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International application number:		**PCT/US2018/035384**
International filing date:		**31 May 2018 (31.05.2018)**
Document type:		**Certified copy of priority document**
Document details:	Country/Office:	**US**
	Number:	**62/512,786**
	Filing date:	**31 May 2017 (31.05.2017)**
Date of receipt at the International Bureau:		**15 June 2018 (15.06.2018)**

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a),(b) or (b-*bis*)

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1211 Geneva 20, Switzerland
www.wipo.int

931647

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

June 14, 2018

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE.

APPLICATION NUMBER: *62/512,786*
FILING DATE: *May 31, 2017*
RELATED PCT APPLICATION NUMBER: *PCT/US18/35384*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS *US62/512,786*

Certified by

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

PTO/SB/16 (03-13)
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PROVISIONAL APPLICATION FOR PATENT COVER SHEET – Page 1 of 2

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. _____

INVENTOR(S)		
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Ray F.	Stewart	Redwood City, CA
John	Lahlouh	San Jose, CA

Additional inventors are being named on the _____ separately numbered sheets attached hereto.

TITLE OF THE INVENTION (500 characters max):

Formable Thermoplastic Compositions and Articles Therefrom

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

☑ The address corresponding to Customer Number: 77268

OR

☐ Firm or Individual Name

Address

City	State	Zip
Country	Telephone	Email

ENCLOSED APPLICATION PARTS (*check all that apply*)

☑ Application Data Sheet. See 37 CFR 1.76.
☐ CD(s), Number of CDs _____
☑ Drawing(s) *Number of Sheets* 6
☐ Other (specify) _____
☑ Specification (e.g., description of the invention) *Number of Pages* 16

Fees Due: Filing Fee of $260 ($130 for small entity) ($65 for micro entity). If the specification and drawings exceed 100 sheets of paper, an application size fee is also due, which is $400 ($200 for small entity) ($100 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

METHOD OF PAYMENT OF THE FILING FEE AND APPLICATION SIZE FEE FOR THIS PROVISIONAL APPLICATION FOR PATENT

☑ Applicant asserts small entity status. See 37 CFR 1.27.
☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Applicant must attach form PTO/SB/15A or B or equivalent.
☐ A check or money order made payable to the *Director of the United States Patent and Trademark Office* is enclosed to cover the filing fee and application size fee (if applicable).
☑ Payment by credit card. Form PTO-2038 is attached.
☐ The Director is hereby authorized to charge the filing fee and application size fee (if applicable) or credit any overpayment to Deposit Account Number: _____.

TOTAL FEE AMOUNT ($)

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. 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 10 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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PROVISIONAL APPLICATION FOR PATENT COVER SHEET – Page 2 of 2

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

- [x] No.
- [ ] Yes, the invention was made by an agency of the U.S. Government. The U.S. Government agency name is: _____
- [ ] Yes, the invention was made under a contract with an agency of the U.S. Government. The name of the U.S. Government agency and Government contract number are: _____

WARNING:

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

SIGNATURE /Linda R. Judge/ DATE 5/31/17

TYPED OR PRINTED NAME Linda R. Judge REGISTRATION NO. 42,702 (*if appropriate*)

TELEPHONE 650-257-3139 DOCKET NUMBER XL-PROV1

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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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	XL-PROV1
	Application Number	
Title of Invention	FORMABLE THERMOPLASTIC COMPOSITIONS AND ARTICLES THEREFROM	

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
Mr.	Ray	F	Stewart	

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

City	Redwood City	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	48450 Lakeview Blvd.		
Address 2			
City	Fremont	State/Province	CA
Postal Code	94538	Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	John		Lahlouh	

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

City	San Jose	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	48450 Lakeview Blvd.		
Address 2			
City	Fremont	State/Province	CA
Postal Code	94538	Country	

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).

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	XL-PROV1
	Application Number	
Title of Invention	FORMABLE THERMOPLASTIC COMPOSITIONS AND ARTICLES THEREFROM	

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

Customer Number	77268		
Email Address	rstewart@baymaterials.com	Add Email	Remove Email
Email Address	lrjudge@comcast.net	Add Email	Remove Email

Application Information:

Title of the Invention	FORMABLE THERMOPLASTIC COMPOSITIONS AND ARTICLES THEREFROM		
Attorney Docket Number	XL-PROV1	**Small Entity Status Claimed**	☒
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	5	**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

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)

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	XL-PROV1
	Application Number	
Title of Invention	FORMABLE THERMOPLASTIC COMPOSITIONS AND ARTICLES THEREFROM	

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix	Remove
Ms.	Linda	R	Judge		
Registration Number	42702				

Additional Representative Information blocks may be generated within this form by selecting the **Add** button.

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			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)

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

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.

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	XL-PROV1
	Application Number	
Title of Invention	FORMABLE THERMOPLASTIC COMPOSITIONS AND ARTICLES THEREFROM	

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.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	XL-PROV1
	Application Number	
Title of Invention	FORMABLE THERMOPLASTIC COMPOSITIONS AND ARTICLES THEREFROM	

Applicant Information:

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

Applicant 1

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

Clear

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

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

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☐

Prefix	Given Name	Middle Name	Family Name	Suffix
Mr.				

Mailing Address Information For Applicant:

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

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

Assignee Information including Non-Applicant Assignee Information:

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

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	XL-PROV1
	Application Number	
Title of Invention	FORMABLE THERMOPLASTIC COMPOSITIONS AND ARTICLES THEREFROM	

Assignee 1

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

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

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.

Signature:

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

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

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

Signature	/Linda Judge/			Date (YYYY-MM-DD)	2017-02-28
First Name	Linda	Last Name	Judge	Registration Number	42,702

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

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	XL-PROV1
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Privacy Act Statement

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

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

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

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

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

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

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

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

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

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

Attorney Docket No.: XL-PROV1

PROVISIONAL PATENT APPLICATION

FORMABLE THERMOPLASTIC COMPOSITIONS AND ARTICLES THEREFROM

Inventor(s): Ray Stewart and John Lahlouh

Assignee: Bay Materials, LLC

Entity: Small

BACKGROUND

[0001] **[0001]** There is a need for improved orthodontic and dental appliances capable of performing orthodontic tooth movements, stabilizing tooth positions or protecting teeth from potentially damaging outside forces.

[0002] Existing materials and products are constructed from single layer materials, bi-layer materials or tri-layer materials which have limited functionality and may suffer from performance deficiencies. Aligners are plastic shells which fit over teeth designed to apply translational or rotational forces to teeth. Their ability to accurately move teeth is limited by their effective modulus, elasticity and ability to resist creep and stress relaxation. Additionally, it is advantageous if they are resistant to staining and environmental stress cracking.

[0003] Appliances for protection of teeth, for example sports mouth guards, and dental splints have contradictory requirements. On the one hand, they should be capable of dissipating impact forces and on the other hand should be thin and not interfere with the natural occlusion of a person's teeth, or impede speaking.

[0004] The formable thermoplastic compositions described herein and their use in orthodontic and dental appliances represent a significant improvement over currently available options.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIGS. 1 -8 (filed herewith)

DETAILED DESCRIPTION

[0006] The present disclosure relates in general to the following problem and the solution provided by the invention.

[0007] Problem: Current orthodontic aligners are have a very limited elastic range (typically 4% to 7%) and when deformed exhibit rapid decay of recovery force. As a result, it may be necessary to change appliances frequently increasing manufacturing costs, teeth may not move as desired, and the patient may experience discomfort from excessively high initial forces. Attempts to improve elastic range by providing a thin outer layer of elastomer (typically a

polyurethane) can result in a tooth contact surface which is readily deformed (reducing accuracy of tooth movement) and may increase propensity for unsightly staining by common foods, beverages or cigarettes. Non-staining polyurethanes used for fabricating dental appliances such as Zendura A available from Bay Material, LLC, Fremont, CA have excellent properties but are very hygroscopic and require rigorous drying prior to thermoforming. Many other polyurethanes must also be dried prior to thermoforming adding time and cost to the manufacturing process.

[0008] Solution/relevance to business: We have discovered that many of the deficiencies of previous materials and dental appliances constructed from them can be reduced or eliminated by construction of a dual shell appliance which is non-staining, lower cost than rigid urethanes, and surprisingly has a significantly greater elastic range. Because the materials contacting the teeth are substantially rigid, they more accurately mate with the teeth providing precise forces while still maintaining the ability to exert more nearly constant force over longer distances. Additionally, appliances of this construction have greater resistance moisture uptake and do not require such specialized processing procedures, as described above.

[0009] The inventors have discovered that a sheet comprised of two amorphous outer layers, designated "A" and "C" and, and an inner component "B", wherein B is a thermoplastic elastomer having a lower modulus than A or C provides advantageous properties. Such sheets can be used to manufacture dental appliances comprised of two outer layers (A and C) and an inner component (B), where A and C are thermoplastic materials having a higher modulus than the elastomeric B component, which dental appliances exhibit improved performance.

[0010] In the following description, various embodiments of the 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 embodiments 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.

[0011] In one embodiment, a thermoformable sheet is comprised of an A, B and C layer wherein layers A and C comprise an amorphous material having a glass transition temperature (Tg) greater than about 80 C and the B layer is comprised of an elastomer selected from polyurethane,

polyolefin, styrenic or polyester thermoplastic elastomer which has a higher modulus than the B layer. (embodiment #1).

[0012] In certain aspects of embodiment #1, layers A and C comprise a polyester, a polyurethane a (meth acrylic), or a polyolefin.

[0013] In certain examples of embodiment #1, layer B comprises a polyurethane elastomer.

[0014] In another embodiment, a dental appliance is made from a thermoformable sheet comprised of an A, B and C layer such as embodiment #1 (embodiment #2).

[0015] In certain aspects of embodiment #2, the dental appliance is an aligner, a retainer, or a mouth guard.

[0016] It should be appreciated that the disclosure in the figures, examples and test results provided herein illustrate various features of the invention. One of ordinary skill in the art will recognize and appreciate that there are many variations, modifications, and alternatives of the materials described herein.

[0017] The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense. It will, however, be evident that various modifications and changes may be made thereunto without departing from the broader spirit and scope of the disclosure as set forth in the claims.

[0018] Other variations are within the spirit of the present disclosure. Thus, while the disclosed materials and embodiments are susceptible to various modifications and alternative constructions, certain illustrated embodiments thereof are shown in the drawings. It should be understood, however, that there is no intention to limit the disclosure to the specific form or forms disclosed, but on the contrary, the intention is to cover all modifications, alternative constructions and equivalents falling within the spirit and scope of the disclosure, as defined in the appended claims.

DEFINITIONS

[0019] The use of the terms "a" and "an" and "the" and similar referents in the context of describing the disclosed 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. The phrase "based on" should be understood to be open-ended, and not limiting in any way, and is intended to be interpreted or otherwise read as "based at least in part on," where appropriate. 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 of the disclosure and does not pose a limitation on the scope of the disclosure unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the disclosure.

EMBODIMENT #1

[0020] Minimum (Min) and maximum (Max) thicknesses (in microns) for A, B and C in the special case where the thickness of A (At) is equal to the thickness of C (Ct) are shown in Table 1. In the case where At is not equal to Ct, the ratios of % B and % A + C may still be used to define preferred compositions.

[0021] Table 1. Thickness Ranges for Symmetric Sheets (microns)

Total	Total	A	B	C	Table 1Total	A + C	% B	% A + C
0.5 mm	500	208	83	208	500	417	17%	83%
	500	167	167	167	500	333	33%	67%
	500	117	267	117	500	233	53%	47%

		A	B	C	Total	A + C	% B	% A + C
0.75 mm	750	312.5	125	312.5	750	625	17%	83%
	750	250	250	250	750	500	33%	67%
	750	175	400	175	750	350	53%	47%

		A	B	C	Total	A + C	% B	% A + C
1 mm	1000	417	167	417	1000	833	17%	83%
	1000	333	333	333	1000	667	33%	67%
	1000	233	533	233	1000	467	53%	47%

		A	B	C	Total	A + C	% B	% A + C
1.5 mm	1500	625	250	625	1500	1250	17%	83%
	1500	500	500	500	1500	1000	33%	67%
	1500	350	800	350	1500	700	53%	47%

		A	B	C	Total	A + C	% B	% A + C
2 mm	2000	833	333	833	2000	1667	17%	83%
	2000	667	667	667	2000	1333	33%	67%
	2000	467	1067	467	2000	933	53%	47%
	2000	350	1300	350	2000	700	65%	35%

[0022] Table 2. Thickness Ranges for Asymmetric Sheets (microns)

Asymmetric sheet			
A	B	C	Total
100	83	317	500
100	167	233	500
100	267	133	500
A	B	C	Total
100	125	525	750
100	250	400	750
100	400	250	750
A	B	C	Total
100	167	733	1000
100	333	567	1000
100	533	367	1000
A	B	C	Total
100	250	1150	1500

100	500	900	1500
100	800	600	1500
A	B	C	Total
100	333	1567	2000
100	667	1233	2000
100	1067	833	2000
100	1300	600	2000

Table 3. Preferred Thicknesses.

Preferred Thicknesses					
A Layer		B Layer		C Layer	
Min	Max	Min	Max	Min	Max
125	400	125	400	125	400

% B		% A + C	
Min	Max	Min	Max
14%	44%	27%	86%

[0023] In the case where A is thinner than C, the minimum thickness should be about 100 microns. In some embodiments, the total thickness of the A+B+C layers is from about 500 to 900 microns.

METHODS

[0024] Tensile properties were measured using an Instron Universal Materials Tester. The procedures of ASTM D xxxx were employed unless otherwise noted. Color and transparency were measured using a BYK XXXXX Spin colorimeter.

[0025] Impact resistance was measured using a Gardner impact tester. Tear strength was measure using a Materials Tester at a rate of 50 mm per minute.

[0026] Stress relaxation of samples at 37 C in water were measured by the method described in US Patent 8716425 B2.

[0027] Resistance to staining was measured by exposing test articles to a staining medium such as mustard or coffee for 24 hours at 37 C and measuring color on a white color tile before and after exposure.

[0028] Translational recovery force was measured by constructing a three-layer structure as shown in the figures. Sample was displaced from 0 to 0.5 mm and force reported in g/cm^2.

UTILITY

[0029] The improved orthodontic and dental materials and appliances described herein provide for: (a) increased adaptation (inner layer can flow more readily during thermoforming); (b) less deformation of inner layer when displaced up to 10%; and (c) a stress strain curve that is more nearly constant than seen with prior art materials.

EXAMPLES

[0030] The invention is further illustrated by the following examples. The examples are provided for illustrative purposes only. They are not to be construed as limiting the scope or content of the invention in any way.

Materials and Methods.
[0031] Materials of Construction.

a. Thermoplastic polyesters such as PET, PETG, PEN. Examples include PETG comprising cycloaliphatic diol or di-acid, cyclohexane-dimethanol and 2,2,4,4-tetramethyl-1,3-cyclobutanediol.

b. Further examples of polyester resins useful in practicing the invention include materials listed at:
http://www.eastman.com/Products/Pages/ProductList.aspx?categoryName=Copolyesters+Other

c. Polyurethane resins useful in practicing the invention include aromatic and aliphatic di-isocyanate based polyurethanes having soft blocks derives from polyesters, polyethers and polycarbonates available from multiple manufacturers including Lubrizol (for example under the designation Pellethane), Covestro under the brand Texin, BASF under the designation Elastollan or "Pro" having hardness from about Shore 80A to about Shore D 75.

d. Thermoplastic polyurethanes useful in practicing the invention include materials comprised of MDI and C2 to C12 diols including hexane diol, Isoplast 2530, 2531, (Lubrizol), and Texin HM series.

EXAMPLE 1

[0032] Monolayer and control samples were prepared by compression molding or extrusion. Multilayer structures were prepared by compression molding, extrusion lamination or co-extrusion.

[0033] Multi-layer films were prepared by press lamination, extrusion lamination, or co-extrusion using standard polymer processing equipment. Press lamination was conducted at 200 to 220 C, extrusion lamination was conducted using a polyurethane melt temperature of 210 to 240 C and coextrusion was conducted with a polyester melt temperature of 240 C to 260 C, and a polyurethane melt temperature of 210 to 240 C. Conditions for time, temperature and pressure were varied to maximize structure quality, thickness and adhesion.

[0034] Mechanical properties, optical properties and stress relaxation were measured to compare the suitability of various materials.

[0035] Table 4A. Test Results for Co-extruded ABA films, #BM125-56-(1-3), Pressed Films #BM125-58-1,2 and Extrusion-Laminated ABA Film #B125-46-1.

			SmarTrac	SE, March 2017	Eastman	Eastman	Eastman	Eastman	Eastman
	Argotec	Pacur	**Re-Const.**	SE #162N-1	**Co-Ex #22**	**Co-Ex #23**	**Co-Ex #24**	**#22 Press 1L**	**#24 Press 3L**
	BM101-168-1	BM116-95-2	**BM116-178-4i**	BM125-46-1	BM125-56-1	BM125-56-2	BM125-56-3	BM125-58-1	BM125-58-2
	ZenduraA	PETG	PU-HT-PU	XL-I	XL	XL	XL	XL	XL
Thickness	30	30	3-25-3	10-12-10	**12.5-5-12.5**	**12.5-5-12.5**	**12.5-5-12.5**	**12.5-5-12.5**	**0-30-0**
Top			TX950	HT-Flex-Corona	MP150	MP150	MP150	MP150	MP150
Middle			Cor-HT-Cor	LI6680/95/1	RxT65D	RxT65D	RxT65D	RxT65D	RxT65D
Bottom			TX-950	HT-Flex-Corona	MP150	MP150	MP150	MP150	MP150
Surface Treatment			Corona	Corona	**200C**	**220C**	**210C**		
Inter-Layer Bonding			Very good	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
(Tg), C	95	80	105.6						
Tensile Yield E%	6.0	4.0	7.4	5.9	5.5	5.4	4.8	5.4	5.2
Tensile Break E% (Layers 1-2)	145	130	115	103	108.7	104.26	101.7	99.71	95.3
Tensile Stress @ Yield, psi				3630	5723	5446	4584	5388	4755
Tensile Strength, psi	12,529	7300	6410	4,930	7122	6418	5955	6585	5938
Tensile Elastic Modulus, psi	247,758	280,000	136,510	112,120	180191	174662	150637	173747	156543
Tensile Stress whitening (yes/no)	no	no	no	no/translcent	no	no	no	no	no
Flexural E-Modulus, psi	281,093	265,202	97,960	156,979	183,660	177,418	161,864	179,706	161,025
Flexural Strength, psi	13,485	11,316	5,558	7,510	9,118	9,772	7,117	8,542	7,760
Stiffness	0.683		**0.2800**						
Gardner Impact, J/mm	15.2	6.9		9.2					
Peel Test, D3163, N				166					
Trouser Tear Force , max. N	18	48	51	160					
Crazing (37C Water/5% Strain)	4.0 ,no	2.0, yes	4.5, no	4.0, yes					
Crazing (Mouthrinse, RT, 5% Strain)	3.0, yes	1.5, yes	3.5, no	2.0, yes	1.5-2.0, yes	1.5, yes	2.5-3.0, yes	1.0-1.5, yes	1.0-1.5, yes
Crazing (Olive Oil, RT, 5% Strain)	4.5, no	2.5, yes	4.5, no	1.5, yes					
Load Retention (g) at 5%ϵ/37C/H2O ;	Load, g	Load, g	Load, g	Load, g	Load, g	Load, g	Load, g	Load, g	Load, g
0 days,	4244	3956	1664	**2739**					
1 day	707	853	885	**1469**					
2 days	498	601	864	**1389**					
7 days			767						
Color after 24 hour Stain Test at 37C	**Zendura**	**PETG**	PU-HT-PU	XL-I (95A)					
p-Mustard ΔdB	0.97	2.087	44.09	2.67					
p-Coffee ΔdB	1.05	1.52		1.57					
p-Red Wine ΔdB	-0.31	0.09		0.26					

[0036] The results show that the prior art example (PU-HT-PU; Align) exhibits a lower tear force and significantly more yellowing (B value of 44 versus 1-3) than Zendura or PETG.

[0037] Table 4B. **Test Results for Various Films.**

	BM-Pressed	SE Trial	SE Trial	SE Trial	BM-Pressed
	BM116-178-4	BM116-157-2	BM116-157-1	BM116-157-1	BM116-88-3
	PU-HT-PU	XL-II	XL-I	XL-I (Start)	XL-I (Pressed)
Thickness	3-25-3	7-16-7	10-10-10	101310	101010
Top	TX950	HT-Corona	HT-Corona	HT-Corona	HT-Corona
Middle	Cor-HT-Cor	TX950LW	TX950LW	TX950LW	TX950LW
Bottom	TX-950	HT-Corona	HT-Corona	HT-Corona	HT-Corona
Inter-Layer Bonding	Very good	Excellent	Excellent	Excellent	Very good
(Tg), C	105.6	110	110	110	110
Tensile Yield E%	7.0	5.8	5.6	7.0	7.1
Tensile Break E% (Layers 1-2)	94	124	126	119	124-361
Tensile Strength, psi	5690	4406	5120	5335	5660
Tensile Elastic Modulus, psi	131,110	98,551	127,180	104,000	111,269
Tensile Stress whitening (yes/no)	no	no	no	no	no
Flexural E-Modulus, psi	97,892	139,970	150,075	160,718	155,434
Flexural Strength, psi	5,801	5915	7075	7990	7900
Stiffness	0.280	0.387	0.435	0.565	0.435
Gardner Impact, J/mm		6.5	6.2	8.3	
Trouser Tear Force , max. N	51	151	156	194	
Load Retention (g) at 5%e/37C/H2O	Load, g	Load, g	Load, g	Load, g	Load, g
0 days,	1664	2491	2962	3027	2685
1 day	875	1088	1379	1474	1335
2 days	823	1026	1248	1397	1275

[0038] BM116-178-4 is a prior art (Bayer) example showing significantly lower tear force than articles of the invention.

[0039] Monolayer and control samples were prepared by compression molding or extrusion. Multilayer structures. Measurement of Translational Force. Test articles were prepared as shown in the Figures (attached and labeled) and displacement force measurements were recorded.

EXAMPLE 2

[0040] The three-layer structure of sample BM116-157-1 was dried at 60 C using a low dew point dryer and thermoformed using a biostar thermoformer with a heater set point of 200 C for 55 seconds. The thermoformed material was tested for mechanical properties along with the same material prior to thermoforming and the polyester material by itself.

[0041] Figure 5. Evaluation of Mechanical Properties.

Sample	Elongation to Break	Yield Stress	Tensile Strength	Yield Elongation
Polyester MP100				
BM116-157-1 (laminate)	133%	4380	6380	5.17 %
Thermoformed laminate	130%	4140 PSI	5405	7.0%

[0042] The elongation to yield was thus improved by about 36% relative to the polyester or the laminate.

WHAT IS CLAIMED IS:

1. A thermoformable composite plastic sheet, comprising a core layer (B), comprising a thermoplastic elastomer having a glass transition temperature (Tg) of less than about 10° C and a hardness of from about 75 Shore A, (80 Shore A, 95 Shore A, 50 Shore D, 65 Shore D) to 75 Shore D on the Shore Hardness Scale, and two outer layers A and C wherein at least one of the A or C layers comprises at least one thermoplastic resin having a Tg of greater than about 80° C, a hardness of greater than about 85 Shore D and a tensile modulus of at least 1 GPa.

2. The plastic sheet according to claim 1, wherein the B layer comprises one or more of (a) a polyether, polyester or polycarbonate polyurethane, (b) a polypropylene thermoplastic elastomer, (c) a polyester elastomer, (d) a styrenic based elastomer, and (e) a cyclic olefin elastomer.

3. The plastic sheet according to claim 1, wherein one or more of the A and C layers are selected from the group of amorphous polyester resin, amorphous polyurethane resin, polycarbonate resin or a blend of polyester and polycarbonate resins.

4. The plastic sheet according to claim 3 wherein the one or more of the A and C layers is a co-polyester is comprised of:

(a) a dicarboxylic acid component comprising 70 mole % to 100 mole % terephthalic acid residues, and

(b) a diol component comprising

(i) 0 to 95% ethylene glycol

(ii) 5 mole % to 50 mole % 2,2,4,4-tetramethyl-1,3-cyclobutanediol residues, and

(iii) 50 mole % to 95 mole % 1,4-cyclohexanedimethanol residues,

(iv) 0 to 1% of a polyol having three or more hydroxyl groups

wherein the sum of the mole % of diol residues i) and ii) and iii) of the amounts to 100 mole % and the copolyester exhibits a glass transition temperature (Tg) from 80° C to 150° C.

5. The plastic sheet according to claim 1 wherein the combined thickness of the A, B and C layers is from about 250 microns (500, 750) to about 2,000 microns (1,500, 1000).

6. The plastic sheet according to claim 5 wherein Bt/(At+Ct) = from about 0.17 (.25, .5) to about 0.75, (.65, .5) where the A, B and C layers have thickness of At, Bt and Ct respectively.

7. The plastic sheet according to claim 5 wherein layer A is thinner than layer C and A has a thickness not less than 100 microns.

8. The plastic sheet of claim 1, having layer thickness that fall within the ranges to Table X or Y.

9. The sheet of claim 1, which when tested according to Test Method Z has a 0.2 mm elastic recovery force (20, 50, 100, 500, 1,000, 5,000 g/cm^2)

10. The sheet according to any one of claims 1 to 9, wherein the B layer exhibits a compression set of less than 40%, 20%.

11. The sheet according to any one of claims 1 to 10, were the B material is comprised of a polyether – polyamide elastomer.

12. The sheet of claim 1, which when tested according to stress relaxation test X has an initial force of less than about 5 Kg and at 96 hours has a force of greater than 1,500 grams, 1,000 grams.; 750 grams, 500 grams.

13. The sheet of claim 1, wherein the thermoplastic elastomer has a 100% modulus of between 4 MPa and 35 MPa (5 MPa to 30 MPa), (7MPa to 25).

14. A thermoformable sheet for manufacture of dual shell dental appliance comprising a first layer of thermoplastic material A having a modulus from about 150,000 PSI to about 350,000 PSI and having a thickness of from about 100 microns to about 400 microns bonded to a second layer of thermoplastic sheet B having a modulus of from about 25,000 PSI to about 75,000 PSI having a thickness of from about 250 microns to about 500 microns bonded to a third layer of thermoplastic sheet C having a modulus of from about 150,000 PSI to about 350,000 PSI and a thickness of from about 100 microns to 400 microns wherein the combined thickness of sheet A and C do not exceed about 500 microns and the total thickness of A + B + C does not exceed about 1,000 microns.

15. A dual shell dental appliance adapted to fit over teeth having a top surface (layer) and a bottom surface, wherein the bottom surface and top surface which can be reversibly displaced relative to each other by up to about 0.3 mm with a shear stress of from about 50 g/^cm2 (75, 100) to about 2,000 g/cm^2 (1,5000, 1,000, 500, 250)

0.3 mm displacement	
Shear Stress(g/cm^2)	
Min	Max
50	2000
75	1000
100	500

16. The dual shell appliance of claim 15, wherein the top surface is comprised of a layer of materials having a greater rigidity than the bottom surface, and a tensile modulus top = > 0.5 GPa, 0.75 GPa, 1GPa, or 1.5 GP.

17. A dental appliance for moving teeth comprising, an inner shell, a middle shell and an outer shell wherein the inner and outer shell are connected by an elastomeric middle shell wherein the inner our outer shells can reversibly move relative to each other by an amount of 0.1 0.2, 0.3, 0.4 mm by application of a force of between about 10, 100, 500, 1,000, 2,000 grams / cm^2.

18. The appliance of claim 17, wherein the inner and outer shell have a total thickness (as in table X or Y).

19. The appliance of claim 16 wherein the middle layer comprises a polyurethane having a hardness from about A 80 to D 75.

20. The appliance of claim 15 where the inner and outer shell comprises a one or more of a polyurethane, a polyester, a polycarbonate or an acrylic or methacrylic polymer.

21. A claim wherein the elastomeric materials comprises a blend of a polyether polyurethane and a polyester.

22. A claim wherein the A and C layers comprise a blend of a polyester and a polyurethane.

23. A dental appliance having improved mechanical properties comprised of two outer shells and an inner shell wherein the inner and outer shells have a non-discreet interface.

24. The appliance of claim 24 wherein the non-discreet interface is produced by thermoforming a sheet comprised of two outer layers and an inner layer wherein at least one of the outer layers and the inner layer form a compatible blend during the thermoforming process.

25. The appliance of claim, 24 where in the improved mechanical property is one or more of elongation to yield, tensile strength, elongation to break, elastic modulus.

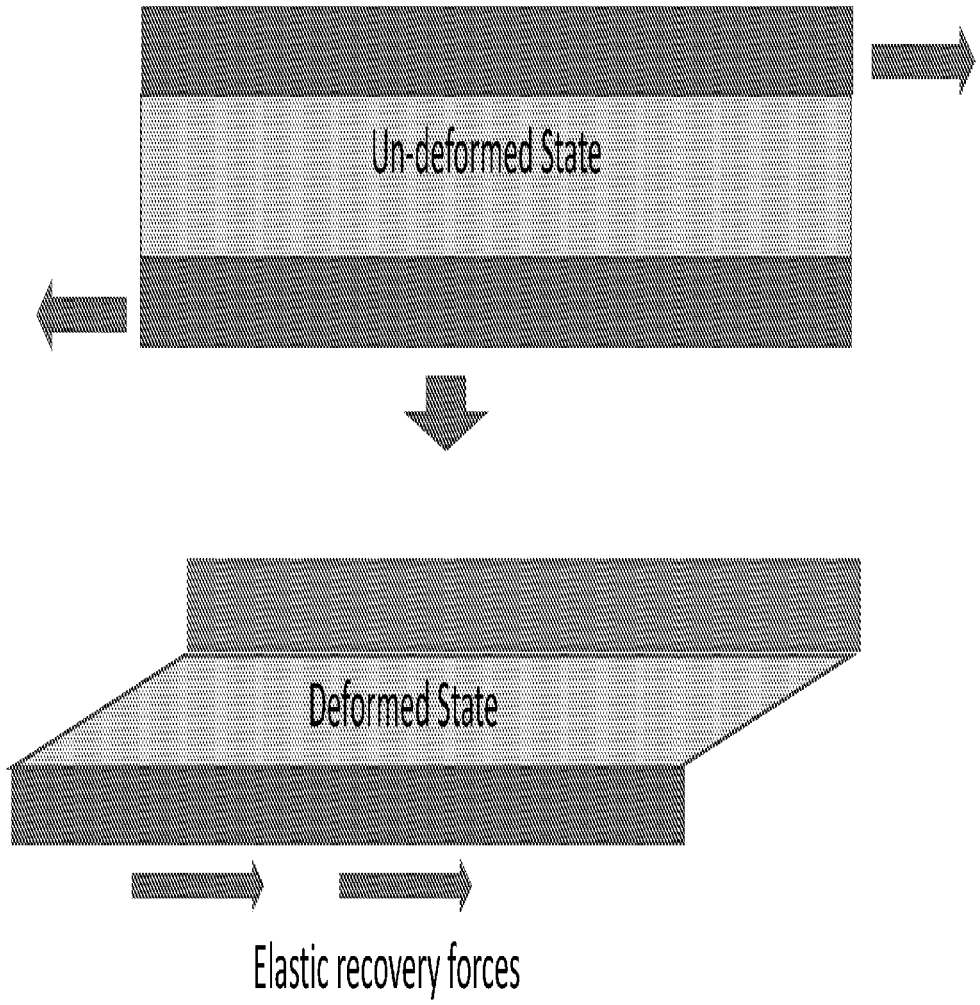
26. The appliance of claim 24 wherein the inner layer and at least an outer layer chemically react during thermoforming.

27. A multilayer sheet comprised of discreet layers of thermoplastic materials which chemically react during thermoforming.

ABSTRACT

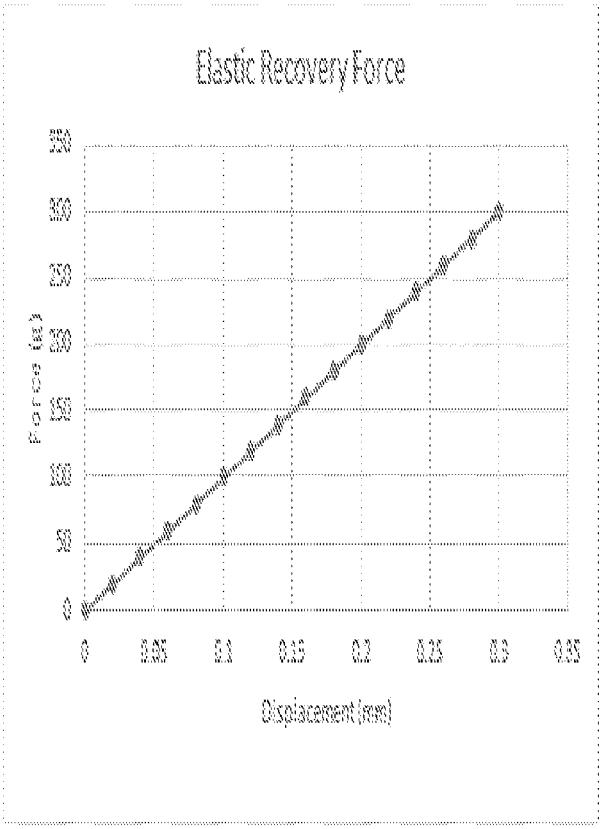
[0043] Improved thermoformable thermoplastic compositions and dental and orthodontic appliances made therefrom re provided.

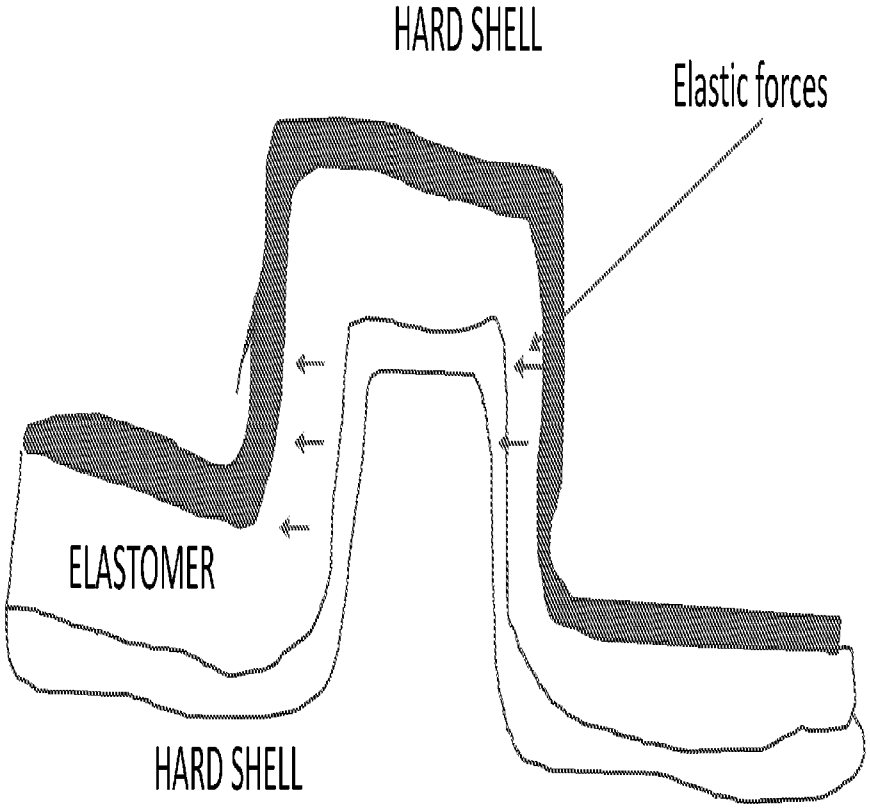
Schematic of a three layer sheet useful for construction of dual shell dental appliances.

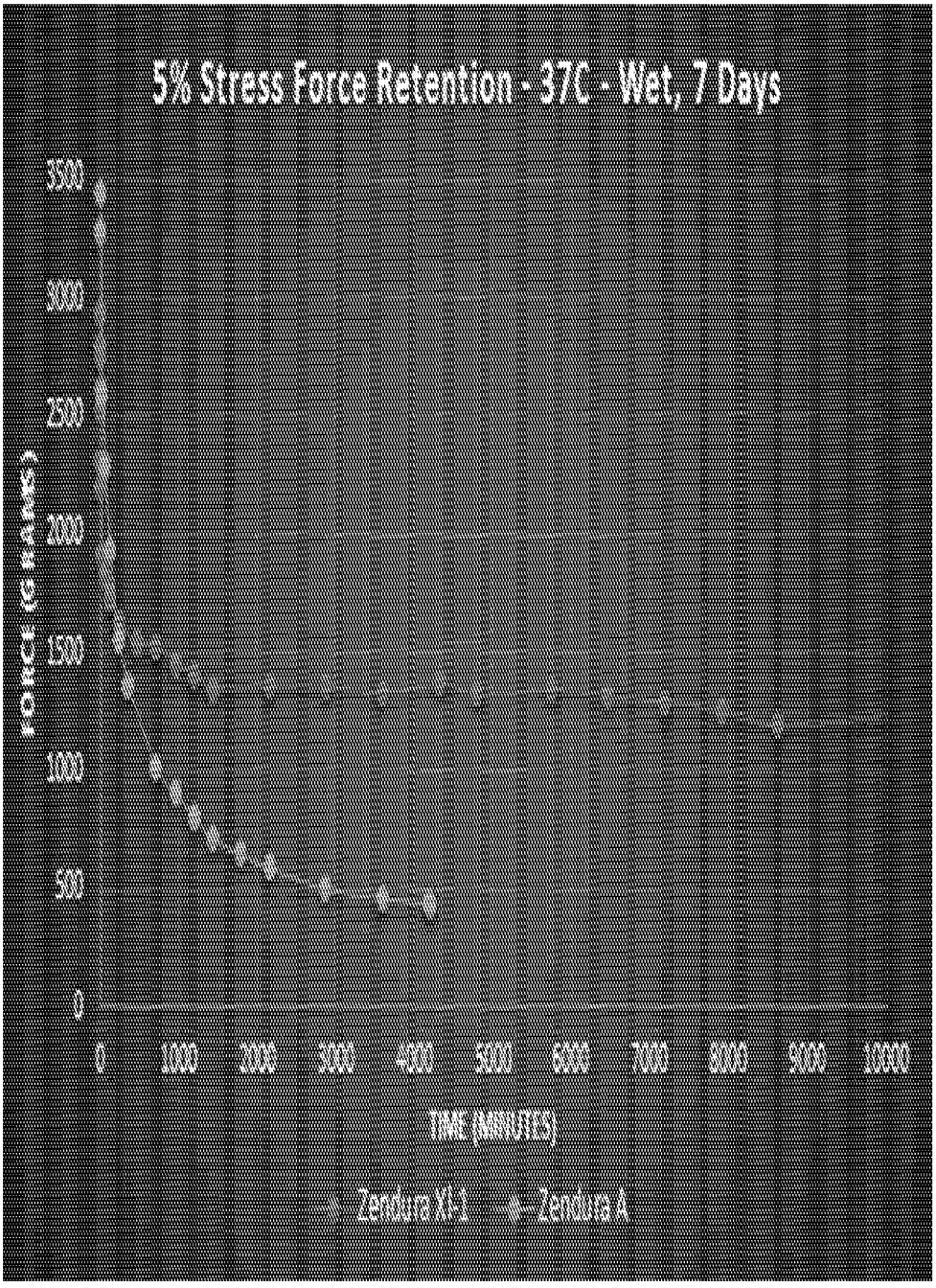


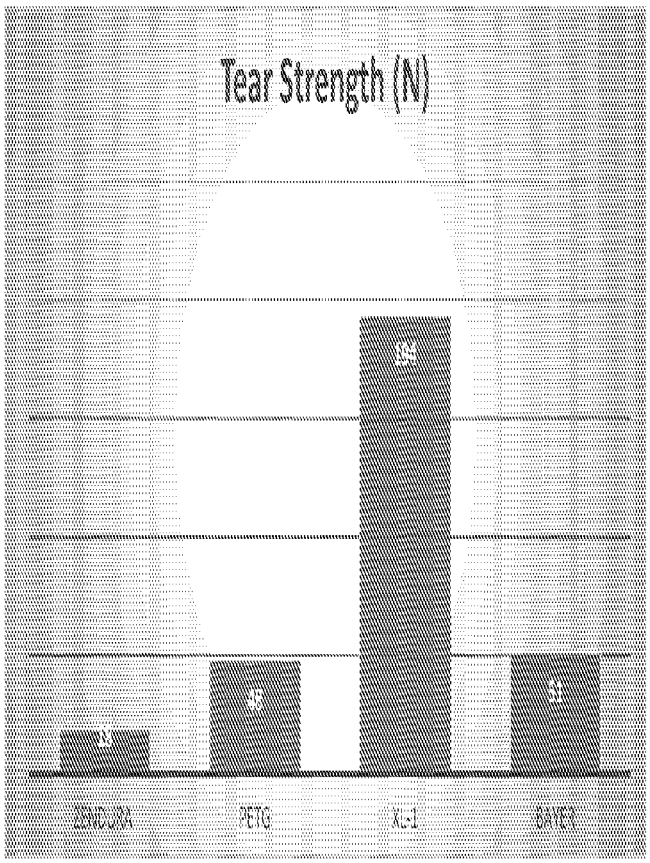
Test Method for Measurement of Elastic Recovery Force

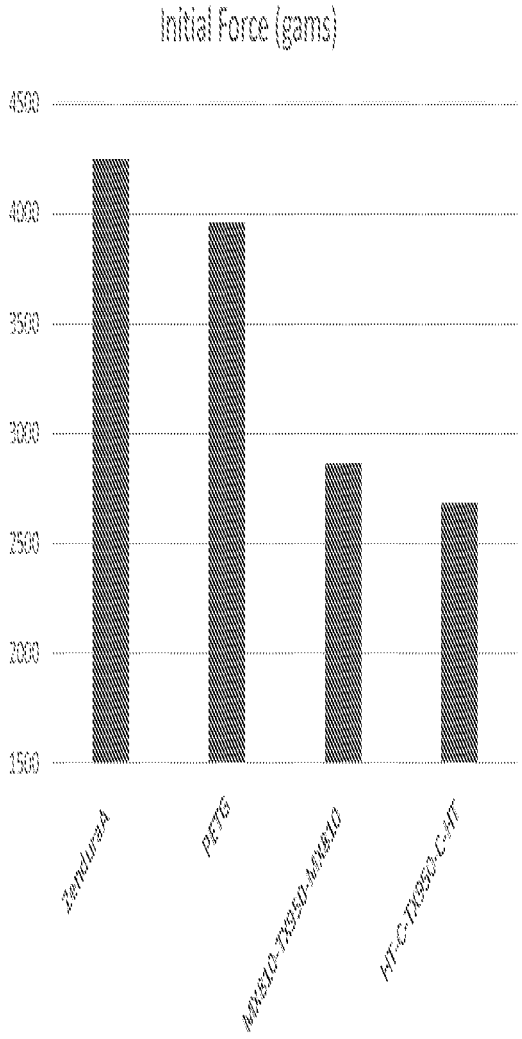


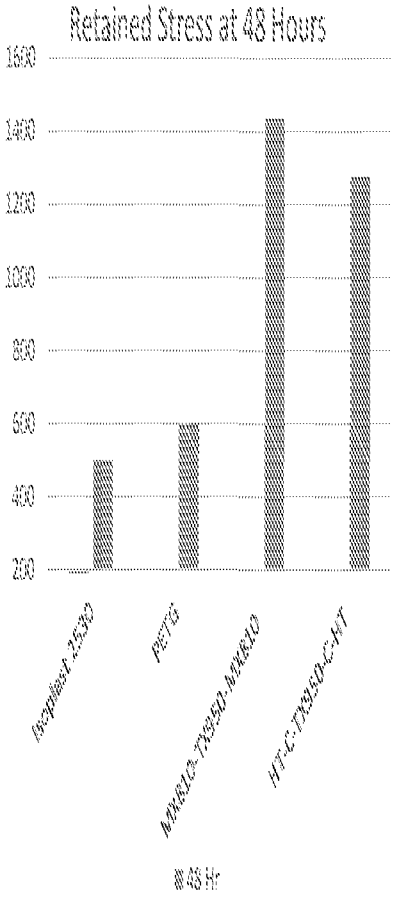


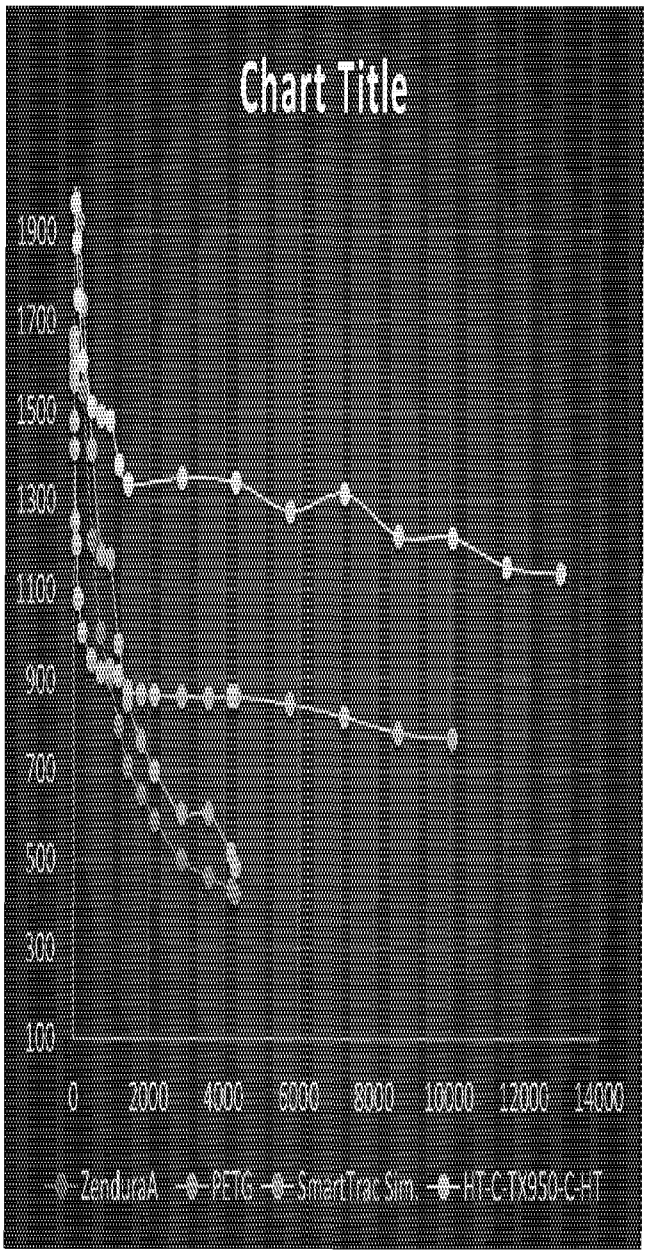

HARD SHELL
Elastic forces
ELASTOMER
HARD SHELL


5% Stress Force Retention - 37C - Wet, 7 Days
3500
3000
2500
2000
1500
1000
500
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
TIME (MINUTES)
Zenbura X1
Zenbura A


Tear Strength (N)
PETG
XES
PAHT


Initial Force (gams)
4500
4000
3500
3000
2500
2000
1500
PETG


Retained Stress at 48 Hours
1650
1450
1250
1050
850
650
450
250
Incumbent 2530
PETG
MM8510-7030SD-MM8510
HT-C-7030SD-C-HT
@ 48 Hr


Chart Title
1900
1700
1500
1300
1100
900
700
500
300
100
0
2000
4000
6000
8000
10000
12000
14000
ZenduraA
PETG
SmoothTec Sim
HT-C-7030SD-C-HT

Electronic Acknowledgement Receipt	
EFS ID:	29351235
Application Number:	62512786
International Application Number:	
Confirmation Number:	7120
Title of Invention:	FORMABLE THERMOPLASTIC COMPOSITIONS AND ARTICLES THEREFROM
First Named Inventor/Applicant Name:	Ray F. Stewart
Customer Number:	77268
Filer:	Linda Judge
Filer Authorized By:	
Attorney Docket Number:	XL-PROV1
Receipt Date:	31-MAY-2017
Filing Date:	
Time Stamp:	11:23:57
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$130
RAM confirmation Number	053117INTEFSW11262900
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	PROVappcoversheetsb0016.pdf	273749 cd6efad1e28ba294c43a5b2ba654e21531def1b2	no	3
Warnings:					
Information:					
2	Application Data Sheet	ADSPROVXL1.pdf	110839 85b8d520cbebc38ce22ea2b8b3a5536a557f9c11	no	8
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
3	Specification	XLPROV1spec.pdf	814855 7deac39ca70f1f25da54cb9513c82be0483cd154	no	16
Warnings:					
Information:					
4	Drawings-other than black and white line drawings	XLPROV1Drawings.pdf	474677 4154e699a7c7cd18d533ad83d3878381e20cd6df	no	6
Warnings:					
The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing					
Information:					
5	Fee Worksheet (SB06)	fee-info.pdf	29586 82d52d685c7d67df446c3ddefc5b894931744d58	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1703706		

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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.

DocCode – SCORE

SCORE Placeholder Sheet for IFW Content

Application Number: 62512786 Document Date: 05/31/2017

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Form Revision Date: August 26, 2013