng et al.	
	045	US-8936463	01-20-2015	MASON; David et al.	
	046	US-8936464	01-20-2015	KOPELMAN; Avi	
	047	US-9022781	05-05-2015	KUO; Eric et al.	
	048	US-9108338	08-18-2015	SIROVSKIY; Yevgeniy et al.	
	049	US-9119691	09-01-2015	NAMIRANIAN; Parshan et al.	
	050	US-9161823	10-20-2015	MORTON; John et al.	
	051	US-9241774	01-26-2016	LI; Chunhua et al.	

Examiner Signature	/VIVIAN CHEN/	Date Considered	08/11/2022

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Complete if Known	
Application Number	17/858,825
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U. S. PATENT DOCUMENTS

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	052	US-9326831	05-03-2016	CHEANG; Ka Man	
	053	US-9433476	09-06-2016	KHARDEKAR; Rahul et al.	
	054	US-9610141	04-04-2017	KOPELMAN; Avi et al.	
	055	US-9675427	06-13-2017	KOPELMAN; Avi	
	056	US-9700385	07-11-2017	WEBBER; Peter	
	057	US-9744001	08-29-2017	CHOI; Jeeyoung et al.	
	058	US-9844424	12-19-2017	WU; Ken et al.	
	059	US-10045835	08-14-2018	BORONKAY; Allen et al.	
	060	US-10111730	10-30-2018	WEBBER; Peter et al.	
	061	US-10150244	12-11-2018	SATO; Jun et al.	
	062	US-10201409	02-12-2019	MASON; David et al.	
	063	US-10213277	02-26-2019	WEBBER; Peter et al.	
	064	US-10299894	05-28-2019	TANUGULA et al.	
	065	US-10363116	07-30-2019	BORONKAY; Allen	
	066	US-10383705	08-20-2019	SHANJANI; Yaser et al.	
	067	US-10449016	10-22-2019	KIMURA; Ryan et al.	
	068	US-10463452	11-05-2019	MATOV; Vadim et al.	
	069	US-10470847	11-12-2019	SHANJANI; Yaser et al.	
	070	US-10517701	12-31-2019	BORONKAY; Allen R.	
	071	US-10537406	01-21-2020	WU; Ken et al.	
	072	US-10537463	01-21-2020	KOPELMAN; Avi	
	073	US-10548700	02-04-2020	FERNIE; Michael Lawrence	
	074	US-10555792	02-11-2020	KOPELMAN; Avi et al.	
	075	US-10588776	03-17-2020	CAM; Bruce et al.	
	076	US-10613515	04-07-2020	CRAMER; Christopher Eric et al.	
	077	US-10639134	05-05-2020	SHANJANI; Yaser et al.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	078	US-10743964	08-18-2020	WU; Fuming et al.	
	079	US-10758323	09-01-2020	KOPELMAN; Avi	
	080	US-10781274	09-22-2020	LISKA; Robert et al.	
	081	US-10813720	10-27-2020	GROVE; Bob et al.	
	082	US-10874483	12-29-2020	BORONKAY; Allen	
	083	US-10881487	01-05-2021	CAM; Bruce et al.	
	084	US-10912629	02-09-2021	TANUGULA; Rohit et al.	
	085	US-10959810	03-30-2021	LI; Chunhua et al.	
	086	US-10993783	05-04-2021	WU; Fuming et al.	
	087	US-11026768	06-08-2021	MOSS; Jon F. et al.	
	088	US-11026831	06-08-2021	KUO; Eric	
	089	US-11045282	06-29-2021	KOPELMAN; Avi et al.	
	090	US-11045283	06-29-2021	RILEY; Jeremy et al.	
	091	US-11103330	08-31-2021	WEBBER; Peter et al.	
	092	US-11123156	09-21-2021	CAM; Bruce et al.	
	093	US-11154382	10-26-2021	KOPELMAN; Avi et al.	
	094	US-11166788	11-09-2021	WEBBER; Peter	
	095	US-11174338	11-16-2021	ROBERT; Liska et al.	
	096	US-11219506	01-11-2022	SHANJANI; Yaser et al.	
	097	US-11259896	03-01-2022	MATOV; Vadim et al.	
	098	US-11273011	03-15-2022	SHANJANI; Yaser et al.	
	099	US-11278375	03-22-2022	YUXIANG; Wang et al.	
	100	US-11318667	05-03-2022	MOJDEH; Mehdi et al.	
	101	US-11331166	05-17-2022	JOHN; Y. Morton et al.	
	102	US-11344385	05-31-2022	MORTON; John et al.	
	103	US-11376101	07-05-2022	SATO; Jun et al.	

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U. S. PATENT DOCUMENTS

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	104	US-20040166462	08-26-2004	PHAN; LOC X. et al.	
	105	US-20040166463	08-26-2004	WEN; Huafeng et al.	
	106	US-20050014105	01-20-2005	ABOLFATHI; Amir et al.	
	107	US-20050186524	08-25-2005	ABOLFATHI; Amir et al.	
	108	US-20050244768	11-03-2005	TAUB; Eldad et al.	
	109	US-20060019218	01-26-2006	KUO; Eric E.	
	110	US-20060078841	04-13-2006	DESIMONE; Joseph M. et al.	
	111	US-20060115782	06-01-2006	LI; Chunhua et al.	
	112	US-20060115785	06-01-2006	LI; Chunhua et al.	
	113	US-20060199142	09-07-2006	LIU; Frank Z. et al.	
	114	US-20060234179	10-19-2006	WEN; Huafeng et al.	
	115	US-20080118882	05-22-2008	SU; Li-Hung	
	116	US-20080160473	07-03-2008	LI; Chunhua et al.	
	117	US-20080286716	11-20-2008	SHERWOOD; Mark	
	118	US-20080286717	11-20-2008	SHERWOOD; Mark	
	119	US-20090280450	11-12-2009	KUO; Eric	
	120	US-20100055635	03-04-2010	KAKAVAND; ALI	
	121	US-20100129763	05-27-2010	KUO; Eric	
	122	US-20110269092	11-03-2011	KUO; Eric et al.	
	123	US-20140067334	03-06-2014	KUO; Eric	
	124	US-20150265376	09-24-2015	KOPELMAN; Avi	
	125	US-20150366638	12-24-2015	AVI; Kopelman et al.	
	126	US-20160193014	07-07-2016	MORTON; John et al.	
	127	US-20170007359	01-12-2017	AVI; Kopelman et al.	
	128	US-20170007360	01-12-2017	KOPELMAN; Avi et al.	
	129	US-20170007361	01-12-2017	ALLEN; Boronkay et al.	

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U. S. PATENT DOCUMENTS

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	130	US-20170007366	01-12-2017	KOPELMAN; Avi et al.	
	131	US-20170007386	01-12-2017	MASON; David et al.	
	132	US-20170135792	05-18-2017	WEBBER; Peter	
	133	US-20170135793	05-18-2017	WEBBER; Peter et al.	
	134	US-20170165032	06-15-2017	WEBBER; Peter et al.	
	135	US-20180360567	12-20-2018	XUE; Ya et al.	
	136	US-20190000592	01-03-2019	CAM; Bruce et al.	
	137	US-20190000593	01-03-2019	BRUCE; CAM et al.	
	138	US-20190021817	01-24-2019	SATO; Jun et al.	
	139	US-20190046297	02-14-2019	KOPELMAN; Avi et al.	
	140	US-20190099129	04-04-2019	KOPELMAN; Avi et al.	
	141	US-20190125494	05-02-2019	LI; Huizhong et al.	
	142	US-20190125497	05-02-2019	MITRA; Derakhshan et al.	
	143	US-20190152152	05-23-2019	O'LEARY; Siobhan et al.	
	144	US-20190175304	06-13-2019	MORTON; John Y. et al.	
	145	US-20190262101	08-29-2019	YASER; Shanjani et al.	
	146	US-20190298494	10-03-2019	WEBBER; Peter et al.	
	147	US-20190314119	10-17-2019	KOPELMAN; Avi et al.	
	148	US-20190343606	11-14-2019	WU; Fuming et al.	
	149	US-20200000553	01-02-2020	SVETLANA; Makarenkova et al.	
	150	US-20200100864	04-02-2020	YUXIANG; Wang et al.	
	151	US-20200100865	04-02-2020	YUXIANG; Wang et al.	
	152	US-20200100866	04-02-2020	VIKTORIA; Medvinskaya et al.	
	153	US-20200155276	05-21-2020	BRUCE; CAM et al.	
	154	US-20200188062	06-18-2020	AVI; Kopelman et al.	

Examiner Signature	/VIVIAN CHEN/	Date Considered	08/11/2022

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	155	US-20200214598	07-09-2020	HUIZHONG; Li et al.	
	156	US-20200214801	07-09-2020	WANG; Yuxiang et al.	
	157	US-20200390523	12-17-2020	SATO; Jun et al.	
	158	US-20210147672	05-20-2021	COLE; Michael Christopher et al.	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
		None				

Examiner Signature	/VIVIAN CHEN/	Date Considered	08/11/2022

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				Art Unit	-
				Examiner Name	-
Sheet	8	of	10	Attorney Docket Number	22773-826.310

NON-PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	Include name of the author(in CAPITAL LETTERS),title of the article(when appropriate), title of the item (book,magazine,journal,serial,symposium,catalog,etc.),date,page(s),volume-issue number(s),publisher, city and/or country where published.	T[2]
		None	

Examiner Signature	/VIVIAN CHEN/	Date Considered	08/11/2022

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				Filing Date	07-06-2022
				First Named Inventor	LI; Chunhua
				Art Unit	-
				Examiner Name	-
Sheet	9	of	10	Attorney Docket Number	22773-826.310

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Garrett T. Potter/	Date (YYYY-MM-DD)	2022-07-08
Name/Print	Garrett T. Potter	Registration Number	76,602

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

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

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /VC/

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	3,808	((Chunhua near1 li) or (yan near1 chen) or (Heinz near1 pudleiner) or (klaus near1 meyer) or (joerg near1 nickel) or (craig near1 pehlert)).in,aanm. or (align).as,aanm.	US-PGPUB; USPAT	OR	ON	2022/08/11 17:51
L2	26,041	(orthodontic or dental) with (appliance or splint or brace or tray or plate)	US-PGPUB; USPAT	OR	ON	2022/08/11 17:51
L3	1,329	(soft or ((polyurethane or urethane) near2 (elastomer$3 or rubber$2))) with (flexural near1 modulus)	US-PGPUB; USPAT	OR	ON	2022/08/11 17:53
L4	163	(soft or ((polyurethane or urethane) near2 (elastomer$3 or rubber$2))) with (ultimate near2 tensile near2 strength)	US-PGPUB; USPAT	OR	ON	2022/08/11 17:53
L5	744	(soft or ((polyurethane or urethane) near2 (elastomer$3 or rubber$2))) with (elongation near2 break)	US-PGPUB; USPAT	OR	ON	2022/08/11 17:54
L6	35,609	(soft or ((polyurethane or urethane) near2 (elastomer$3 or rubber$2))) with (hardness or shore)	US-PGPUB; USPAT	OR	ON	2022/08/11 17:54
L7	14	1 and 2 and 3 and 4 and 5 and 6	US-PGPUB; USPAT	OR	ON	2022/08/11 17:54
L8	1	("11109946").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2022/08/11 18:12
L9	3	(("20090246724") or ("4791156") or ("7641828")).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2022/08/11 18:26
L10	1	("20060078688").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2022/08/11 18:28
L11	17,348	(orthodontic or dental) near2 (appliance or splint or brace or tray or plate)	US-PGPUB; USPAT	OR	ON	2022/08/11 18:37
L12	2,357	11 and trim$4	US-PGPUB; USPAT	OR	ON	2022/08/11 18:37
L13	527	11 and (trim$4 with excess)	US-PGPUB; USPAT	OR	ON	2022/08/11 18:38
L14	3,606	((orthodontic or dental) near2 (appliance or splint or brace or tray or plate)).ab.	US-PGPUB; USPAT	OR	ON	2022/08/11 18:38
L15	206	13 and 14	US-PGPUB; USPAT	OR	ON	2022/08/11 18:38
L16	25	1 and 15	US-PGPUB; USPAT	OR	ON	2022/08/11 18:38
L17	2	(("20150374464") or ("5335675")).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2022/08/11 18:47
L20	158	("20200100866" | "10045835" | "10111730" | "10150244" | "10201409" | "10213277" | "10299894" | "10363116" | "10383705" | "10449016" |	US-PGPUB; USPAT	OR	ON	2022/08/11 19:07

		"10463452" | "10470847" | "10517701" | "10537406" | "10537463" | "10548700" | "10555792" | "10588776" | "10613515" | "10639134" | "10743964" | "10758323" | "10781274" | "10813720" | "10874483" | "10881487" | "10912629" | "10959810" | "10993783" | "11026768" | "11026831" | "11045282" | "11045283" | "11103330" | "11123156" | "11154382" | "11166788" | "11174338" | "11219506" | "11259896" | "11273011" | "11278375" | "11318667" | "11331166" | "11344385" | "11376101" | "20040166462" | "20040166463" | "20050014105" | "20050186524" | "20050244768" | "20060019218" | "20060078841" | "20060115782" | "20060115785" | "20060199142" | "20060234179" | "20080118882" | "20080160473" | "20080286716" | "20080286717" | "20090280450" | "20100055635" | "20100129763" | "20110269092" | "20140067334" | "20150265376" | "20150366638" | "20160193014" | "20170007359" | "20170007360" | "20170007361" | "20170007366" | "20170007386" | "20170135792" | "20170135793" | "20170165032" | "20180360567" | "20190000592" | "20190000593" | "20190021817" | "20190046297" | "20190099129" | "20190125494" | "20190125497" | "20190152152" | "20190175304" | "20190262101" | "20190298494" | "20190314119" | "20190343606" | "20200000553" | "20200100864" | "20200100865" | "20200155276" | "20200188062" | "20200214598" | "20200214801" | "20200390523" | "20210147672" | "5820368" | "6386864" | "6450807" | "6471511" | "6607382" | "6783604" | "6790035" | "6814574" | "6830450" | "6947038" | "7074039" | "7104792" | "7160107" | "7192273" | "7347688" | "7448514" | "7481121" | "7543511" | "7553157" | "7600999" | "7658610" | "7766658" | "7771195" | "7854609" | "7871269" | "7878801" | "7878805" | "7914283" | "7947508" | "8152518" | "8172569" | "8235715" | "8292617" | "8337199" | "8401686" | "8517726" | "8562337" | "8641414" | "8684729" | "8708697" | "8771149" | "8899976" | "8899977" | "8936463" | "8936464" | "9022781" | "9108338" | "9119691" | "9161823" | "9241774" | "9326831" | "9433476" | "9610141" | "9675427" | "9700385" | "9744001" | "9844424" | "D865180").PN.				
L21	3,801	((orthodontic or dental) near2 (appliance or splint or brace or tray or plate or aligner)).ab.	US-PGPUB; USPAT	OR	ON	2022/08/11 19:08
L22	34,079	(flexural near1 modulus)	US-PGPUB; USPAT	OR	ON	2022/08/11 19:08
L23	114	21 and 22	US-PGPUB; USPAT	OR	ON	2022/08/11 19:08
L24	5,012	(soft or ((polyurethane or urethane) near2 (elastomer$3 or rubber$2))) with (tensile adj strength)	US-PGPUB; USPAT	OR	ON	2022/08/11 19:09
L25	75	23 and (tensile adj strength)	US-PGPUB; USPAT	OR	ON	2022/08/11 19:09
L26	54,304	(elongation near2 break)	US-PGPUB; USPAT	OR	ON	2022/08/11 19:10
L27	59	25 and (hardness or shore or durometer)	US-PGPUB; USPAT	OR	ON	2022/08/11 19:10

L28	56	26 and 27	US-PGPUB; USPAT	OR	ON	2022/08/11 19:11
L29	22	28 and 1	US-PGPUB; USPAT	OR	ON	2022/08/11 19:11
L30	34	28 not 1	US-PGPUB; USPAT	OR	ON	2022/08/11 19:12
L31	2	(("20050100853") or ("20090298006")).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2022/08/11 19:18
L32	0	20 and texin$	US-PGPUB; USPAT	OR	ON	2022/08/11 19:24
L33	1,808	(flexural near1 modulus) and ((tensile adj strength) with (ultimate or break$3)) and (elongation near2 break$3) and (hardness or shore or durometer)	US-PGPUB; USPAT	OR	ON	2022/08/11 19:26
L34	1,015	(urethane or polyurethane) and 33	US-PGPUB; USPAT	OR	ON	2022/08/11 19:26
L35	151	(urethane or polyurethane).ab. and 33	US-PGPUB; USPAT	OR	ON	2022/08/11 19:26
L36	53	35 and (orthodontic or dental or medical)	US-PGPUB; USPAT	OR	ON	2022/08/11 19:27
L37	83	21 and (trim$4 with excess) and thermoform$	US-PGPUB; USPAT	OR	ON	2022/08/11 19:34
L38	57,150	(B32B27/36 or B32B27/08 or B32B27/34 or B32B27/40 or A61C7/08 or B32B27/285 or B32B27/32 or B32B25/20 or B32B2375/00 or B32B2555/00 or B32B2323/04 or B32B2371/00 or B32B2323/10 or B32B2377/00 or B32B2367/00).cpc. or (a61c7/08 or a61c19/06 or a61f5/56 or a63b71/085).cpc.	US-PGPUB; USPAT	OR	ON	2022/08/11 19:41
L39	228	33 and 38	US-PGPUB; USPAT	OR	ON	2022/08/11 19:42
L40	78	39 and (((polyurethane or urethane) near2 (elastomer$3 or rubber$2)) or tpu)	US-PGPUB; USPAT	OR	ON	2022/08/11 19:42
L41	17,616	((orthodontic or dental) near2 (appliance or splint or brace or tray or plate or aligner))	US-PGPUB; USPAT	OR	ON	2022/08/11 19:43
L42	30	40 and 41	US-PGPUB; USPAT	OR	ON	2022/08/11 19:43
L43	32,671	((orthodontic or dental) near2 (appliance or splint or brace or tray or plate or aligner))	FPRS; EPO; JPO; DERWENT	OR	ON	2022/08/11 19:44
L44	51	43 and (((polyurethane or urethane) near2 (elastomer$3 or rubber$2)) or tpu)	FPRS; EPO; JPO; DERWENT	OR	ON	2022/08/11 19:44
L45	94	(flexural near1 modulus) and ((tensile adj strength) with (ultimate or break$3)) and (elongation near2 break$3) and (hardness or shore or durometer)	FPRS; EPO; JPO; DERWENT	OR	ON	2022/08/11 19:46
L46	9	43 and 45	FPRS; EPO; JPO; DERWENT	OR	ON	2022/08/11 19:46
L47	37	43 and (copolyester or petg)	FPRS; EPO; JPO; DERWENT	OR	ON	2022/08/11 19:47

L48	1,889	(hard or polyester or copolyester or petg) with (flexural near1 modulus)	US-PGPUB; USPAT	OR	ON	2022/08/11 19:48
L49	17,616	((orthodontic or dental) near2 (appliance or splint or brace or tray or plate or aligner))	US-PGPUB; USPAT	OR	ON	2022/08/11 19:48
L50	49	48 and 49	US-PGPUB; USPAT	OR	ON	2022/08/11 19:48

EAST Search History (Interference)

<This search history is empty>

8/11/2022 7:50:34 PM
C:\Users\vchen\Documents\EAST\Workspaces\17858825.wsp

To: patentdocket@wsgr.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 107046

Aug 26, 2022 03:35:50 AM

Dear PAIR Customer:

Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 107046 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

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The list of documents shown below is provided as a courtesy and is not part of the official file wrapper. The content of the images shown in PAIR is the official record.

Application	Document	Mailroom Date	Attorney Docket No.
17858825	CTNF	08/26/2022	22773-826.310
	892	08/26/2022	22773-826.310
	1449	08/26/2022	22773-826.310

To view your correspondence online or update your email addresses, please visit us anytime at https://sportal.uspto.gov/secure/myportal/privatepair.

If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

Thank you for prompt attention to this notice,

UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

Doc Code: ECOMM.AUTH/ECOMM.WTDW
Doc Description: Internet Communications Authorization/Internet Communications Authorization Withdrawal

PTO/SB/439 (11-15)

AUTHORIZATION FOR INTERNET COMMUNICATIONS IN A PATENT APPLICATION OR REQUEST TO WITHDRAW AUTHORIZATION FOR INTERNET COMMUNICATIONS		
	Application No.	17/858,825
	Filing Date	July 6, 2022
	First Named Inventor	Chunhua LI, et al.
	Art Unit	1787
	Examiner Name	Vivian CHEN
	Practitioner Docket No.	22773-826.310

To: Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

I. To authorize permission for Internet Communications.

☒ Recognizing that Internet communications are not secure, I hereby authorize the USPTO to communicate with the undersigned and practitioners in accordance with 37 CFR 1.33 and 37 CFR 1.34 concerning any subject matter of this application via video conferencing, instant messaging, or electronic mail. I understand that a copy of these communications will be made of record in the application file. (MPEP 502.03)

II. To withdraw authorization for Internet Communications.

☐ The authorization given on _____, to the USPTO to communicate with the undersigned and any practitioner in accordance with 37 CFR 1.33 and 37 CFR 1.34 concerning any subject matter of this application via Internet communications such as video conferencing, instant messaging, or electronic mail is hereby withdrawn. I understand that the withdrawal is effective when approved rather than when received.

I am the

☐ applicant.

☒ attorney or agent of record. Registration number 75,946.

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.

/Yahn Lin CHU/	October 6, 2022
Signature	Date
Yahn Lin CHU	(206) 573-2274
Typed or printed name	Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Juristic entities must be represented by a patent practitioner (see 37 CFR 1.31, which is applicable to any paper filed on or after September 16, 2012, that is presented on behalf of a juristic entity, regardless of application filing date). Submit multiple forms if more than one signature is required, see below*.

☐ * Total of _____ forms are submitted.

Electronic Acknowledgement Receipt	
EFS ID:	46769783
Application Number:	17858825
International Application Number:	
Confirmation Number:	1348
Title of Invention:	MULTILAYER POLYMER SHEETS
First Named Inventor/Applicant Name:	Chunhua LI
Customer Number:	107046
Filer:	Yahn Lin Chu/Selena Whitaker-Paquiet
Filer Authorized By:	Yahn Lin Chu
Attorney Docket Number:	22773-826.310
Receipt Date:	06-OCT-2022
Filing Date:	06-JUL-2022
Time Stamp:	16:22:00
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	22773_826_310_exTRNSMTL.pdf	206014 54845a5db0346b84b20a3900eb658d257ff13ec9	no	1
Warnings:					

Information:					
2	Internet Communications Authorization	22773_826_310_exAuthorization_Internet_Communications.pdf	100557 6451f933633eac65870eeb70bd7732de3676fa09	no	1
Warnings:					
Information:					
			Total Files Size (in bytes):	306571	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

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

Doc Code: TRAN.LET

Document Description: Transmittal Letter

PTO/SB/21 (07-09)
Approved for use through 12/31/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Total Number of Pages in This Submission	2

Application Number	17/858,825
Filing Date	July 6, 2022
First Named Inventor	Chunhua LI, et al.
Art Unit	1787
Examiner Name	Vivian CHEN
Attorney Docket Number	22773-826.310

ENCLOSURES (*Check all that apply*)

- ☐ Fee Transmittal Form
  - ☐ Fee Attached
- ☐ Amendment/Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
  - ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s) _____
  - ☐ Landscape Table on CD
- ☐ After Allowance Communication to TC
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☑ Other Enclosure(s) (please Identify below):
  Authorization for Internet Communications

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	WILSON SONSINI GOODRICH & ROSATI		
Signature	/Yahn Lin CHU/		
Printed name	Yahn Lin CHU		
Date	October 6, 2022	Reg. No.	75,946

CERTIFICATE OF TRANSMISSION/MAILING

I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below:

Signature	/Selena Whitaker-Paquiet/		
Typed or printed name	Selena WHITAKER-PAQUIET	Date	October 6, 2022

This collection of information is required by 37 CFR 1.5. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and1.14. This collection is estimated to 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/858,825	07/06/2022	Chunhua LI	22773-826.310	1348

107046 7590 10/26/2022

Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304

EXAMINER	
CHEN, VIVIAN	

ART UNIT	PAPER NUMBER
1787	

NOTIFICATION DATE	DELIVERY MODE
10/26/2022	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentdocket@wsgr.com

Applicant-Initiated Interview Summary	**Application No.** 17/858,825	**Applicant(s)** LI et al.		
	Examiner VIVIAN CHEN	**Art Unit** 1787	**AIA (First Inventor to File) Status** Yes	**Page** 1 of 2

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
VIVIAN CHEN	Primary Examiner	Telephonic
Mr. Franklin Chu	Attorney	
Ms. Lora Green	Attorney	

Date of Interview: 20 October 2022

Issues Discussed:

Proposed Amendment(s)

With respect to the outstanding rejections under 35 USC 112(b) issues in the Office Action mailed 08/26/2022, the Examiner indicated that the proposed claim amendments submitted in the Interview Agenda emailed 10/18/2022 (if applied to all pending claims) appear to address the 35 USC 112(b) rejections.

With respect to the outstanding rejections under 35 USC 103 in the Office Action mailed 08/26/2022, Mr. Chu argued that there is no motivation to utilize the material of WHEELER, deceased ET AL '675 in the dental articles of TADROS ET AL '853 since the medical usages in WHEELER ET AL are materially different than dental appliances. The Examiner indicated that Applicant's arguments appear to be persuasive.

Regarding claims 1-7, the Examiner indicated that these claims would appear to be allowable over the present prior art of record, due to the specificity (i.e., the multiple physical properties required) of the thermoplastic polyurethane elastomer (unless a particularly relevant reference is discovered during an updated search).

However, regarding claims 8-30, the Examiner noted that independent claim 8 contains NO physical property requirements with respect to the thermoplastic polyurethane elastomer and that independent claim 18 contains only one physical property requirement with respect to the thermoplastic polyurethane elastomer, and therefore the scope of claims 8-30 (or a majority thereof) are substantially broader than for claims 1-7. Therefore, even if Applicant's arguments with respect to WHEELER are persuasive, the Examiner indicated that the breadth of claims 8-30 necessitated an additional search of the prior art and most likely new grounds of rejection.

In view of the Track One status of the present application, the Examiner suggested that if Applicant was interested in receiving an allowance as expeditiously as possible, Applicant should consider cancelling claims 8-30.

The Examiner further indicated that if Applicant is interested in pursuing the subject matter of claims 8-30, Applicant may consider incorporating those claims into parent Application 17/553,590 which contains substantially similar claims.

The Examiner reminded Applicant that the present application is subject to multiple double patenting rejections, which need to be addressed by the appropriate Terminal Disclaimers.

ATTACHMENT: 17858825-Interview-Agenda-18-OCT-2022-email.pdf

ClearCorrect Exhibit 1137, Page 222 of 337
ClearCorrect v. Align - IPR2025-00819

Applicant-Initiated Interview Summary	**Application No.** 17/858,825	**Applicant(s)** LI et al.		
	Examiner VIVIAN CHEN	**Art Unit** 1787	**AIA (First Inventor to File) Status** Yes	**Page** **2 of 2**

☑ Attachment

/VIVIAN CHEN/ Primary Examiner, Art Unit 1787	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

ClearCorrect Exhibit 1137, Page 223 of 337
ClearCorrect v. Align - IPR2025-00819

For Discussion Purposes Only
Please Do Not Enter

Application No.:	17/858,825
Title:	Multilayer Polymer Sheets
Filing Date:	July 6, 2022
Examiner:	Vivian Chen
Attorney Docket No.:	22773-826.310

Patent Examiner Telephonic Interview Agenda – (October 20th, 2022, 2 PM EST)

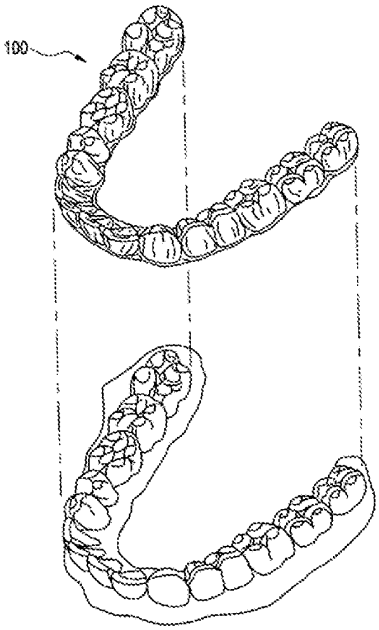
Applicant thanks Examiner Chen for her availability at the above indicated time. The interview will be attended by representatives for Applicant, Lora M. Green (Reg. No. 43,541; lgreen@wsgr.com) and Yahn Lin (Franklin) Chu (Reg. No. 75,946; ychu@wsgr.com) and Examiner Chen.

Proposed Topics for Discussion:

I. Rejections of record

A. 35 USC § 112(b) (see proposed amendment below)

B. 35 USC § 103(a)



Tadros, FIG. 3

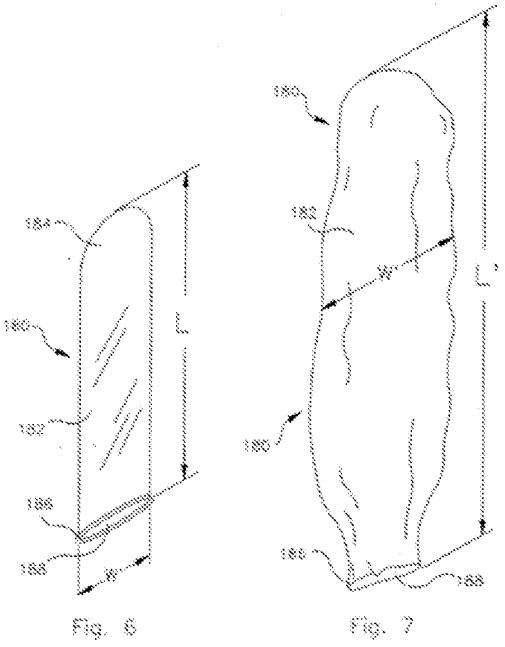


Fig. 6 Fig. 7

Wheeler, FIGS. 6-7

II. Proposed Amendment:

1. A method of making a multilayer dental aligner for repositioning a patient's teeth from a first arrangement toward a second arrangement, the method comprising:

providing a multilayer sheet comprising three polymer layers, the three polymer layers comprising:

a first layer comprising a co-polyester, the co-polyester having a flexural modulus greater than 150,000 psi, an elongation at yield of greater than 4%, a tensile modulus greater than 150,000 psi, a tensile strength at yield of 4000-6500 psi, and an elongation at break of greater than 70%; and

a second layer comprising a thermoplastic polyurethane elastomer, the thermoplastic polyurethane elastomer having a flexural modulus greater than 35,000 psi, an ultimate tensile strength of greater than 5000 psi; an elongation at break of greater than 200%, and a hardness of 60A to 85D; and

a third layer;

wherein the co-polyester has an elastic modulus greater than the thermoplastic polyurethane elastomer;

providing a mold;

thermoforming the multilayer sheet over the mold to form a plurality of tooth-receiving cavities configured to receive and reposition the patient's teeth from the first arrangement toward the second arrangement; and

trimming excess material from the thermoformed multilayer sheet to form the multilayer dental aligner.

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Application	Document	Mailroom Date	Attorney Docket No.
17858825	EXIN	10/26/2022	22773-826.310
	OA.APPENDIX	10/26/2022	22773-826.310

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/858,825	07/06/2022	Chunhua LI	22773-826.310

CONFIRMATION NO. 1348

107046
Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304

PUBLICATION NOTICE

OC000000136691181

Title:MULTILAYER POLYMER SHEETS

Publication No.US-2022-0338957-A1
Publication Date:10/27/2022

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

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Attorney Docket No.: 22773-826.310
Client Ref. No.: 1228.US.D1.C1.C1.C1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Confirmation No.: 1348
Chunhua LI et al.	
Application No.: 17/858,825	Examiner: Vivian CHEN
Filed: July 6, 2022	Art Unit: 1787
For: MULTILAYER DENTAL APPLIANCES AND RELATED METHODS AND SYSTEMS	RESPONSE TO NON-FINAL OFFICE ACTION
Customer No.: 107046	

MAIL STOP: AMENDMENT
Commissioner for Patents
P.O. Box 1450
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Commissioner:

In response to the Non-final Office Action mailed August 26, 2022, please enter the following remarks. This response is submitted prior to the three-month response ending on November 26, 2022. Accordingly, this response is timely filed.

Amendments to the Claims begin on **page 2** of this paper.

Remarks begin on **page 4**.

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ClearCorrect v. Align - IPR2025-00819

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

1. (Currently Amended) A method of making a multilayer dental aligner for repositioning a patient's teeth from a first arrangement toward a second arrangement, the method comprising:

providing a multilayer sheet comprising three polymer layers, the three polymer layers comprising:

a first layer comprising a co-polyester, the co-polyester having a flexural modulus greater than 150,000 psi, an elongation at yield of greater than 4%, a tensile modulus greater than 150,000 psi, a tensile strength at yield of 4000-6500 psi, and an elongation at break of greater than 70%; and

a second layer comprising a thermoplastic polyurethane elastomer, the thermoplastic polyurethane elastomer having a flexural modulus greater than 35,000 psi, an ultimate tensile strength of greater than 5000 psi; an elongation at break of greater than 200%, and a hardness of 60A to 85D; and

a third layer;

wherein the co-polyester has an elastic modulus greater than the thermoplastic polyurethane elastomer;

providing a mold;

thermoforming the multilayer sheet over the mold to form a plurality of tooth-receiving cavities configured to receive and reposition the patient's teeth from the first arrangement toward the second arrangement; and

trimming excess material from the thermoformed multilayer sheet to form the multilayer dental aligner.

2. (Original) The method of claim 1, wherein the co-polyester has a light transmission between 400 nm and 800 nm of greater than about 75%.

3. (Original) The method of claim 1, wherein the third layer comprises a same or different co-polyester.

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4. (Original) The method of claim 1, wherein the first layer is disposed adjacent to the third layer.

5. (Original) The method of claim 1, wherein the first layer is coextruded with or laminated to the third layer.

6. (Original) The method of claim 1, wherein the multilayer sheet further comprises a fourth layer comprising a same or different thermoplastic polyurethane elastomer.

7. (Original) The method of claim 6, wherein the first layer and the third layer are disposed between the second layer and the fourth layer.

8-30. (Canceled)

31. (New) The method of claim 1, wherein the thermoplastic polyurethane elastomer comprises a compression set at about 70° C of greater than 40% after 24 hours.

32. (New) The method of claim 1, wherein the thermoplastic polyurethane elastomer comprises a light transmission between 400 nm and 800 nm of greater than about 75%.

33. (New) The method of claim 1, wherein the co-polyester has a stress relaxation at 24 hours in a wet environment of between 90-100% humidity of greater than 10%.

34. (New) The method of claim 1, wherein the first layer is thicker than the second layer.

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REMARKS

Upon entry of the instant amendments, claims 1-7 and 31-34 will be pending. Independent claim 1 has been herein amended. New claims 31-34 are added. Support for the amendments and new claims can be found throughout the application as filed. No new matter is introduced. Claims 8-30 are canceled without prejudice or disclaimer. Applicant reserves the right to pursue the canceled claims in a separate, related application. Reconsideration in view of the remarks herein is respectfully requested.

Examiner Interview Summary

Applicant thanks Examiner Vivian Chen for her time and courtesy during the examiner interview conducted on October 20, 2022. The interview was attended by Examiner Chen and representatives for Applicant, Lora M. Green (Reg. No. 43,541) and Yahn Lin (Franklin) Chu (Reg. No. 75,946). During the interview, the rejections of record, proposed amendments, and cited references were discussed. Agreement was reached that the amendments proposed and reflected in the present response would overcome the § 112 rejections. Agreement was also reached that the arguments presented would overcome the § 103 rejections at least with respect to claims 1-7. Applicant respectfully submits that the pending claims have been herein amended in accordance with the discussion during the interview.

35 USC § 112 Rejections

Claims 1-30 were rejected under 35 U.S.C. § 112 as allegedly indefinite for failing to particularly point out and distinctly claim the subject matter. Claims 8-30 have been herein canceled, rendering the rejections directed at those claims moot.

With respect to claims 1-7, Applicant respectfully submits that independent claim 1 has been herein amended in the manner agreed upon during the examiner interview. Withdrawal of the § 112 rejections to independent claim 1 and dependent claims 2-7 is respectfully requested.

35 USC § 103 Rejections

Claims 1-30 were rejected under 35 U.S.C. § 103 as allegedly unpatentable over Tadros et al. (U.S. Publication No. 2005/0100853), in view of Desimone et al. (U.S. Publication No. 2006/0078841), in view of Wheeler, deceased et al. (U.S. Patent No. 5,335,675), and further in

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view of Kalili (U.S. Publication No. 2011/0020761). Claims 1-30 were also rejected under 35 U.S.C. § 103 as allegedly unpatentable over Tadros, Desimone, Wheeler, Kalili, and further in view of Wrosz (US 2005/0082703). Claims 8-30 have been herein canceled, rendering the rejections directed at those claims moot.

With respect to claims 1-7, as discussed during the examiner interview, Applicant respectfully submits that the asserted rejections fail at least because a person of ordinary skill in the art would not have been motivated to combine Tadros and Wheeler as proposed, or have any reasonable expectation of success in doing so. Accordingly, Applicant respectfully requests withdrawal of the § 103 rejections to claims 1-7.

Double Patenting Rejections

Claims 1-30 were rejected on the ground of nonstatutory double patenting as allegedly unpatentable over claims 1-31 of U.S. Patent No. 9,655,691; or claims 1-20 of U.S. Patent No. 9,655,693; or claims 1-27 of U.S. Patent No. 10,052,176; or claims 1-22 of U.S. Patent No. 10,973,613, in view of Tadros. Claims 1-30 were also rejected on the ground of nonstatutory double patenting as allegedly unpatentable over claims 1-30 of U.S. Patent No. 11,154,384, in view of Tadros and Desimone. Claims 1-30 were also provisionally rejected on the ground of nonstatutory double patenting as allegedly being unpatentable over claims 30-31, 36-37, 39-40, 48-49, 58, 62-63, 69, 71-88 of U.S. Application No. 16/043,065; or claims 1-30 of U.S. Application No. 16/264,420; or claims 1, 5, 7, 9-13, 17, 19-25, 29-41 of U.S. Application No. 16/382,918, in view of Tadros and Desimone. Claims 1-30 were also provisionally rejected on the ground of nonstatutory double patenting as allegedly being unpatentable over claims 2-33 of co-pending U.S. Application No. 17/553,590 in view of Tadros and Desimone.

Without conceding to the Office Action's characterizations of the various references above, Applicant respectfully submits that a Terminal Disclaimer has been submitted herewith. Accordingly, withdrawal of the double patenting rejections and a Notice of Allowance of claims 1-7 is respectfully requested.

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CONCLUSION

In view of the foregoing, Applicant believes all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested. Further, the Commissioner is hereby authorized to charge any additional fees or credit any overpayment in connection with this paper to Deposit Account No. 23-2415.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 206-573-2274.

Respectfully submitted,

Dated: October 27, 2022 /Yahn Lin CHU/
Yahn Lin CHU
Registration No. 75,946

WILSO SONSINI GOODRICH & ROSATI
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TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT	Docket Number (Optional) 22773-826.310

In re Application of: Chunhua LI, et al.

Application No.: 17/858,825

Filed: July 6, 2022

For: MULTILAYER POLYMER SHEETS

The applicant, Align Technology, Inc., owner of 100 percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of **prior patent Nos. 9,655,691; 9,655,693; 10,052,176; 10,973,613**; and **11,154,384**; as the term of said **prior patent** is presently shortened by any terminal disclaimer. The applicant hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the **prior patent** are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the applicant does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the **prior patent**, "as the term of said **prior patent** is presently shortened by any terminal disclaimer," in the event that said **prior patent** later:

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2. ☑ The undersigned is an attorney or agent of record. Reg. No. 75,946

/Yahn Lin CHU/ — Signature
October 27, 2022 — Date

Yahn Lin CHU — Typed or printed name

Attorney of Record — Title
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In re Application of: Chunhua LI, et al.

Application No.: 17/858,825

Filed: July 6, 2022

For: MULTILAYER POLYMER SHEETS

The applicant, Align Technology, Inc., owner of 100 percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of any patent granted on pending **reference Application Numbers: 16/043,065, filed July 23, 2018; 16/264,420, filed January 31, 2019; 16/382,918, filed April 12, 2019;** and **17/553,590 filed December 16, 2021**, as the term of any patent granted on said **reference** application may be shortened by any terminal disclaimer filed prior to the grant of any patent on pending **reference** application. The applicant hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the **reference** application are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the applicant does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of any patent granted on said **reference** application, "as the term of any patent granted on said **reference** application may be shortened by any terminal disclaimer filed prior to the grant of patyent on the pending **reference** application," in the event that: any such patent granted on the pending **reference** application expires for failure to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321, has all claims canceled by a reexamination certificate, is reissued, or in any manner terminated prior to the expiration of its full statuatory term as shortened by any terminal disclaimer filed prior to its grant.

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2. ☑ The undersigned is an attorney or agent of record. Reg. No. 75,946

/Yahn Lin CHU/ — Signature
October 27, 2022 — Date

Yahn Lin CHU — Typed or printed name

Attorney of Record — Title
206/573-2274 — Telephone Number

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Title of Invention:	MULTILAYER POLYMER SHEETS			
First Named Inventor/Applicant Name:	Chunhua LI			
Filer:	Yahn Lin Chu/Selena Whitaker-Paquiet			
Attorney Docket Number:	22773-826.310			
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	**Fee Code**	**Quantity**	**Amount**	**Sub-Total in USD($)**
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Application Number:	17858825
International Application Number:	
Confirmation Number:	1348
Title of Invention:	MULTILAYER POLYMER SHEETS
First Named Inventor/Applicant Name:	Chunhua LI
Customer Number:	107046
Filer:	Yahn Lin Chu/Selena Whitaker-Paquiet
Filer Authorized By:	Yahn Lin Chu
Attorney Docket Number:	22773-826.310
Receipt Date:	27-OCT-2022
Filing Date:	06-JUL-2022
Time Stamp:	20:14:24
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$170
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	Applicant Arguments/Remarks Made in an Amendment	4	6

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Warnings:					
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Application Number	17/858,825
Filing Date	July 6, 2022
First Named Inventor	Chunhua LI, et al.
Art Unit	1787
Examiner Name	Vivian CHEN
Attorney Docket Number	22773-826.310

ENCLOSURES (*Check all that apply*)

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- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
  - ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☑ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s) _____
  - ☐ Landscape Table on CD
- ☐ After Allowance Communication to TC
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☐ Other Enclosure(s) (please Identify below):

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	WILSON SONSINI GOODRICH & ROSATI		
Signature	/Yahn Lin CHU/		
Printed name	Yahn Lin CHU		
Date	October 27, 2022	Reg. No.	75,946

CERTIFICATE OF TRANSMISSION/MAILING

I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below:

Signature	/Selena Whitaker-Paquiet/		
Typed or printed name	Selena WHITAKER-PAQUIET	Date	October 27, 2022

This collection of information is required by 37 CFR 1.5. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and1.14. This collection is estimated to 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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To: patentdocket@wsgr.com,,
From: PAIR_eOfficeAction@uspto.gov
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Subject: Private PAIR Correspondence Notification for Customer Number 107046

Oct 28, 2022 03:24:10 AM

Dear PAIR Customer:

Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 107046 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

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Application	Document	Mailroom Date	Attorney Docket No.
17858825	NTC.PUB	10/27/2022	22773-826.310

To view your correspondence online or update your email addresses, please visit us anytime at https://sportal.uspto.gov/secure/myportal/privatepair.

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PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

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Document Code:WFEE

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Sale Accounting Date:10/31/2022

Sale Item Reference Number	Effective Date
17858825	10/27/2022

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method
I20220U710272259	1814	STATUTORY OR TERMINAL DISCLAIMER	$170.00	Deposit Account

Application Number * 17/858,825 *	Application/Control No. 17/858,825	Applicant(s)/Patent under Reexamination LI et al.	
	Examiner CHEN, VIVIAN	Art Unit 1787	

Document Code - DISQ	Internal Document - DO NOT MAIL

TERMINAL DISCLAIMER	☑ APPROVED	☐ DISAPPROVED
Date Filed: 27 October 2022	**This patent is subject to a Terminal Disclaimer**	

Approved/Disapproved by:

/FELICIA D ROBERTS/

Technology Center: OPLC

Telephone: (571)272-0550

2 TDs approved with this filing date

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/858,825	Filing Date 07/06/2022	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

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

APPLICATION AS AMENDED - PART II

AMENDMENT	10/27/2022	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 11	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 1	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/BRUCE D HARRISON/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/858,825	07/06/2022	Chunhua LI	22773-826.310	1348

107046 7590 12/01/2022

Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304

EXAMINER	
CHEN, VIVIAN	

ART UNIT	PAPER NUMBER
1787	

NOTIFICATION DATE	DELIVERY MODE
12/01/2022	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentdocket@wsgr.com

Office Action Summary	**Application No.** 17/858,825	**Applicant(s)** LI et al.	
	Examiner VIVIAN CHEN	**Art Unit** 1787	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 10/27/2022.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-7 and 31-34 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-7 and 31-34 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 07/06/2022 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☑ Interview Summary (PTO-413) Paper No(s)/Mail Date 11/20/2022.

4) ☐ Other: _____.

DETAILED ACTION

Status of Claims

1. Claims 1-7, 31-34 is/are pending.

2. Claims 1-7, 31-34 is/are rejected.

3. Claim 8-30 is/are cancelled in the Claim Amendment filed 10/27/2022.

Notice of Pre-AIA or AIA Status

4. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

5. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

Priority

6. Applicant's claim for the benefit of a prior-filed application under 35 U.S.C. 119(e) or under 35 U.S.C. 120, 121, 365(c), or 386(c) is acknowledged. Applicant has not complied with one or more conditions for receiving the benefit of an earlier filing date under 35 U.S.C. 120 as follows:

The later-filed application must be an application for a patent for an invention which is also disclosed in the prior application (the parent or original nonprovisional application or

provisional application). The disclosure of the invention in the parent application and in the later-filed application must be sufficient to comply with the requirements of 35 U.S.C. 112(a) or the first paragraph of pre-AIA 35 U.S.C. 112, except for the best mode requirement. See *Transco Products, Inc. v. Performance Contracting, Inc.*, 38 F.3d 551, 32 USPQ2d 1077 (Fed. Cir. 1994)

The disclosure of the prior-filed applications, Application Nos. 13/470,681 and 15/476,655 and 16/835,101 fails to provide adequate support or enablement in the manner provided by 35 U.S.C. 112(a) or pre-AIA 35 U.S.C. 112, first paragraph for one or more claims of this application.

The originally filed disclosures of Application Nos. 13/470,681 (filed 05/14/2012) and 15/476,655 (filed 03/31/2017) and 16/835,101 (filed 03/30/2020) only provides support for:

> (1) **layers as a whole** having specific physical properties (e.g., flexural modulus, elongation at break, etc.);
>
> (2) **layers as a whole** having elastic modulus which are greater than the elastic modulus of other **layers as a whole**.

However, the originally filed disclosures of Application Nos. 13/470,681 and 15/476,655 and 16/835,101 do **NOT** provide support for:

> (1) **polymers** themselves (e.g., copolyesters; thermoplastic polyurethane elastomers) having specific physical properties (e.g., flexural modulus, elongation at break, etc.);
>
> (2) **polymers** themselves (e.g., copolyesters) having an elastic modulus which are greater than the elastic modulus of other **polymers**. (e.g., thermoplastic polyurethane elastomers).

Since in the originally filed claims, a **layer as a whole** can contain other components other than the recited polymer, this means that the recited polymer in said layer does not inherently have the

same physical properties as the **layer as a whole**. Similarly, the recited polymer in said layer does not inherently have the same elastic modulus as the **layer as a whole**.

Application 17/553,590 (filed 12/16/2021) provides support for: (1) polymers having specific physical properties; and (2) polymers having an elastic modulus which is greater than the elastic modulus of other polymers. However, Application 17/553,590 does **not** provide support for thermoplastic polyurethane elastomers having a flexural modulus of greater than 35,000 psi.

Therefore, since the language of the present claims requires the polymers themselves to have specific physical properties and elastic modulus values, claims 1-7, 31-34 have an effective priority date of **07/06/2022**.

However, if the language of the present claims is amended to require the **layers as a whole** to have specific physical properties and elastic modulus values, claims 1-7, 31-34 could have an effective filing date of **05/14/2012**.

Claim Rejections - 35 USC § 112

7. The following is a quotation of the first paragraph of 35 U.S.C. 112(a):

> (a) IN GENERAL.—The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

The following is a quotation of the first paragraph of pre-AIA 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

8. Claims 1-7, 31-34 is/are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for pre-AIA the inventor(s), at the time the application was filed, had possession of the claimed invention.

The disclosure as originally filed fails to provide support for requiring: (i) **polymers** themselves (e.g., copolyesters; thermoplastic polyurethane elastomers) having specific physical properties (e.g., flexural modulus, elongation at break, etc.); and (2) **polymers** themselves (e.g., copolyesters) having an elastic modulus which are greater than the elastic modulus of other **polymers**. (e.g., thermoplastic polyurethane elastomers).

The disclosure as originally filed (including parent Application Nos. 13/470,681 (filed 05/14/2012) and 15/476,655 (filed 03/31/2017) and 16/835,101 (filed 03/30/2020)) only discloses **layers as a whole** having specific physical properties or differences in elastic modulus. While parent Application 17/553,590 (filed 12/16/2021) provides support for: (1) polymers having specific physical properties; and (2) polymers having an elastic modulus which is greater than the elastic modulus of other polymers, parent Application 17/553,590 does **not** provide support for thermoplastic polyurethane elastomers having a flexural modulus of greater than 35,000 psi.

Therefore, the Claim Amendments filed 10/27/2022 introduce new matter not supported by the disclosure as originally filed (since previously, it is unclear whether: (i) the recited physical properties were required to be the physical properties of the polymers themselves; or (ii)

the recited physical properties were required to be the physical properties of the layers as a whole.

9. The following is a quotation of 35 U.S.C. 112(b):

> (b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

10. The rejections under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, in the previous Office Action mailed 08/26/2022 have been withdrawn in view of the Claim Amendments filed 10/27/2022.

However, the Claim Amendments filed 10/27/2022 necessitate new ground(s) of rejection based on under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph as set forth in the present Office Action.

Terminal Disclaimer

11. The terminal disclaimer filed on 10/27/2022 disclaiming the terminal portion of the statutory term which would extend beyond the expiration date of U.S. Patent Nos. 9,544,691 and 9,655,693 and 10,052,176 and 10,973,613 and 11,154,384 has been reviewed and is accepted. The terminal disclaimer has been recorded.

12. The terminal disclaimer filed on 10/27/2022 disclaiming the terminal portion of the statutory term which would extend beyond the expiration date of any patents granted on U.S.

Applications Nos. 16/043,065 and 16/264,420 and 16/382,918 and 17,553,590 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Double Patenting

13. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP §§ 706.02(l)(1) - 706.02(l)(3) for applications not subject to examination under the first inventor

to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

14. The nonstatutory double patenting rejections based on U.S. Patent Nos. 9,655,691 (LI ET AL) or 9,655,693 (LI ET AL) or 10,052,176 (LI ET AL) or 10,973,613 (LI ET AL) or 11,154,384 (LI ET AL) in the previous Office Action mailed 10/27/2022 have been withdrawn in view of the Terminal Disclaimers filed 10/27/2022.

15. The **provisional** nonstatutory double patenting rejections based on copending Application Nos. 16/043,065 (US 2019/0183611) (LI ET AL) or 16/264,420 (U.S. 2019/0159870) (LI ET AL) or 16/382,918 (US 2019/0231484) (LI ET AL) or Application No. 17/553,590 (LI ET AL) in the previous Office Action mailed 10/27/2022 have been withdrawn in view of the Terminal Disclaimers filed 10/27/2022.

* * *

16. Claims 1-7, 31-34 is/are **provisionally** rejected on the ground of nonstatutory double patenting as being unpatentable over:

• claims 1-30 of copending Application No. 17/902,445 (LI ET AL);

in view of TADROS ET AL (US 2005/0100853),

and in view of DESIMONE ET AL (US 2006/0078841).

The above copending Application claims a dental appliance comprising a multilayer film, or methods related to said multilayer film, wherein the multilayer film comprises:

• a second layer comprising a thermoplastic polyurethane (TPU) elastomer (corresponding to the recited "second layer"), wherein the first soft outer layer has physical properties (e.g., hardness, elongation at break, tensile strength, etc.) as recited in present application claims 1, 31-32, etc.;

• a first layer comprising a copolyester (corresponding to the recited "first layer"), wherein the first layer has physical properties (e.g., flexural modulus, elongation at yield, tensile modulus, tensile strength at yield, elongation at break, light transmission, etc.) as recited in present application claims 1-2, 33, etc.;

• a third layer comprising a copolyester (corresponding to the recited "third layer");

• a fourth layer comprising thermoplastic polyurethane (TPU) elastomer (corresponding to the recited "fourth layer");

wherein the copolyester of at least the first layer has an elastic modulus which is greater than the thermoplastic polyurethane elastomer in the soft outer polymer layers.

Features not explicitly claimed in the above U.S. copending Application are known in the prior art.

TADROS ET AL '853 discloses that it is well known in the art to form dental appliances for adjusting the alignment of a patent's teeth, wherein the appliance is formed from a multilayer sheet comprising:

- a first elastomer layer (e.g., containing polyurethane elastomer);

- a copolyester layer (e.g., containing polyethylene terephthalate copolymerized with cyclohexanedimethanol (PETG), etc.);

- a second elastomer layer (e.g., containing polyurethane elastomer).

The dental appliance is formed by:

- providing the above multilayer sheet;

- providing a mold;

- thermoforming the multilayer sheet over the mold to form a plurality of cavities designed to receive and reposition the patient's teeth from a first position to a second position.

(paragraph 0015, 0019, 0022-0023, 0067, 0073, 0087-0088, etc.)

DESIMONE ET AL '841 discloses that it is well known in the art to use copolyesters having physical properties (e.g., flexural modulus, elongation at yield, tensile modulus, tensile strength at yield, elongation at break, light transmission, etc.) as recited in present application claims 1-2, 8-11, 18, 24-27, etc., as components in dental appliances (e.g., appliances for repositioning a patient's teeth). (paragraph 0023, 0027, 0030, 0044, etc.)

Regarding claims 1-7, 31-34, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to utilize a multilayer sheet comprising soft outer layers containing TPU elastomer on both sides of a hard inner layer containing copolyester as claimed in copending Application No. 17/553,590 in a known dental appliance production method as disclosed in TADROS ET AL '853 in order to produce useful dental aligning appliances with compliant teeth-containing surfaces (to provide uniform repositioning force across teeth surfaces) and optionally compliant mouth-contacting surfaces (to provide enhanced comfort during usage).

Further regarding claims 3-7, one of ordinary skill in the art would have used two copolyester sub-layers to form the hard inner layer in the multilayer materials claimed in copending Application No. 17/553,590 in order to optimize the strength, thermoforming properties, and/or rigidity (or flexibility) of the dental appliance for specific applications and/or usage conditions.

Further regarding claims 1-2, 31-33, one of ordinary skill in the art would have utilized: (i) TPU elastomers having physical properties which are substantially similar to the desired physical properties of the soft outer layer(s); and (ii) copolyesters having physical properties which are substantially similar to the desired physical properties of the hard inner layer(s); in the multilayer materials as claimed in copending Application No. 17/902,445 in order to simplify the production of dental appliances with specific overall physical mechanical properties.

Further regarding claims 1-2, 33, one of ordinary skill in the art would have utilize known, commercially available copolyester materials having physical properties as recited in application claims 1-2, 33 as disclosed in DESIMONE ET AL '841 in the hard layer(s) in the multilayer materials as claimed in copending Application No. 17/902,445 in order to produce dental appliances with the required structural strength, shape-retention, as well as the necessary tooth-repositioning force for specific applications.

Further regarding claim 1, one of ordinary skill in the art would have selected the stiffness and/or flexibility (as reflected by the flexural modulus) of the thermoplastic polyurethane elastomer in at least the first layer in the multilayer materials as claimed in copending Application No. 17/902,445 in order to obtain the desired comfort and/or repositioning force for specific applications.

Further regarding claim 1, it is conventional in the art to trim excess material from thermoformed articles after shaping in order to obtain the desired final product.

Regarding claim 34, one of ordinary skill in the art would have selected the relative thicknesses of the first layer and second layers in the multilayer materials as claimed in copending Application No. 17/902,445 in order to obtain a desirable compromise between patient comfort (as provided by softer outer layers) and repositioning force (as provided by stiffer inner layers).

This is a **provisional** nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

Claim Rejections - 35 USC § 103 (AIA)

17. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

18. The rejections under 35 U.S.C. 103 as being unpatentable based on TADROS ET AL (US 2005/0100853), and citing WHEELER, deceased ET AL (US 5,335,675) has been withdrawn in view of Applicant's arguments presented in the Interview on 10/20/2022 and in Applicant's arguments filed 10/27/2022.

WHEELER, deceased ET AL '675 does not provide adequately specific teachings or suggestions with respect to the application of the disclosed polyurethane elastomers in dental applications.

Response to Arguments

19. Applicant's arguments filed 10/27/2022 with respect to the nonstatutory double patent rejections and **provisional** nonstatutory double patent rejections rejection(s) in the previous Office Action mailed 08/26/2022 have been fully considered and are persuasive in the Terminal Disclaimers filed 10/27/2022.

20. Applicant's arguments filed 10/27/2022 and Applicant's arguments presented during the Interview on 10/20/2022 with respect to the rejections under 35 U.S.C. 103 based on TADROS ET AL (US 2005/0100853) and citing WHEELER, deceased ET AL (US 5,335,675) have been fully considered and are persuasive.

WHEELER, deceased ET AL '675 does not provide adequately specific teachings or suggestions with respect to the application of the disclosed polyurethane elastomers in dental applications.

However, upon further consideration, the present Office Action contains new ground(s) of rejection under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, (new matter) in view of the Claim Amendments filed 10/27/2022.

Conclusion

21. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Vivian Chen (Vivian.chen@uspto.gov) whose telephone number is (571) 272-1506. The examiner can normally be reached on Monday through Thursday from 8:30 AM to 6 PM. The examiner can also be reached on alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Callie Shosho, can be reached on (571) 272-1123. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

The General Information telephone number for Technology Center 1700 is (571) 272-1700.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

November 20, 2022

/Vivian Chen/
Primary Examiner, Art Unit 1787

Examiner-Initiated Interview Summary	**Application No.** 17/858,825	**Applicant(s)** LI et al.		
	Examiner VIVIAN CHEN	**Art Unit** 1787	**AIA (First Inventor to File) Status** Yes	**Page** 1 of 2

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
VIVIAN CHEN	Primary Examiner	Telephonic
Mr. Franklin Chu	Attorney	

Date of Interview: 18 November 2022

Issues Discussed:

35 U.S.C. 112

The Examiner informed Mr. Chu that the Claim Amendments discussed in the Interview on 10/20/2022 and filed 10/27/2022 would address the outstanding rejections under 35 USC 112(b) in the previous Office Action mailed 08/26/2022.

However, upon closer review of the disclosure as originally filed (and the parent applications), it appears that the the disclosure as originally filed (including the parent applications) do NOT provide adequate support for claim limitations requiring the polymers themselves (e.g., copolyester; thermoplastic polyurethane elastomer) to have specific physical properties and therefore raise issues of new matter, since the disclosure as originally filed (and of the parent applications) only disclose (or claim) various LAYERS AS A WHOLE having specific physical properties.

The Examiner also noted that there may also be issues related to the effective filing date of the claims in the present application due to the newly clarified requirement that the polymers themselves have the specified physical properties.

The Examiner apologized for mistakenly informing Mr. Chu that the proposed Amendments and Terminal Disclaimer discussed in the Interview on 10/20/2022 would resolve all outstanding issues and make the application allowable.

The Examiner indicated that the next Office Action would be non-final, which will give Applicant a better opportunity to address these issues (and a new double patenting rejection).

/VIVIAN CHEN/ Primary Examiner, Art Unit 1787	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

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Examiner-Initiated Interview Summary	**Application No.** 17/858,825	**Applicant(s)** LI et al.		
	Examiner VIVIAN CHEN	**Art Unit** 1787	**AIA (First Inventor to File) Status** Yes	**Page** **2 of 2**

Applicant recordation instructions: It is not necessary for applicant to provide a separate record of the substance of interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

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Notice of References Cited	Application/Control No. 17/858,825	Applicant(s)/Patent Under Reexamination LI et al.	
	Examiner VIVIAN CHEN	Art Unit 1787	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-11213369-B2	01-2022	Li; Chunhua	B32B27/34	1/1
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/858,825	LI et al.
	Examiner	Art Unit
	VIVIAN CHEN	1787

CPC - Searched*		
Symbol	**Date**	**Examiner**
(see EAST text search history printout)	08/11/2022	/vc/
(see PE2E text search history printout)	11/18/2022	/vc/

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
inventor / assignee / applicant search (PE2E, EAST)	08/11/2022	/vc/
EAST text search history printout	08/11/2022	/vc/
related applications - 13/470,681; 15/476,655; 16/835,101; 17/553,590	08/11/2022	/vc/
inventor / assignee / applicant search (PE2E)	11/20/2022	/vc/
PE2E text search history printout	11/20/2022	/vc/
related application - 17/902,445	11/20/2022	/vc/

/VIVIAN CHEN/ Primary Examiner, Art Unit 1787	

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/858,825	LI et al.
	Examiner	Art Unit
	VIVIAN CHEN	1787

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/VIVIAN CHEN/ Primary Examiner, Art Unit 1787	

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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/858,825	LI et al.
	Examiner	Art Unit
	VIVIAN CHEN	1787

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	08/22/2022	11/20/2022							
	1	✓	✓							
	2	✓	✓							
	3	✓	✓							
	4	✓	✓							
	5	✓	✓							
	6	✓	✓							
	7	✓	✓							
	8	✓	-							
	9	✓	-							
	10	✓	-							
	11	✓	-							
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	31		✓							
	32		✓							
	33		✓							
	34		✓							

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ClearCorrect v. Align - IPR2025-00819

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L500	3935	((Chunhua near1 li) or (yan near1 chen) or (Heinz near1 pudleiner) or (klaus near1 meyer) or (joerg near1 nickel) or (craig near1 pehlert)).in,aanm. or (align).as,aanm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:04 PM
L501	1367	(soft or ((polyurethane or urethane) near2 (elastomer$3 or rubber$2))) with (flexural near1 modulus)	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:04 PM
L502	166	(soft or ((polyurethane or urethane) near2 (elastomer$3 or rubber$2))) with (ultimate near2 tensile near2 strength)	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:04 PM
L503	791	(soft or ((polyurethane or urethane) near2 (elastomer$3 or rubber$2))) with (elongation near2 break)	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:05 PM
L504	36527	(soft or ((polyurethane or urethane) near2 (elastomer$3 or rubber$2))) with (hardness or shore)	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:05 PM
L505	26481	(orthodontic or dental) with (appliance or splint or brace or tray or plate)	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:05 PM
L506	17397	(orthodontic or dental) near2 (appliance or splint or brace or tray or plate)	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:05 PM
L507	1523	500 AND 506	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:06 PM
L508	18	507 AND 501 AND 502 AND 503 AND 504	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:07 PM
L509	18	505 AND 501 AND 502 AND 503 AND 504	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:16 PM
L510	18	501 AND 502 AND 503 AND 504	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:17 PM
L511	58284	(B32B27/36 or B32B27/08 or B32B27/34 or	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:17 PM

		B32B27/40 or A61C7/08 or B32B27/285 or B32B27/32 or B32B25/20 or B32B2375/00 or B32B2555/00 or B32B2323/04 or B32B2371/00 or B32B2323/10 or B32B2377/00 or B32B2367/00).cpc. or (a61c7/08 or a61c19/06 or a61f5/56 or a63b71/085).cpc.					
L512	18	511 AND 501 AND 502 AND 503	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:18 PM
L513	34780	(flexural near1 modulus)	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:18 PM
L514	48933	((ultimate OR break OR breaking) near5 (tensile near2 strength))	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:19 PM
L515	61711	(elongation near2 (break OR breaking))	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:20 PM
L516	649916	(hardness OR shore OR durometer)	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:20 PM
L517	2772	((polyurethane OR urethane) near2 (elastomer$3 OR rubber$2)).ab.	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:21 PM
L518	31	517 AND 516 AND 515 AND 514 AND 513	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:21 PM
L519	31	518 NOT 500	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:22 PM
L520	0	518 AND 506	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:22 PM
L521	7	518 AND medical	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 06:22 PM
L522	130076	(flexural near1 modulus)	(FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT)	OR	ON	ON	2022/11/18 06:26 PM
L523	228741	((ultimate OR break OR breaking) near5 (tensile	(FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH,	OR	ON	ON	2022/11/18 06:27 PM

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		near2 strength))	CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT)				
L524	404372	(elongation near2 (break OR breaking))	(FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT)	OR	ON	ON	2022/11/18 06:27 PM
L525	3889075	(hardness OR shore OR durometer)	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)	OR	ON	ON	2022/11/18 06:27 PM
L526	963	((polyurethane OR urethane) WITH (elastomer$3 OR rubber$2)) AND 522 AND 523 AND 524 AND 525	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)	OR	ON	ON	2022/11/18 06:28 PM
L527	138410	(orthodontic OR dental) near2 (appliance OR splint OR brace OR tray	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD,	OR	ON	ON	2022/11/18 06:29 PM

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		OR plate OR retainer)	DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)				
L528	44	526 AND 527	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)	OR	ON	ON	2022/11/18 06:29 PM
L529	17997	(orthodontic OR dental) near2 (appliance OR splint OR brace OR tray OR plate OR retainer)	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/18 07:21 PM

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

To: patentdocket@wsgr.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 107046

Dec 01, 2022 03:35:14 AM

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Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 107046 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

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Application	Document	Mailroom Date	Attorney Docket No.
17858825	CTNF	12/01/2022	22773-826.310
	EXIN	12/01/2022	22773-826.310
	892	12/01/2022	22773-826.310

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Monday - Friday 6:00 a.m. to 12:00 a.m.

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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/858,825	07/06/2022	Chunhua LI	22773-826.310	1348

107046 7590 02/02/2023

Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304

EXAMINER	
CHEN, VIVIAN	

ART UNIT	PAPER NUMBER
1787	

NOTIFICATION DATE	DELIVERY MODE
02/02/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentdocket@wsgr.com

Applicant-Initiated Interview Summary	**Application No.** 17/858,825	**Applicant(s)** LI et al.		
	Examiner VIVIAN CHEN	**Art Unit** 1787	**AIA (First Inventor to File) Status** Yes	**Page** 1 of 2

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
VIVIAN CHEN	Primary Examiner	Telephonic
Mr. Franklin Chu	Attorney	
Ms. Esther Kepplinger	Attorney	

Date of Interview: 19 January 2023

Issues Discussed:

Other

Mr. Chuu discussed the proposed Claim Amendments emailed 01/09/2023 with respect to: (i) the outstanding rejections under 35 USC 112(a); and (ii) the issue of effective priority dates for the claims.

The Examiner indicate that the proposed Claim Amendments emailed 01/09/2023 would NOT fully address (i) and (ii) above, since the proposed language "layer HAS a single polymer" still allows for the presence of other materials which allows the physical properties of the "single polymer" to be different from the physical properties of the layer AS A WHOLE.

The Examiner suggested 2 possible claim amendments which would probably simultaneously resolve both (i) and (ii) above:

(1) claim language such as "...layer CONSISTING of a single polymer, wherein the POLYMER has [specific physical properties]..."

(2) claim language such as "...layer contains a SINGLE POLYMER, wherein the LAYER has [specific physical properties]..."

Option (2) is the most clearly supported by the disclosure as originally filed and preferred by the Examiner.

Option (1) is only implicitly supported by the disclosure as originally filed since for a layer CONSISTING of a single material, the physical properties of the layer and the material necessarily would be effectively the same. The Examiner further noted that the use of "consisting" language makes option (1) substantially more restrictive than option (2), which allows for the presence of other non-polymeric materials (e.g., conventional additives, etc.).

No definite agreement on patentability was reached.

ATTACHMENT: 17858825-Interview-Agenda-09-JAN-2023-email.pdf

☑ Attachment

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Applicant-Initiated Interview Summary	**Application No.** 17/858,825	**Applicant(s)** LI et al.		
	Examiner VIVIAN CHEN	**Art Unit** 1787	**AIA (First Inventor to File) Status** Yes	**Page** **2 of 2**

/VIVIAN CHEN/ Primary Examiner, Art Unit 1787	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

ClearCorrect Exhibit 1137, Page 274 of 337
ClearCorrect v. Align - IPR2025-00819

For Discussion Purposes Only
Please Do Not Enter

Application No.: 17/858,825
Title: Multilayer Polymer Sheets
Filing Date: July 6, 2022
Examiner: Vivian Chen
Attorney Docket No.: 22773-826.310

Patent Examiner Telephonic Interview Agenda – (January 19th, 2023, 3 PM EST)

Applicant thanks Examiner Chen for her availability at the above indicated time. The interview will be attended by representatives for Applicant, Yahn Lin (Franklin) Chu (Reg. No. 75,946; ychu@wsgr.com) and Esther Kepplinger (Reg. No. 57,243; ekepplinger@wsgr.com), and Examiner Chen.

PROPOSED TOPICS FOR DISCUSSION:

I. Rejections under 35 USC § 112(a)

II. Proposed Amendment:

1. A method of making a multilayer dental aligner for repositioning a patient's teeth from a first arrangement toward a second arrangement, the method comprising:

providing a multilayer sheet comprising three polymer layers, the three polymer layers comprising:

a first layer ~~comprising a~~, wherein the first layer has a single polymer, and wherein the single polymer of the first layer is a co-polyester~~, the co-polyester~~ having a flexural modulus greater than 150,000 psi, an elongation at yield of greater than 4%, a tensile modulus greater than 150,000 psi, a tensile strength at yield of 4000-6500 psi, and an elongation at break of greater than 70%; and

a second layer ~~comprising a~~, wherein the second layer has a single polymer, and wherein the single polymer of the second layer is a thermoplastic polyurethane elastomer~~, the thermoplastic polyurethane elastomer~~ having ~~a flexural modulus greater than 35,000 psi~~, an ultimate tensile strength of greater than 5000 psi; an elongation at break of greater than 200%, and a hardness of 60A to 85D; and

a third layer;

wherein the co-polyester has an elastic modulus greater than the thermoplastic polyurethane elastomer;

providing a mold;

thermoforming the multilayer sheet over the mold to form a plurality of tooth-receiving cavities configured to receive and reposition the patient's teeth from the first arrangement toward the second arrangement; and

trimming excess material from the thermoformed multilayer sheet to form the multilayer dental aligner.

I hereby certify that this correspondence is being filed via EFS-Web with the United States Patent and Trademark Office

on **February 1, 2023**

WILSON SONSINI GOODRICH & ROSATI

By: **/Selena Whitaker-Paquiet /**

Attorney Docket No.: 22773-826.310
Client Ref. No.: 1228.US.D1.C1.C1.C1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Confirmation No.: 1348
Chunhua LI et al.	
Application No.: 17/858,825	Examiner: Vivian CHEN
Filed: July 6, 2022	Art Unit: 1787
For: MULTILAYER POLYMER SHEETS	RESPONSE TO NON-FINAL OFFICE ACTION
Customer No.: 107046	

MAIL STOP: AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

In response to the Non-final Office Action mailed December 1, 2022, please enter the following remarks. This response is submitted prior to the three-month response ending on March 1, 2023. Accordingly, this response is timely filed.

Amendments to the Claims begin on **page 2** of this paper.

Remarks begin on **page 4**.

ClearCorrect Exhibit 1137, Page 276 of 337
ClearCorrect v. Align - IPR2025-00819

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

1. (Currently Amended) A method of making a multilayer dental aligner for repositioning a patient's teeth from a first arrangement toward a second arrangement, the method comprising:

providing a multilayer sheet comprising three polymer layers, the three polymer layers comprising:

a first layer ~~comprising~~ consisting of a co-polyester, the co-polyester having a flexural modulus greater than 150,000 psi, an elongation at yield of greater than 4%, a tensile modulus greater than 150,000 psi, a tensile strength at yield of 4000-6500 psi, and an elongation at break of greater than 70%; and

a second layer ~~comprising~~ consisting of a thermoplastic polyurethane elastomer, the thermoplastic polyurethane elastomer having ~~a flexural modulus greater than 35,000 psi,~~ an ultimate tensile strength of greater than 5000 psi[[;]], an elongation at break of greater than 200%, and a hardness of 60A to 85D; and

a third layer;

wherein the co-polyester has an elastic modulus greater than the thermoplastic polyurethane elastomer;

providing a mold;

thermoforming the multilayer sheet over the mold to form a plurality of tooth-receiving cavities configured to receive and reposition the patient's teeth from the first arrangement toward the second arrangement; and

trimming excess material from the thermoformed multilayer sheet to form the multilayer dental aligner.

2. (Original) The method of claim 1, wherein the co-polyester has a light transmission between 400 nm and 800 nm of greater than about 75%.

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3. (Original) The method of claim 1, wherein the third layer comprises a same or different co-polyester.

4. (Original) The method of claim 1, wherein the first layer is disposed adjacent to the third layer.

5. (Original) The method of claim 1, wherein the first layer is coextruded with or laminated to the third layer.

6. (Original) The method of claim 1, wherein the multilayer sheet further comprises a fourth layer comprising a same or different thermoplastic polyurethane elastomer.

7. (Original) The method of claim 6, wherein the first layer and the third layer are disposed between the second layer and the fourth layer.

8-30. (Canceled)

31. (Previously Presented) The method of claim 1, wherein the thermoplastic polyurethane elastomer comprises a compression set at about 70° C of greater than 40% after 24 hours.

32. (Previously Presented) The method of claim 1, wherein the thermoplastic polyurethane elastomer comprises a light transmission between 400 nm and 800 nm of greater than about 75%.

33. (Previously Presented) The method of claim 1, wherein the co-polyester has a stress relaxation at 24 hours in a wet environment of between 90-100% humidity of greater than 10%.

34. (Previously Presented) The method of claim 1, wherein the first layer is thicker than the second layer.

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REMARKS

Upon entry of the instant amendments, claims 1-7 and 31-34 will be pending. Independent claim 1 has been herein amended. Support for the amendments can be found throughout the application as filed. No new matter is introduced. Reconsideration in view of the remarks herein is respectfully requested.

Examiner Interview Summary

Applicant thanks Examiner Vivian Chen for her time and courtesy during the examiner interview conducted on January 19th, 2023. The interview was attended by Examiner Chen and representatives for Applicant, Esther Kepplinger (Reg. No. 57,243) and Yahn Lin (Franklin) Chu (Reg. No. 75,946). During the interview, the rejections of record and proposed amendments were discussed. Agreement was reached that certain claim language would overcome the asserted priority and § 112 rejections, including, for example, reciting "a first layer ~~comprising~~ consisting of a co-polyester" and "a second layer ~~comprising~~ consisting of a thermoplastic polyurethane elastomer." Applicant respectfully submits that the pending claims have been amended in accordance with the claim language discussed during the interview.

Priority to Parent Applications

The Office Action alleged a lack of compliance with conditions under 35 U.S.C. § 120 for receiving the benefit of an earlier filing date, including to parent applications 13/470,681 (filed 05/14/2012), 15/476,655 (filed 03/31/2017), and 16/835,101 (filed 03/30/2020). Applicant respectfully disagrees. Nonetheless, solely in the interest of expediting allowance, the pending claims have been herein amended. Consistent with the discussions during the examiner interview, independent claim 1 has been amended to recite in part "a first layer consisting of a co-polyester, the co-polyester" having certain properties, and "a second layer consisting of a thermoplastic polyurethane elastomer, the thermoplastic polyurethane elastomer" having certain properties. In view of the present amendments, Applicant respectfully submits that the claimed subject matter is entitled to the benefit of the earlier filing dates of the parent applications, including to May 14, 2012. *See* Office Action, 4. Accordingly, withdrawal of the remarks against the claimed priority is respectfully requested.

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ClearCorrect v. Align - IPR2025-00819

35 USC § 112

Applicant notes with appreciation the withdrawal of the prior rejections under 35 U.S.C. § 112(b) or 35 U.S.C. § 112 (pre-AIA), second paragraph. *See* Office Action, 6.

In the instant Office Action, claims 1-7 and 31-34 were rejected under 35 U.S.C. § 112(a) or 35 U.S.C. § 112 (pre-AIA), first paragraph, as allegedly failing to comply with the written description requirement. Applicant respectfully disagrees. Nonetheless, solely in the interest of expediting allowance, the pending claims have been herein amended. Consistent with the discussions during the examiner interview, independent claim 1 has been amended to recite in part "a first layer consisting of a co-polyester, the co-polyester" having certain properties, and "a second layer consisting of a thermoplastic polyurethane elastomer, the thermoplastic polyurethane elastomer" having certain properties. In view of the present amendments, Applicant respectfully submits that the alleged written description issues have been addressed. Withdrawal of the rejections under 35 U.S.C. § 112 is respectfully requested.

35 USC § 103

Applicant notes with appreciation the withdrawal of the prior rejections under 35 U.S.C. § 103. *See* Office Action, 12-13. As the instant Office Action indicates, "WHEELER, deceased ET AL '675 does not provide adequately specific teachings or suggestions with respect to the application of the disclosed polyurethane elastomers in dental applications." *Id.*

Alleged Double Patenting

Claims 1-7 and 31-34 were provisionally rejected on the ground of alleged nonstatutory double patenting over co-pending Application No. 17/902,445 (Li et al.) in view of Tadros et al. (US 2005/0100853) and in view of Desimone et al. (US 2006/0078841). Without conceding to the Office Action's characterizations of these various references, Applicant respectfully submits that a Terminal Disclaimer has been submitted herewith. Withdrawal of the double patenting rejections and a Notice of Allowance of claims 1-7 and 31-34 is respectfully requested.

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ClearCorrect v. Align - IPR2025-00819

CONCLUSION

In view of the foregoing, Applicant believes all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested. Further, the Commissioner is hereby authorized to charge any additional fees or credit any overpayment in connection with this paper to Deposit Account No. 23-2415.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 206-573-2274.

Respectfully submitted,

Dated: February 1, 2023

/Yahn Lin CHU/
Yahn Lin CHU
Registration No. 75,946

WILSO SONSINI GOODRICH & ROSATI
650 Page Mill Road
Palo Alto, CA 94304-1050
Tel: 650-493-9300
Fax 650-493-6811

PTO/AIA/25 (04-13)
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TERMINAL DISCLAIMER TO OBVIATE A PROVISIONAL DOUBLE PATENTING REJECTION OVER A PENDING "REFERENCE" APPLICATION	Docket Number (Optional) 22773-826.309

In re Application of: Chunhua LI et al.

Application No.: 17/858,825

Filed: July 6, 2022

For: MULTILAYER POLYMER SHEETS

The applicant, Align Technology, Inc., owner of 100 percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of any patent granted on pending **reference Application No. 17/902,445 filed September 2, 2022**, as the term of any patent granted on said **reference** application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending **reference** application. The applicant hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and any patent granted on the **reference** application are commonly owned.

This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the applicant does not disclaim the terminal part of any patent granted on the instant application that would extend to the expiration date of the full statutory term of any patent on said **reference** application, "as the term of any patent granted on said **reference** application may be shortened by any terminal disclaimer filed prior tot he grant of any patent on the pending **reference** application," in the event that: any such patent granted on the pending **reference** application expires for failure to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321, has all claims canceled by a reexamination certificate, is reissued, or is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer filed prior to its grant.

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1. ☐ The undersigned is the applicant. If the applicant is an assignee, the undersigned is authorized to act on behalf of the assignee.

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2. ☑ The undersigned is an attorney or agent of record. Reg. No. 75,946

/Yahn Lin CHU/ — Signature
February 1, 2023 — Date

Yahn Lin CHU — Typed or printed name

Attorney of Record — Title
206-573-2274 — Telephone Number

☑ Terminal disclaimer fee under 37 CFR 1.20(d) included.

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Electronic Patent Application Fee Transmittal				
Application Number:	17858825			
Filing Date:	06-Jul-2022			
Title of Invention:	MULTILAYER POLYMER SHEETS			
First Named Inventor/Applicant Name:	Chunhua LI			
Filer:	Yahn Lin Chu/Selena Whitaker-Paquiet			
Attorney Docket Number:	22773-826.310			
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	**Fee Code**	**Quantity**	**Amount**	**Sub-Total in USD($)**
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
STATUTORY OR TERMINAL DISCLAIMER	1814	1	170	170
		Total in USD ($)		**170**

Electronic Acknowledgement Receipt	
EFS ID:	47465112
Application Number:	17858825
International Application Number:	
Confirmation Number:	1348
Title of Invention:	MULTILAYER POLYMER SHEETS
First Named Inventor/Applicant Name:	Chunhua LI
Customer Number:	107046
Filer:	Yahn Lin Chu/Selena Whitaker-Paquiet
Filer Authorized By:	Yahn Lin Chu
Attorney Docket Number:	22773-826.310
Receipt Date:	01-FEB-2023
Filing Date:	06-JUL-2022
Time Stamp:	17:06:00
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$170
RAM confirmation Number	E202321H06353772
Deposit Account	232415
Authorized User	Selena Whitaker-Paquiet
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	22773_826_310_exTRNSMTL.pdf	265887 88766c1f6150e41a97f9821ceaa447cd1c2e077f	no	1
Warnings:					
Information:					
2		22773_826_310_exResp_NFOA_dtd_12_1_2022.pdf	117662 474b25c39c46344911f1c5533c6e268192eaa981	yes	6

Multipart Description/PDF files in .zip description

Document Description	Start	End
Amendment/Request for Reconsideration-After Non-Final Rejection	1	1
Claims	2	3
Applicant Arguments/Remarks Made in an Amendment	4	6

Warnings:					
Information:					
3	Terminal Disclaimer Filed	22773_826_310_exTerminal_Disclaimer_Ref_Applns.pdf	1424888 a4055b8c3fe8b0c7a3a8f30487a238365e56bcf1	no	1
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	37693 73b01923fa39583dc9669a95207ab4b69ab4a2bc	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1846130		

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

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

New International Application Filed with the USPTO as a Receiving Office

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Doc Code: TRAN.LET

Document Description: Transmittal Letter

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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Total Number of Pages in This Submission: 8

Application Number	17/858,825
Filing Date	July 6, 2022
First Named Inventor	Chunhua LI et al.
Art Unit	1787
Examiner Name	Vivian CHEN
Attorney Docket Number	22773-826.310

ENCLOSURES (*Check all that apply*)

- ☐ Fee Transmittal Form
- ☑ Fee Attached
- ☑ Amendment/Reply
- ☐ After Final
- ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
- ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☑ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s) _____
- ☐ Landscape Table on CD
- ☐ After Allowance Communication to TC
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☐ Other Enclosure(s) (please Identify below):

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	WILSON SONSINI GOODRICH & ROSATI		
Signature	/Yahn Lin CHU/		
Printed name	Yahn Lin CHU		
Date	February 1, 2023	Reg. No.	75,946

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Typed or printed name	Selena WHITAKER-PAQUIET	Date	February 1, 2023

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Feb 02, 2023 03:40:10 AM

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Palo Alto, CA 94304
UNITED STATES

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Application	Document	Mailroom Date	Attorney Docket No.
17858825	EXIN	02/02/2023	22773-826.310
	OA.APPENDIX	02/02/2023	22773-826.310

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PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

Application Number * 17/858,825 *	Application/Control No. 17/858,825	Applicant(s)/Patent under Reexamination LI et al.	
	Examiner CHEN, VIVIAN	Art Unit 1787	

Document Code - DISQ	Internal Document - DO NOT MAIL

TERMINAL DISCLAIMER	☑ APPROVED	☐ DISAPPROVED
Date Filed: 01 February 2023	This patent is subject to a Terminal Disclaimer	

Approved/Disapproved by:

/JEAN PROCTOR/

Technology Center: OPLC

Telephone: (571)272-1040

_____

PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/858,825	Filing Date 07/06/2022	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

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

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	02/01/2023	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 11	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 1	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/BRENDA MURPHY/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

UNITED STATES PATENT AND TRADEMARK OFFICE

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

NOTICE OF ALLOWANCE AND FEE(S) DUE

107046 7590 02/17/2023

Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304

EXAMINER
CHEN, VIVIAN

ART UNIT	PAPER NUMBER
1787	

DATE MAILED: 02/17/2023

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/858,825	07/06/2022	Chunhua LI	22773-826.310	1348

TITLE OF INVENTION: MULTILAYER POLYMER SHEETS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	05/17/2023

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PTOL-85 (Rev. 02/11)

ClearCorrect Exhibit 1137, Page 292 of 337
ClearCorrect v. Align - IPR2025-00819

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

107046 7590 02/17/2023
Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/858,825	07/06/2022	Chunhua LI	22773-826.310	1348

TITLE OF INVENTION: MULTILAYER POLYMER SHEETS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	05/17/2023

EXAMINER	ART UNIT	CLASS-SUBCLASS
CHEN, VIVIAN	1787	428-332000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑Issue Fee ❑Publication Fee (if required) ❑Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

ClearCorrect Exhibit 1137, Page 293 of 337
ClearCorrect v. Align - IPR2025-00819

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
CHEN, VIVIAN	
ART UNIT	PAPER NUMBER
1787	

DATE MAILED: 02/17/2023

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 02/11)

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

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

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

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 17/858,825	Applicant(s) LI et al.	
	Examiner VIVIAN CHEN	Art Unit 1787	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the Amendment and RCE and Terminal Disclaimer filed 02/01/2023.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1-7 and 31-34 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information , please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☑ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 08/23/2022.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/VIVIAN CHEN/
Primary Examiner, Art Unit 1787

EXAMINER'S REASONS FOR ALLOWANCE

Status of Claims

1. Claims 1-7, 31-34 is/are allowed.

2. Claims 8-30 is/are previously cancelled.

Priority

3. Applicant's claim for the benefit of a prior-filed application under 35 U.S.C. 119(e) or under 35 U.S.C. 120, 121, 365(c), or 386(c) is acknowledged.

In view of the Claim Amendments filed 02/01/2023, claims 1-7, 31-34 have an effective filing date of **05/14/2012**.

Terminal Disclaimer

4. The terminal disclaimer filed on 02/01/2023 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of any patent issuing from Application No. 17/902,445 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Reasons for Allowance

5. The following is an examiner's statement of reasons for allowance:

The prior art of record fails to disclose the recited method of forming a multilayer dental aligner, wherein the multilayer sheet comprising: (i) the recited first layer **consisting** of a copolyester with the recited properties; (ii) the recited second layer **consisting** of a thermoplastic

polyurethane elastomer with the recited properties; and (iii) the recited third layer; wherein the copolyester and the thermoplastic polyurethane elastomer has the recited difference in elastic modulus (claim 1).

The provisional rejections on the ground of nonstatutory double patenting based on copending Application No. 17/902,445 (LI ET AL) in the previous Office Action mailed 12/01/2022 have been withdrawn in view of the Terminal Disclaimers filed 02/01/2023.

TADROS ET AL (US 2005/0100853) discloses the use of layers containing polymeric blends, and therefore fails to specifically disclose or suggest a multilayer sheet containing at least one layer **consisting** of the specified copolyester combined with at least one layer **consisting** of the specified thermoplastic polyurethane elastomer.

DESIMONE ET AL (US 2006/0078841) and LI ET AL (US 2011/0039223) fail to specifically disclose or suggest a multilayer sheet containing at least one layer **consisting** of the specified thermoplastic polyurethane elastomer.

KALILI (US 2011/0020761) and CN 108394152 fail to specifically disclose or suggest a multilayer sheet containing at least one layer **consisting** of the specified copolyester.

RIEDL ET AL (US 2012/035484) fails to disclose or suggest multilayer sheets containing at least one layer **consisting** of the specified copolyester which are formed into an orthodontic or dental appliances.

WO 2010/043419 (HINZ-WO ‘419) and KALLILI (US 2011/0020761) and ADELL ET AL (US 7,201,575) and DESIMONE ET AL (US 2008/0248438) and WHEELER, deceased ET AL (US 5,335,675) and DE 102010036107 fail to specifically disclose or suggest multilayer sheets containing at least one layer **consisting** of the specified copolyester and at least one layer **consisting** of the specified thermoplastic polyurethane elastomer.

CHIN ET AL (US 2004/0146670) and CN 103374211 and ABBATTE ET AL (US 4,755,139) and WILLISON ET AL (US 2007/0087300) and KRANENBURG-VAN DIJK ET AL (US 2002/0146549) and WOLFE, JR (4,843,124) and HAGMAN (US 4,739,012) and TAKAGI ET AL (US 6,746,757) fail to disclose multilayer sheets containing three layers or more which contain at least one layer **consisting** of the specified copolyester and at least one layer **consisting** of the specified thermoplastic polyurethane elastomer, and which are formed into an orthodontic or dental appliances.

MATSUMOTO ET AL (US 4,410,595) and WHEELER, deceased ET AL (US 5,335,675) fail to disclose multilayer sheets formed into orthodontic or dental appliances.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Vivian Chen whose telephone number is (571) 272-1506. The examiner can normally be reached on Monday through Thursday from 8:30 AM to 6 PM. The examiner can also be reached on alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Callie Shosho, can be reached on (571) 272-1123. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

The General Information telephone number for Technology Center 1700 is (571) 272-1700.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

February 11, 2023

/Vivian Chen/
Primary Examiner, Art Unit 1787

Notice of References Cited	Application/Control No. 17/858,825	Applicant(s)/Patent Under Reexamination LI et al.	
	Examiner VIVIAN CHEN	Art Unit 1787	Page 1 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20110039223-A1	02-2011	Li; Chunhua	B29C45/0001	264/16
*	B	US-20120315484-A1	12-2012	Riedl; Josef	B29C48/307	156/306.6
*	C	US-20110020761-A1	01-2011	Kalili; Thomas	A61C7/08	433/214
*	D	US-7201575-B2	04-2007	Adell; Loren S.	A61C13/0001	433/80
*	E	US-20080248438-A1	10-2008	DeSimone; Joseph M.	A61C7/08	433/6
*	F	US-5335675-A	08-1994	Wheeler, deceased; Robert G.	B29C49/00	128/842
*	G	US-20040146670-A1	07-2004	Chin, Albert	B29C48/13	428/35.2
*	H	US-4755139-A	07-1988	Abbatte; Gerard P.	A61C7/08	433/6
*	I	US-20070087300-A1	04-2007	Willison; Brian D.	A61C7/12	433/6
*	J	US-20020146549-A1	10-2002	Kranenburg-Van Dijk, Saskia I.	B32B27/06	428/480
*	K	US-4843124-A	06-1989	Wolfe, Jr.; James R.	C08L11/00	525/173
*	L	US-4739012-A	04-1988	Hagman; John F.	C08L27/06	525/166
*	M	US-6746757-B1	06-2004	Takagi; Kiyoji	B32B27/34	428/476.3

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
*	N	CN 108394152 A	08-2018	CN	WANG	
*	O	WO 2010/043419 A	04-2010	WO	HINZ et al	
*	P	DE 102010036107 A	03-2012	DE	SCHEU et al	
*	Q	CN 103374211 A	10-2013	CN	BAI et al	
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

ClearCorrect Exhibit 1137, Page 301 of 337
ClearCorrect v. Align - IPR2025-00819

Notice of References Cited	Application/Control No. 17/858,825	Applicant(s)/Patent Under Reexamination LI et al.	
	Examiner VIVIAN CHEN	Art Unit 1787	Page 2 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-4410595-A	10-1983	Matsumoto; Koichi	B32B27/34	428/424.4
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

ClearCorrect Exhibit 1137, Page 302 of 337
ClearCorrect v. Align - IPR2025-00819

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/858,825	LI et al.
	Examiner	Art Unit
	VIVIAN CHEN	1787

CPC						
Symbol					Type	Version
A61C	/	7	/	08	F	2013-01-01
B32B	/	27	/	285	I	2013-01-01
B32B	/	7	/	022	I	2019-01-01
B32B	/	25	/	08	I	2013-01-01
B32B	/	25	/	20	I	2013-01-01
B32B	/	27	/	08	I	2013-01-01
B32B	/	27	/	281	I	2013-01-01
B32B	/	27	/	286	I	2013-01-01
B32B	/	27	/	308	I	2013-01-01
B32B	/	27	/	32	I	2013-01-01
B32B	/	27	/	34	I	2013-01-01
B32B	/	27	/	36	I	2013-01-01
B32B	/	27	/	365	I	2013-01-01
B32B	/	27	/	40	I	2013-01-01
B29C	/	51	/	14	I	2013-01-01
B32B	/	2323	/	04	A	2013-01-01
B32B	/	2323	/	10	A	2013-01-01
B32B	/	2367	/	00	A	2013-01-01
B32B	/	2371	/	00	A	2013-01-01
B32B	/	2375	/	00	A	2013-01-01
B32B	/	2377	/	00	A	2013-01-01
B32B	/	2555	/	00	A	2013-01-01
B32B	/	2307	/	50	A	2013-01-01
B32B	/	2307	/	51	A	2013-01-01
B32B	/	25	/	14	A	2013-01-01
B32B	/	2250	/	40	A	2013-01-01
B32B	/	2323	/	16	A	2013-01-01
B32B	/	2319	/	00	A	2013-01-01
B32B	/	27	/	30	A	2013-01-01
B32B	/	2323	/	00	A	2013-01-01
B32B	/	2307	/	40	A	2013-01-01

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	11	
/VIVIAN CHEN/ Primary Examiner, Art Unit 1787	11 February 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20230210

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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/858,825	LI et al.
	Examiner	Art Unit
	VIVIAN CHEN	1787

CPC						
Symbol					Type	Version
B32B	/	2383	/	00	A	2013-01-01
B32B	/	27	/	302	A	2013-01-01
B32B	/	27	/	283	A	2013-01-01
B32B	/	2333	/	04	A	2013-01-01
A61C	/	13	/	00	A	2013-01-01
A61F	/	5	/	56	A	2013-01-01
A61C	/	19	/	06	A	2013-01-01
Y10T	/	428	/	31551	A	2015-04-01
Y10T	/	428	/	31565	A	2015-04-01
Y10T	/	428	/	31786	A	2015-04-01
A61C	/	7	/	00	A	2013-01-01
A63B	/	71	/	085	A	2013-01-01
B32B	/	2250	/	03	A	2013-01-01
B32B	/	2274	/	00	A	2013-01-01
B32B	/	2307	/	412	A	2013-01-01
B32B	/	2307	/	536	A	2013-01-01
B32B	/	2307	/	54	A	2013-01-01
B32B	/	2307	/	546	A	2013-01-01
B32B	/	2535	/	00	A	2013-01-01
B32B	/	2250	/	24	A	2013-01-01
B29K	/	2067	/	00	A	2013-01-01
B29K	/	2075	/	00	A	2013-01-01
B29K	/	2995	/	0026	A	2013-01-01
B29K	/	2995	/	007	A	2013-01-01
B29K	/	2995	/	0077	A	2013-01-01
B29K	/	2995	/	0082	A	2013-01-01
B29L	/	2031	/	753	A	2013-01-01

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	11	
/VIVIAN CHEN/ Primary Examiner, Art Unit 1787	11 February 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20230210

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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/858,825	LI et al.
	Examiner	**Art Unit**
	VIVIAN CHEN	1787

CPC Combination Sets				
Symbol	**Type**	**Set**	**Ranking**	**Version**
/ /				

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	11	
/VIVIAN CHEN/ Primary Examiner, Art Unit 1787	11 February 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/858,825	LI et al.
	Examiner	Art Unit
	VIVIAN CHEN	1787

INTERNATIONAL CLASSIFICATION				
CLAIMED				
A61C7/08	/	7	/	08
B32B27/28	/	27	/	28
B32B7/022	/	7	/	022
B32B25/08	/	25	/	08
B32B25/20	/	25	/	20
B32B27/08	/	27	/	08
B32B27/30	/	27	/	30
B32B27/32	/	27	/	32
B32B27/34	/	27	/	34
B32B27/36	/	27	/	36
B32B27/40	/	27	/	40
B29C51/14	/	51	/	14
B32B25/14	/	25	/	14
A61C13/00	/	13	/	00
A61F5/56	/	5	/	56
A61C19/06	/	19	/	06
A61C7/00	/	7	/	00
A63B71/08	/	71	/	08
B29K67/00	/	67	/	00
B29K75/00	/	75	/	00
B29L31/00	/	31	/	00

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	11	
/VIVIAN CHEN/ Primary Examiner, Art Unit 1787	11 February 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20230210

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	Examiner	Art Unit
	VIVIAN CHEN	1787

CROSS REFERENCES(S)						
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	11	
/VIVIAN CHEN/ Primary Examiner, Art Unit 1787	11 February 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/858,825	LI et al.
	Examiner	Art Unit
	VIVIAN CHEN	1787

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1		10		19		28								
2	2		11		20		29								
3	3		12		21		30								
4	4		13		22	8	31								
5	5		14		23	9	32								
6	6		15		24	10	33								
7	7		16		25	11	34								
	8		17		26										
	9		18		27										

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	11	
/VIVIAN CHEN/ Primary Examiner, Art Unit 1787	11 February 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office Part of Paper No.: 20230210

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/858,825	LI et al.
	Examiner	Art Unit
	VIVIAN CHEN	1787

CPC - Searched*		
Symbol	**Date**	**Examiner**
(see EAST text search history printout)	08/11/2022	/vc/
(see PE2E text search history printout)	11/18/2022	/vc/
(see PE2E text search history printout)	02/10/2023	/vc/

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
inventor / assignee / applicant search (PE2E, EAST)	08/11/2022	/vc/
EAST text search history printout	08/11/2022	/vc/
related applications - 13/470,681; 15/476,655; 16/835,101; 17/553,590	08/11/2022	/vc/
inventor / assignee / applicant search (PE2E)	11/20/2022	/vc/
PE2E text search history printout	11/20/2022	/vc/
related application - 17/902,445	11/20/2022	/vc/
inventor / assignee / applicant search (PE2E)	02/10/2023	/vc/
PE2E text search history printout	02/10/2023	/vc/

/VIVIAN CHEN/ Primary Examiner, Art Unit 1787	

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
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	Examiner	Art Unit
	VIVIAN CHEN	1787

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	(see Interference search history in PE2E text search printout)	02/10/2023	/vc/

/VIVIAN CHEN/ Primary Examiner, Art Unit 1787	

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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
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	Examiner	**Art Unit**
	VIVIAN CHEN	1787

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	08/22/2022	11/20/2022	02/11/2023						
1	1	✓	✓	=						
2	2	✓	✓	=						
3	3	✓	✓	=						
4	4	✓	✓	=						
5	5	✓	✓	=						
6	6	✓	✓	=						
7	7	✓	✓	=						
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8	31		✓	=						
9	32		✓	=						
10	33		✓	=						
11	34		✓	=						

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PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L529	1	("20220338957").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:42 PM
L530	106369	(A61C13/00 OR A61C19/06 OR A61C7/00 OR A61C7/08 OR A61F5/56 OR A63B71/085 OR B29C51/14 OR B29K2067/00 OR B29K2075/00 OR B29K2995/0026 OR B29K2995/007 OR B29K2995/0077 OR B29K2995/0082 OR Y10T428/31551 OR Y10T428/31565 OR Y10T428/31786 OR B32B2250/03 OR B32B2250/24 OR B32B2250/40 OR B32B2274/00 OR B32B2307/40 OR B32B2307/412 OR B32B2307/50 OR B32B2307/51 OR B32B2307/536 OR B32B2307/54 OR B32B2307/546 OR B32B2319/00 OR B32B2323/00 OR B32B2323/04 OR B32B2323/10 OR B32B2323/16 OR B32B2333/04 OR B32B2367/00 OR B32B2371/00 OR B32B2375/00 OR B32B2377/00 OR B32B2383/00 OR B32B25/08 OR B32B25/14 OR B32B25/20 OR B32B2535/00 OR B32B2555/00 OR B32B27/08 OR B32B27/281 OR B32B27/283 OR B32B27/285 OR B32B27/286 OR B32B27/30 OR B32B27/302 OR B32B27/308 OR	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:44 PM

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		B32B27/32 OR B32B27/34 OR B32B27/36 OR B32B27/365 OR B32B27/40 OR B32B7/022 OR B29L2031/753).cpc.					
L531	30473	((Chunhua near1 li) OR (yan near1 chen) OR (Heinz near1 pudleiner) OR (klaus near1 meyer) OR (joerg near1 nickel) OR (craig near1 pehlert)).in,aanm. OR (align OR bayer).as,aanm.	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:45 PM
L532	29852	(("CHEN; YAN".ine. OR "LI; CHUNHUA".ine. OR "MEYER; KLAUS".ine. OR "NICKEL; JOERG".ine. OR "PEHLERT; CRAIG".ine. OR "PUDLEINER; HEINZ".ine.)) OR (align OR bayer).as,aanm.	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:45 PM
L533	1687	531 AND 530	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:46 PM
L538	18304	(orthodontic OR orthodontal OR dental) near2 (appliance OR splint OR brace OR tray OR plate OR retainer)	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:47 PM
L539	34410	flexural ADJ modulus	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:47 PM
L540	53	533 AND 538 AND 539	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:48 PM
L541	401	539 AND 538	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:49 PM
L542	4206	(elongation near2 yield$3) AND (elongation near2 break$4)	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:50 PM
L543	66	541 AND 542	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:50 PM
L544	297296	tensile ADJ strength	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:51 PM
L545	66	544 AND 543	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:51 PM
L546	5654	(orthodontic OR orthodontal OR dental) near2 (appliance OR splint OR brace OR tray	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:51 PM

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		OR plate OR retainer).clm.					
L547	50	546 AND 545	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:51 PM
L548	1193	(elongation near2 yield$3) AND (elongation near2 break$4) AND (tensile ADJ modulus) AND (tensile ADJ strength)	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:53 PM
L549	38	547 AND 548	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:53 PM
L550	621	(flexural ADJ modulus) AND (elongation near2 yield$3) AND (elongation near2 break$4) AND (tensile ADJ modulus) AND (tensile ADJ strength)	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:54 PM
L551	38	546 AND 550	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:54 PM
L552	261187	(polyurethane OR urethane) WITH (rubber$4 OR elastomer$4)	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:57 PM
L553	28	552 AND 551	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 05:57 PM
L554	42	538 AND 550 AND 552	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:00 PM
L555	0	553 NOT 531	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:01 PM
L556	0	554 NOT 531	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:01 PM
L557	9171	(rubber$4 OR elastomer$4 OR polyurethane OR urethane) WITH (elongation near2 break$4)	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:02 PM
L558	100843	(rubber$4 OR elastomer$4 OR polyurethane OR urethane) WITH (hardness OR shore OR durometer)	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:03 PM
L559	23833	(rubber$4 OR elastomer$4 OR polyurethane OR urethane) WITH (tensile ADJ strength)	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:03 PM
L560	14	538 AND (559 AND 558 AND 557)	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:04 PM
L561	27161	(rubber$4 OR	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10

		elastomer$4 OR polyurethane OR urethane OR soft) WITH (tensile ADJ strength)					06:04 PM
L562	122002	(rubber$4 OR elastomer$4 OR polyurethane OR urethane OR soft) WITH (hardness OR shore OR durometer)	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:04 PM
L563	9614	(rubber$4 OR elastomer$4 OR polyurethane OR urethane OR soft) WITH (elongation near2 break$4)	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:04 PM
L565	37	538 AND (561 AND 562 AND 563)	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:05 PM
L566	23	550 AND 565	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:06 PM
L567	75778	(rubber$4 OR elastomer$4 OR polyurethane OR urethane OR soft OR softer) WITH (elongation near2 break$4)	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)	OR	ON	ON	2023/02/10 06:08 PM
L568	695452	(rubber$4 OR elastomer$4 OR polyurethane OR urethane OR soft OR softer) WITH (hardness OR shore OR durometer)	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)	OR	ON	ON	2023/02/10 06:08 PM
L569	196676	(rubber$4 OR elastomer$4 OR polyurethane OR urethane OR soft OR softer) WITH (tensile ADJ strength)	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV,	OR	ON	ON	2023/02/10 06:09 PM

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			MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)				
L570	16656	569 AND 568 AND 567	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)	OR	ON	ON	2023/02/10 06:09 PM
L571	146857	(orthodontic OR orthodontal OR dental) near2 (appliance OR splint OR brace OR tray OR plate OR retainer)	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)	OR	ON	ON	2023/02/10 06:10 PM
L572	49	571 AND 570	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)	OR	ON	ON	2023/02/10 06:10 PM
L573	11	((polyester OR copolyester OR PETG OR hard OR harder) WITH (flexural ADJ modulus)) AND ((polyester OR copolyester OR PETG OR hard OR harder)	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL,	OR	ON	ON	2023/02/10 06:13 PM

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ClearCorrect v. Align - IPR2025-00819

		WITH (elongation near2 yield$3)) AND ((polyester OR copolyester OR PETG OR hard OR harder) WITH (elongation near2 break$4)) AND ((polyester OR copolyester OR PETG OR hard OR harder) WITH (tensile ADJ modulus)) AND ((polyester OR copolyester OR PETG OR hard OR harder) WITH (tensile ADJ strength))	NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)				
L574	7	573 AND 571	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)	OR	ON	ON	2023/02/10 06:14 PM
L575	16656	((rubber$4 OR elastomer$4 OR polyurethane OR urethane OR soft OR softer) WITH (tensile ADJ strength)) AND ((rubber$4 OR elastomer$4 OR polyurethane OR urethane OR soft OR softer) WITH (hardness OR shore OR durometer)) AND ((rubber$4 OR elastomer$4 OR polyurethane OR urethane OR soft OR softer) WITH (elongation near2 break$4))	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)	OR	ON	ON	2023/02/10 06:16 PM
L576	7	575 AND 573 AND 571	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT,	OR	ON	ON	2023/02/10 06:16 PM

ClearCorrect Exhibit 1137, Page 317 of 337
ClearCorrect v. Align - IPR2025-00819

			JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)				
L577	87	571 AND texin$5	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)	OR	ON	ON	2023/02/10 06:21 PM
L578	82	577 AND (polyester OR copolyester OR PETG OR hard OR harder)	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)	OR	ON	ON	2023/02/10 06:21 PM
L579	0	577 AND 573	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)	OR	ON	ON	2023/02/10 06:22 PM
L580	22	578 AND (flexural ADJ modulus)	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV,	OR	ON	ON	2023/02/10 06:23 PM

ClearCorrect Exhibit 1137, Page 318 of 337
ClearCorrect v. Align - IPR2025-00819

			MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)				
L582	24	571 AND ((polyurethane OR urethane) WITH (rubber$4 OR elastomer$4) WITH texin$5)	(FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT)	OR	ON	ON	2023/02/10 06:24 PM
L584	23	538 AND ((polyurethane OR urethane) WITH (rubber$4 OR elastomer$4) WITH texin$5)	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:26 PM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N452	2362	((rubber$4 OR elastomer$4 OR polyurethane OR urethane OR soft OR softer) WITH (tensile ADJ strength)) AND ((rubber$4 OR elastomer$4 OR polyurethane OR urethane OR soft OR softer) WITH (hardness OR shore OR durometer)) AND ((rubber$4 OR elastomer$4 OR polyurethane OR urethane OR soft OR softer) WITH (elongation near2 break$4))	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:16 PM
N453	23	((polyester OR copolyester OR PETG OR hard OR harder) WITH (flexural ADJ	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:17 PM

		modulus)) AND ((polyester OR copolyester OR PETG OR hard OR harder) WITH (elongation near2 yield$3)) AND ((polyester OR copolyester OR PETG OR hard OR harder) WITH (elongation near2 break$4)) AND ((polyester OR copolyester OR PETG OR hard OR harder) WITH (tensile ADJ modulus)) AND ((polyester OR copolyester OR PETG OR hard OR harder) WITH (tensile ADJ strength))					
N454	18304	(orthodontic OR orthodontal OR dental) near2 (appliance OR splint OR brace OR tray OR plate OR retainer)	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:17 PM
N455	23	454 AND 453 AND 452	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:18 PM
N456	37	454 AND 452	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:18 PM
N457	23	454 AND 453	(US-PGPUB; USPAT)	OR	ON	ON	2023/02/10 06:18 PM

UNITED STATES PATENT AND TRADEMARK OFFICE

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

BIB DATA SHEET

CONFIRMATION NO. 1348

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
17/858,825	07/06/2022 RULE	428	1787	22773-826.310

APPLICANTS
ALIGN TECHNOLOGY, INC., San Jose, CA;

INVENTORS
Chunhua LI, Cupertino, CA;
Yan CHEN, Cupertino, CA;
Heinz PUDLEINER, Krefeld, GERMANY;
Klaus MEYER, Dormagen, GERMANY;
Joerg NICKEL, Dormagen, GERMANY;
Craig PEHLERT, Lenox, MA;

**** CONTINUING DATA ***************************
This application is a CON of 17/553,590 12/16/2021
which is a CON of 16/835,101 03/30/2020 PAT 11213369
which is a CON of 15/476,655 03/31/2017 PAT 10973613
which is a DIV of 13/470,681 05/14/2012 PAT 9655691

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****
07/14/2022

Foreign Priority claimed	35 USC 119(a-d) conditions met	Verified and Acknowledged	Met after Allowance	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
❑ Yes ☑ No	❑ Yes ☑ No	/VIVIAN CHEN/ Examiner's Signature	❑ Initials	CA	8	30	3

ADDRESS
Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304
UNITED STATES

TITLE
MULTILAYER POLYMER SHEETS

FILING FEE RECEIVED	FEES: Authority has been given in Paper	
0.00	No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	❑ All Fees ❑ 1.16 Fees (Filing) ❑ 1.17 Fees (Processing Ext. of time) ❑ 1.18 Fees (Issue) ❑ Other _____ ❑ Credit

BIB (Rev. 05/07).

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 4

Complete if Known	
Application Number	17/858,825
Filing Date	07-06-2022
First Named Inventor	LI; Chunhua
Art Unit	1787
Examiner Name	CHEN, VIVIAN
Attorney Docket Number	22773-826.310

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		None			

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
	001	CN-108394152-A	08-14-2018	SUZHOU POLLY POLYMER NEW MATERIAL TECH CO LTD.		☒
	002	JP-H0696486-A	04-08-1994	HITACHI LTD.		☒
	003	JP-H07156349-A	06-20-1995	KUREHA CHEMICAL IND CO LTD., et al.		☒
	004	JP-H11279389-A	10-12-1999	GEN ELECTRIC.		☒

Examiner Signature	/VIVIAN CHEN/	Date Considered	02/10/2023

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /VC/

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 2 of 4

Complete if Known	
Application Number	17/858,825
Filing Date	07-06-2022
First Named Inventor	LI; Chunhua
Art Unit	1787
Examiner Name	CHEN, VIVIAN
Attorney Docket Number	22773-826.310

NON-PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	Include name of the author(in CAPITAL LETTERS),title of the article(when appropriate), title of the item (book,magazine,journal,serial,symposium,catalog,etc.),date,page(s),volume-issue number(s),publisher, city and/or country where published.	T[2]
		None	

Examiner Signature	/VIVIAN CHEN/	Date Considered	02/10/2023

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant's unique citation designation number (optional). 2 Applicant is to place a check mark here if English language Translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /VC/

Substitute for form 1449/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)				Application Number	17/858,825
				Filing Date	07-06-2022
				First Named Inventor	LI; Chunhua
				Art Unit	1787
				Examiner Name	CHEN, VIVIAN
Sheet	3	of	4	Attorney Docket Number	22773-826.310

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Garrett T. Potter/	Date (YYYY-MM-DD)	2022-08-23
Name/Print	Garrett T. Potter	Registration Number	76,602

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /VC/

Privacy Act Statement

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

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

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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To: patentdocket@wsgr.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 107046

Feb 23, 2023 12:22:51 PM

Dear PAIR Customer:

Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 107046 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

Disclaimer:
The list of documents shown below is provided as a courtesy and is not part of the official file wrapper. The content of the images shown in PAIR is the official record.

Application	Document	Mailroom Date	Attorney Docket No.
17858825	NOA	02/17/2023	22773-826.310
	892	02/17/2023	22773-826.310
	1449	02/17/2023	22773-826.310

To view your correspondence online or update your email addresses, please visit us anytime at https://sportal.uspto.gov/secure/myportal/privatepair.

If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

Thank you for prompt attention to this notice,

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Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304

Courtesy Reminder for
Application Serial No: 17/858,825

Attorney Docket No: 22773-826.310
Customer Number: 107046
Date of Electronic Notification: 02/23/2023

This is a courtesy reminder that new correspondence is available for this application. If you have not done so already, please review the correspondence. The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

An email notification regarding the correspondence was sent to the following email address(es) associated with your customer number:
patentdocket@wsgr.com

To view your correspondence online or update your email addresses, please visit us anytime at **https://ppair-my.uspto.gov/pair/PrivatePair.**
If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov or call 1-866-217-9197.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

107046 7590 02/17/2023
Align Technology, Inc. / WSGR
650 Page Mill Road
Palo Alto, CA 94304

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

James Brady	(Typed or printed name)
/James Brady/	(Signature)
April 5, 2023	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/858,825	07/06/2022	Chunhua LI	22773-826.310	1348

TITLE OF INVENTION: MULTILAYER POLYMER SHEETS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	05/17/2023

EXAMINER	ART UNIT	CLASS-SUBCLASS
CHEN, VIVIAN	1787	428-332000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Wilson Sonsini Goodrich & Rosati
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Align Technology, Inc.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): San Jose, CA

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ☒ Corporation or other private group entity ❑ Government

4a. Fees submitted: ☒ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 23-2415

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Garrett T. Potter/ Date April 5, 2023

Typed or printed name Garrett T. Potter, Ph.D. Registration No. 76,602

ClearCorrect Exhibit 1137, Page 328 of 337
ClearCorrect v. Align - IPR2025-00819

Electronic Patent Application Fee Transmittal				
Application Number:	17858825			
Filing Date:	06-Jul-2022			
Title of Invention:	MULTILAYER POLYMER SHEETS			
First Named Inventor/Applicant Name:	Chunhua LI			
Filer:	Garrett T Potter/James Brady			
Attorney Docket Number:	22773-826.310			
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	**Fee Code**	**Quantity**	**Amount**	**Sub-Total in USD($)**
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1200	1200

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1200**

Electronic Acknowledgement Receipt	
EFS ID:	47798455
Application Number:	17858825
International Application Number:	
Confirmation Number:	1348
Title of Invention:	MULTILAYER POLYMER SHEETS
First Named Inventor/Applicant Name:	Chunhua LI
Customer Number:	107046
Filer:	Garrett T Potter/James Brady
Filer Authorized By:	Garrett T Potter
Attorney Docket Number:	22773-826.310
Receipt Date:	05-APR-2023
Filing Date:	06-JUL-2022
Time Stamp:	17:14:07
Application Type:	Utility under 35 USC 111(a)

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Submitted with Payment	yes
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Payment was successfully received in RAM	$1200
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1	Issue Fee Payment (PTO-85B)	22773-826-310-issue-fee-transmittal-04-05-2023.pdf	113063 9c9b39cce0ee8b8565b2b943f419e2a4db59e8a2	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	37609 5d1a4cca0725ba9ce5b79b35ff56663862fee9ea	no	2
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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/858,825	05/16/2023	11648090	22773-826.310	1348

107046 7590 04/26/2023

Align Technology, Inc. / WSGR
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Palo Alto, CA 94304

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at https://patentcenter.uspto.gov/. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

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Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

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INVENTOR(s) (Please see PAIR WEB site http://pair.uspto.gov for additional inventors):

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TO: patentdocket@wsgr.com
FROM: noreply@uspto.gov
CC: PatentCenter_eOfficeAction@uspto.gov
SUBJECT: USPTO: Patent Electronic System - Correspondence Notification for Customer Number 107046

Thu Apr 27 05:10:37 EDT 2023

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Application	Document	Mailroom Date	Attorney Docket No.
17858825	ISSUE.NTF	04/26/2023	22773-826.310

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APPLICATION NO.	ISSUE DATE	PATENT NO.
17/858,825	16-MAY-23	11648090

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