



(51) International Patent Classification:

<i>B32B 7/00</i> (2006.01)	<i>B32B 27/30</i> (2006.01)
<i>B32B 7/02</i> (2006.01)	<i>B32B 27/32</i> (2006.01)
<i>B32B 7/04</i> (2006.01)	<i>B32B 27/34</i> (2006.01)
<i>B32B 7/06</i> (2006.01)	<i>B32B 1/00</i> (2006.01)
<i>B32B 7/12</i> (2006.01)	<i>B32B 1/02</i> (2006.01)
<i>B32B 27/00</i> (2006.01)	<i>B32B 3/00</i> (2006.01)
<i>B32B 27/06</i> (2006.01)	<i>B32B 3/02</i> (2006.01)
<i>B32B 27/08</i> (2006.01)	<i>B32B 3/06</i> (2006.01)
<i>B32B 27/28</i> (2006.01)	<i>B32B 3/30</i> (2006.01)

(21) International Application Number:

PCT/US2015/053920

(22) International Filing Date:

5 October 2015 (05.10.2015)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

14/519,070 20 October 2014 (20.10.2014) US

(71) Applicant: **DOW GLOBAL TECHNOLOGIES LLC**
[US/US]; 2040 Dow Center, Midland, MI 48674 (US).

(72) Inventors: **MAZZOLA, Nicolas, Cardoso**; Rua Aurora Germano De Lemos 333, Apt. 94, 13209-460 Jundiai (BR).
GARGALAKA, João, Junior; Rua Guarei 160 Apt. 93, 03187-060 Sao Paulo (BR). **GOMES, Jorge, Caminero**; Rua Gil Earnes 315 Apt. 73, 04601-040 Sao Paulo (BR).

BUASZCZYK, Gianna; Rua Felix Engel 48 Apt. 102, 95320-000 Nova Praia (BR).

(74) Agent: **FRIEDRICH, Valerie, K.**; JL Salazar Law Firm, 1934 W. Gray Street, Suite 401, Houston, TX 77019 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: A MULTILAYER STRUCTURE, A FILM MADE THEREFROM AND A PACKAGE FORMED THEREFROM

(57) Abstract: A multilayer structure including a first layer; a sealant layer formed from one or more ethylene-based polymers; and a cohesive failure layer adjacent to the sealant layer and formed from a polymer blend which comprises an elastomeric propylene based polymer and a second polymer, wherein the second polymer is selected from the group consisting of high pressure low density polyethylene, high density polyethylene, ethylene acrylic acid copolymers, ethylene (meth) acrylic acid copolymers and combinations thereof is provided.



WO 2016/064557 A1

A MULTILAYER STRUCTURE, A FILM MADE THEREFROM AND A PACKAGE FORMED THEREFROM

Field of Invention

The disclosure relates to a multilayer structure, a film made therefrom and a package formed therefrom.

Background of the Invention

Reliable and reproducible easy open packages are generally hard to find as it such properties depend upon the sealant layer composition, sealing conditions and/or aging time. Variability in these properties is particularly pronounced in packages with different package and lid compositions (e.g. rigid containers and lids, flexible containers and lids). There remains a need for multilayer structures allowing easy open sealing areas and which may be used in a variety of applications and with a wide variety of processing conditions.

Summary of the Invention

The disclosure is for a multilayer structure, a film made therefrom and a package formed therefrom.

In one embodiment, the disclosure provides a multilayer structure comprising a first layer; a sealant layer formed from one or more ethylene-based polymers; and a cohesive delamination layer adjacent to the sealant layer and formed from a polymer blend which comprises an elastomeric propylene based polymer and a second polymer, wherein the second polymer is selected from the group consisting of high pressure low density polyethylene, high density polyethylene, ethylene acrylic acid copolymers, ethylene (meth) acrylic acid copolymers and combinations thereof.

In alternative embodiments, the disclosure provides a film made from the multilayer structure, a package made therefrom and a lid formed from the multilayer structure or film.

Brief Description of the Drawings

Fig. 1A is a schematic illustrating two multilayer structures according to an embodiment of the invention prior to sealing;

Fig. 1B is a schematic illustrating the two multilayer structures following sealing of the two structures;

Fig. 1C is a schematic illustrating the sealing area following application of force to open the seal;

Fig. 2 is a graph illustrating the peak seal strength as a function of temperature for Comp. Ex. 1-6 and Inv. Ex. 1-3;

Fig. 3A is a schematic illustrating the equipment used to measure peak seal strength for the examples;

Fig. 3B is a schematic illustrating the sealing bars pressing against multilayer structures to form a seal;

Fig. 3C is a schematic illustrating the process of opening the seal to measure the seal strength.

Fig. 4 is a graph illustrating the peak seal force as a function of temperature for Comp. Ex. 8 and Inv. Ex. 5-8;

Fig. 5 is a graph illustrating the peak seal force as a function of temperature for Comp. Ex. 9 (plus bottom films 1 and 2) and Inv. Ex. 9 (plus bottom films 1 and 2);

Fig. 6 is a graph illustrating the peak seal force as a function of temperature for Comp. Ex. 10 (plus bottom films 1 and 2) and Inv. Ex. 10 (plus bottom films 1 and 2); and

Fig. 7 is a graph illustrating the peak seal force as a function of temperature for Inv. Ex. 11-14.

Detailed Description of the Invention

The disclosure provides a multilayer structure, a film made therefrom and a package formed therefrom.

The term "polymer," as used herein, refers to a polymeric compound prepared by polymerizing monomers, whether of the same or a different type. The generic term polymer thus embraces the term homopolymer (employed to refer to polymers prepared from only one type of monomer, with the understanding that trace amounts of impurities can be incorporated into the polymer structure), and the term interpolymer as defined hereinafter. Trace amounts of impurities (for example, catalyst residues) may be incorporated into and/or within the polymer.

The term "interpolymer," as used herein, refers to polymers prepared by the polymerization of at least two different types of monomers. The generic term interpolymer includes

copolymers (employed to refer to polymers prepared from two different types of monomers), and polymers prepared from more than two different types of monomers.

The term “olefin-based polymer,” as used herein, refers to a polymer that comprises a majority amount of polymerized olefin monomer, for example ethylene or propylene (based on weight of the polymer) and, optionally, may contain at least one comonomer.

The term “ethylene-based polymer,” as used herein, refers to a polymer that comprises a majority amount of polymerized ethylene monomer (based on weight of the polymer) and, optionally, may contain at least one comonomer.

The term “ethylene/ α -olefin interpolymers,” as used herein, refers to an interpolymers that comprises a majority amount of polymerized ethylene monomer (based on the weight of the interpolymers) and at least one α -olefin.

The term, “ethylene/ α -olefin copolymer,” as used herein, refers to a copolymer that comprises a majority amount of polymerized ethylene monomer (based on the weight of the copolymer), and an α -olefin, as the only two monomer types.

The term “propylene-based polymer,” as used herein, refers to a polymer that comprises a majority amount of polymerized propylene monomer (based on weight of the polymer) and, optionally, may comprise at least one comonomer.

The term “composition,” as used herein, includes a mixture of materials which comprise the composition, as well as reaction products and decomposition products formed from the materials of the composition.

The terms “blend” or “polymer blend,” as used herein, refers to a mixture of two or more polymers. A blend may or may not be miscible (not phase separated at the molecular level). A blend may or may not be phase separated. A blend may or may not contain one or more domain configurations, as determined from transmission electron spectroscopy, light scattering, x-ray scattering, and other methods known in the art. The blend may be effected by physically mixing the two or more polymers on the macro level (for example, melt blending resins or compounding) or the micro level (for example, simultaneous forming within the same reactor).

The term “ionomer,” as used herein means (or includes) polyethylene based copolymers modified with cations to provide ionic links. These copolymers are well known and described at The Wiley Encyclopedia of Packaging Technology or Handbook of Engineering and Specialty Thermoplastics, Polyolefins and Styrenics.

The terms “cyclic olefin copolymers” and “COC,” are known and described, for example, in EP-A-0 407 870, EP-A-0 485 893, EP-A-0 503 422, and DE-A-40 36 264, the disclosures of which are incorporated herein by reference.

The multilayer structure according to a first embodiment of the invention provides a multilayer structure comprising a first layer; a sealant layer formed from one or more ethylene-based polymers; and a cohesive failure layer adjacent to the sealant layer and formed from a polymer blend which comprises an elastomeric propylene based polymer and a second polymer, wherein the second polymer is selected from the group consisting of high pressure low density polyethylene, high density polyethylene, ethylene acrylic acid copolymers, ethylene (meth) acrylic acid copolymers and combinations thereof.

The film according to another embodiment of the invention comprises one or more multilayer structures according to any embodiment described herein.

The package according to yet another embodiment of the invention comprises one or more components formed from the multilayer structure according to any embodiment described herein.

The lid for a package according to another embodiment of the invention comprises a lid formed from the multilayer structure according to any embodiment disclosed herein.

In embodiments of the multilayer structure, the cohesive failure layer is adjacent to the sealant layer. As used in this context, adjacent means that the cohesive failure layer abuts the sealing layer over at least a portion of a surface of the sealing layer. The polymer blend from which the cohesive failure layer is formed may include any one or more polymer blends, each of which comprises an elastomeric propylene based polymer and a second polymer, wherein the second polymer is selected from the group consisting of high pressure low density polyethylene, high density polyethylene, ethylene acrylic acid copolymers, ethylene (meth) acrylic acid copolymers and combinations thereof. Various combinations of such polymer blends are described, for example, in U.S. Patent 7,863,383 and PCT Publication WO2013101931, the disclosures of which are incorporated herein by reference. Commercial polymer blends are available under the name SEALUTION, from The Dow Chemical Company (Midland, MI, USA).

In yet another embodiment, the disclosure provides a multilayer structure, film, package or lid in accordance with any embodiment described herein, except that a seal force of the multilayer structure with any olefin-based layer does not substantially increase with increasing sealing

temperature. As used in this context, “substantially increase” means an increase of 50% with an increase of 40 °C in sealing temperature.

In yet another embodiment, the disclosure provides a multilayer structure, film, package or lid in accordance with any embodiment described herein, except that the sealing layer is made from one or more materials selected from the group consisting of ethylene-based polymers, polar ethylene based copolymers, and ionomers.

In yet another embodiment, the disclosure provides a multilayer structure, film, package or lid in accordance with any embodiment described herein, except that the sealing layer has a thickness equal to or less than 50 microns. All individual values and subranges from equal to or less than 50 microns are included and disclosed herein. For example, the sealing layer may have a thickness equal to or less than 50 microns, or in the alternative, equal to or less than 20 microns, or in the alternative, equal to or less than 10 microns. In a particular embodiment, the lower limit of the sealing layer thickness is 0.5 micron. A skilled artisan would understand that the lower thickness limit is generally defined by the extrusion equipment limitations and may range from 0.5 to 5 microns, with all individual values therebetween disclosed herein. In yet another embodiment, the disclosure provides a multilayer structure, film, package or lid in accordance with any embodiment described herein, except that the multilayer structure has 3 or more layers. All individual values from at least 3 layers are included and disclosed herein. For example, the multilayer structure may have 3, 4, 5, 6, or 7 layers.

In yet another embodiment, the disclosure provides a multilayer structure, film, package or lid in accordance with any embodiment described herein, except that the sealant layer consists of low density polyethylene. Any low density polyethylene may be used. Exemplary LDPE include 640i, LDPE 219M, LDPE 132i, LDPE 515E, LDPE 301E, all commercially available from The Dow Chemical Company.

In yet another embodiment, the disclosure provides a multilayer structure, film, package or lid in accordance with any embodiment described herein, except that the sealant layer is formed from 1 to 100 wt% one or more polymers selected from LLDPE, olefin-based plastomers and ionomers and, optionally, from 1 to 50 wt% one or more materials selected from COC, HDPE and PP and PP based copolymers. All individual values and subranges from 1 to 100 wt% one or more polymers selected from LLDPE, olefin-based plastomers and ionomers are included and disclosed herein; for example, the amount of such components may range from a lower limit of 1, 15, 30, 45, 60, 75 or 90

wt% to an upper limit of 10, 25, 40, 55, 70, 85 or 100 wt%. For example, the amount of one or more polymers selected from LLDPE, olefin-based plastomers and ionomers can be from 1 to 100 wt%, or in the alternative, from 50 to 100 wt%, or in the alternative, from 1 to 50 wt%, or in the alternative, from 25 to 75 wt%, or in the alternative, from 40 to 80 wt%. When present, the amount of one or more materials selected from COC, HDPE and PP can range from 1 to 50 wt%. All individual values and subranges from 1 to 50 wt% are included and disclosed herein; for example, the amount of such components can range from a lower limit of 1, 10, 20, 30 or 40 wt% to an upper limit of 5, 15, 25, 35, 45 or 50 wt%. For example, the amount of one or more materials selected from COC, HDPE and PP can range from 1 to 50 wt%, or in the alternative, from 1 to 25 wt%, or in the alternative, from 25 to 50 wt%, or in the alternative, from 10 to 25 wt%.

In yet another embodiment, the disclosure provides a multilayer structure, film, package or lid in accordance with any embodiment described herein, except that the sealant layer is formed from 1 to 100 wt% one or more polymers selected from LLDPE, olefin-based plastomers and ionomers and, optionally, from 20 to 99 wt% one or more materials selected from LDPE. All individual values and subranges from 1 to 100 wt% one or more polymers selected from LLDPE, olefin-based plastomers and ionomers are included and disclosed herein; for example, the amount of such components may range from a lower limit of 1, 15, 30, 45, 60, 75 or 90 wt% to an upper limit of 10, 25, 40, 55, 70, 85 or 100 wt%. For example, the amount of one or more polymers selected from LLDPE, olefin-based plastomers and ionomers can be from 1 to 100 wt%, or in the alternative, from 50 to 100 wt%, or in the alternative, from 1 to 50 wt%, or in the alternative, from 25 to 75 wt%, or in the alternative, from 40 to 80 wt%. All individual values and subranges from 20 to 99 wt% one or more materials selected from LDPE are included and disclosed herein; for example, when present, the amount of one or more materials selected from LDPE may range from a lower limit of 20, 30, 40, 50, 60, 70, 80 or 90 wt% to an upper limit of 25, 35, 45, 55, 5, 75, 85, 95 or 99 wt%. For example, when present, the amount of one or more materials selected from LDPE may range from 20 to 99 wt%, or in the alternative, from 50 to 99 wt%, or in the alternative, from 20 to 50 wt%.

In yet another embodiment, the disclosure provides a multilayer structure, film, package or lid in accordance with any embodiment described herein, except that the multilayer structure further comprises one or more additional layers selected from the group consisting of barrier layers and tie layers. In a particular embodiment, the multilayer structure comprises one or more barrier layers. In

a specific embodiment, the one or more barrier layers is formed from one or more of polyamide, ethylene vinylalcohol and polyvinylidene chloride.

In another embodiment, the disclosure provides a film formed by adhesion of any embodiment of the multilayer structure disclosed herein to a substrate selected from the group consisting of monolayer and multilayer films. Lamination substrates includes OPET, BOPP, PA, BOPA, PVOH and other substrates.

In yet another embodiment, the disclosure provides a package in accordance with any embodiment described herein, except that the package is a pouch.

In yet another embodiment, the disclosure provides a package in accordance with any embodiment described herein, except that the package is a food or beverage container.

Fig. 1 illustrates a seal formed using one embodiment of the inventive multilayer structure. As shown in Fig. 1a, a first film 10 includes an external layer 11, a cohesive failure layer 12 and a sealant layer 13. Likewise, a second film 20 includes an external layer 21, a cohesive failure layer 22 and a sealant layer 23. In Fig. 1a, the sealant layers of each of the first and second films are facing each other. In Fig. 1b, the two sealant layers are fused in a sealing area 30. Fig. 1c illustrates the sealing area 39 following application of a force to pull the first and second films apart. As can be seen in Fig. 1c, the first and second films are separated by cohesive failure within the cohesive failure layer 12 of the first film. Alternatively, cohesive failure could occur in the cohesive failure layer 22 of the second film 20 or in both of layers 12 and 22.

Examples

The following examples illustrate the present invention but are not intended to limit the scope of the invention.

Resins used in forming the comparative and inventive examples are described in Table 1.

Table 1

Resin	Commercial Name/Supplier	Type	I ₂ or MFR (g/10min)	Density (g/cm ³)
Resin 1	RP 240 / Braskem (São Paulo, Brasil)	rPP	1.50*	0.900
Resin 2	VERSIFY 2200 / The Dow Chemical Co. (TDCC) (Midland, MI, USA)	propylene/ethylene plastomer	2.00*	0.888
Resin 3	LDPE 301 / TDCC	LDPE	2.00**	0.920
Resin 4	DOWLEX TG2085B / TDCC	LLDPE	0.95**	0.919
Resin 5	ELITE 5960G / TDCC	HDPE	0.85**	0.965

* MFR @ 2.16kg, 230°C

** I₂ @ 2.16kg, 190 °C

Five layer structures, having a layer structure designated as A/B/C/D/E. were prepared to illustrate comparative and inventive multilayer structures. Layer A is a sealing layer, Layer B is a cohesive failure layer, and Layers C, D, and E are additional layers with Layer E being the outermost layer. Table 2 provides the structure and layer composition of Comparative multilayer structures 1-6 (Comp. Ex. 1-6) and Inventive multilayer structures 1-3 (Inv. Ex. 1-3). For example, as illustrated in Table 2, Resin 1 is used to make layer A of Comp. Ex. 1 and 50 wt% Resin 2 and 50 wt% Resin 3 is used to make layer B of Comp. Ex. 1.

Table 2

Film	Comp Ex. 1	Comp Ex. 2	Comp Ex. 3	Comp Ex. 4	Comp Ex. 5	Inv. Ex. 1	Inv. Ex. 2	Inv. Ex. 3	Comp. Ex. 6
Thickness	60	60	60	60	60	60	60	60	60
%	A	10	20	10	10	10	10	10	10
	B	30	30	20	10	30	30	30	30
	C	20	20	30	30	20	20	20	30
	D	20	15	20	30	20	20	20	20
	E	20	15	20	20	20	20	20	20
Resin	A	1	1	1	1	5	4	4	50% 2 / 50% 3
	B	50% 2 / 50% 3	50% 2 / 50% 3	50% 2 / 50% 3	50% 2 / 50% 3	50% 2 / 50% 3	50% 2 / 50% 3	50% 2 / 50% 3	5
	C	5	5	5	5	1	5	1	5
	D	5	5	5	5	1	5	1	5
	E	5	5	5	5	1	5	1	5

The films were sealed using conventional heat seal conditions (layer A being sealed onto layer E) and were tested to measure sealing force. The sealing force results are illustrated in Fig. 2. Referring to Fig. 2, it is seen that the seal force is dependent upon the sealing layer thickness and the heat seal initiation temperature (HSIT) is dependent on seal layer composition. The thickness of the cohesive failure layer also has an impact on sealing strength, the lower the sealing layer thickness the lower the seal strength. Inventive examples 1 to 3 exhibit a broad seal window; that is, the films can be used in a wide range of sealing temperatures, with heat seal temperatures from 120 °C to 180 °C.

Additional examples were produced to illustrate the sealing of two different film structures. Inv. Ex. 1 was sealed to a commercial thermoforming bottom film having the following structure: Resin 4/Tie Layer/Barrier Layer/Tie Layer/ External Layer, to form Inv. Ex. 4. Specifically, Layer A of Inv. Ex. 1 was sealed to the Resin 4 Layer of the commercial film using a Multivac R145 with a seal time of 1 second and a sealing temperature of 150 °C.

Using the same conditions, Comp. Ex. 6 was sealed to the same commercial thermoforming bottom film to form Comp. Ex. 7.

Each of Inv. Ex. 4 and Comp. Ex. 7 were cut to form a specimen with 25.4mm width and were opened in a standard universal testing machine using the procedure described in ASTM F88. The results are shown in Table 3.

Table 3

	Seal Temperature (°C)	Seal Strength (N)
Comp. Ex. 7	150	72.08
Inv. Ex. 4	150	14.3

Additional inventive and comparative examples were formed utilizing the resins listed and described in Tables 2 and 4.

Table 4

Resin	Commercial Name / Supplier	Type	I₂ or MFR (g/10min)	Density (g/cm³)
Resin 6	DOWLEX 2050B / TDCC	HDPE	0.95**	0.950
Resin 7	DOWLEX NG 2038.11B / TDCC	MDPE	1.00**	0.935
Resin 8	DOWLEX 2049B/ TDCC	LLDPE	1.00**	0.926

Table 5 describes the structure of Comp. Ex.8 and Inv. Ex. 5-8.

Table 5

Film	Comp Ex. 8	Inv Ex. 5	Inv Ex. 6	Inv Ex. 7	Inv Ex. 8
Thickness	90	90	90	90	90
%	A	35	10	10	10
	B	10	35	35	35
	C	10	10	10	10
	D	22.5	22.5	22.5	22.5
	E	22.5	22.5	22.5	22.5
Resin	A	50% 2 / 50% 3	80% 6 / 20% 3	80% 7 / 20% 3	80% 8 / 20% 3
	B	4	50% 2 / 50% 3	50% 2 / 50% 3	50% 2 / 50% 3
	C	4	4	4	4
	D	4	4	4	4
	E	4	4	4	4

Each of Comp. Ex. 8 and Inv. Ex. 5-8 were sealed to the commercial thermoforming bottom film (with a thickness of 160 microns) described above according to ASTM F88. However, the seals were opened using the procedure shown in Fig. 3. Fig. 4 illustrates the peak seal force as a function of temperature for each of Comp. Ex. 8 and Inv. Ex. 5-8. As can be seen in Fig. 4, the Inv. Ex. 5-8 exhibit more stable values in a broader range of temperatures.

Comparative Examples 9 and 10 and Inventive Examples 9 and 10 were produced having the composition and structure described in Table 6. In this set, 2 different bottom films were used; both

with 160 microns thickness and composed of 100% resin 4 (bottom film 1) or 100% resin 3 (bottom film 2).

Table 6

Film		Comp Ex. 9	Inv Ex. 9	Comp Ex. 10	Inv Ex. 10
Thickness		90	90	90	90
%	A	35	10	35	10
	B	10	35	10	35
	C	10	10	10	10
	D	22.5	22.5	22.5	22.5
	E	22.5	22.5	22.5	22.5
Resin	A	50% 2 / 50% 3	80% 6 / 20% 3	75% 2 / 25% 3	80% 8 / 20% 3
	B	4	50% 2 / 50% 3	4	75% 2 / 25% 3
	C	4	4	4	4
	D	4	4	4	4
	E	4	4	4	4

The seal forces are illustrated in Figs. 5 and 6, with the combinations of the 4 different top films with the 2 different bottom films. These results illustrate the consistency of seal force achieved when the compositions of the cohesive failure layer are used adjacent to the sealing layer (Inv. Ex. 9 ad 10) versus using such cohesive failure compositions as the sealing layer (Comp. Ex. 9 and 10).

Additional examples were prepared using the resins described in Tables 2, 4 and 7.

Table 7

Resin	Commercial Name / Supplier	Type	I ₂ @2.16kg, 190°C (g/10min)	Density (g/cm ³)
Resin 9	AMPLIFY TY 1352/ TDCC	MAH graft	1.00	-
Resin 4	DOWLEX TG 2085B/ TDCC	LLDPE	0.95	0.919
Resin 10	SURLYN 1650/E. I. du Pont de Nemours and Company (Wilmington, DE, USA)	Ionomer	1.80	0.940
Resin 11	UBE 5034B/ UBE Corporation Europe SA (Spain)	Polyamide	Not available	Not available

* MFR @ 2.16kg, 230 °C

The films were produced in a blown film Collin line, and tested using standard heat seal methods (ASTM F88). The film structures are described in Table 8 and heat seal results are shown Fig. 7.

Table 8

Film		Inv. Ex. 11	Inv. Ex. 12	Inv. Ex. 13	Inv. Ex. 14
Thickness		70	70	70	70
%	A	10	10	10	10
	B	29	29	29	29
	C	28	28	28	28
	D	7	7	7	7
	E	26	26	26	26
Resin	A	6	4	4	10
	B	50% 2 / 50% 3	50% 2 / 50% 3	50% 2 / 50% 3	50% 2 / 50% 3
	C	6	6	9	6
	D	9	9	9	9
	E	11	11	11	11

Test Methods

Test methods include the following:

Density was measured according to ASTM-D 792.

Melt index, I₂, is measured according to ASTM D-1238 at 190°C and at 2.16 kg.

Melt Flow Rate, MFR, is measured according to ASTM D1238.

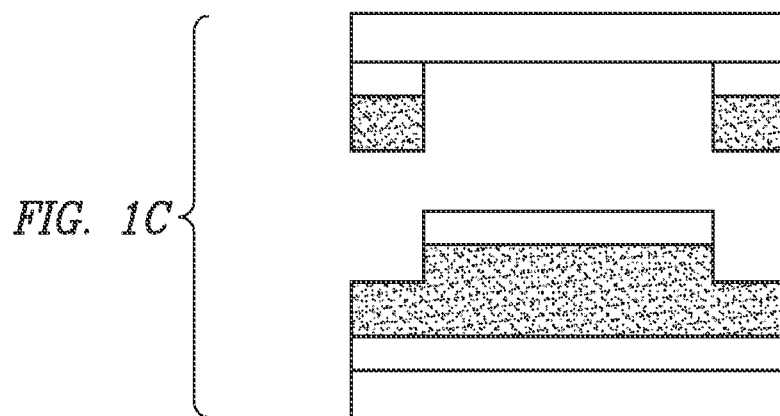
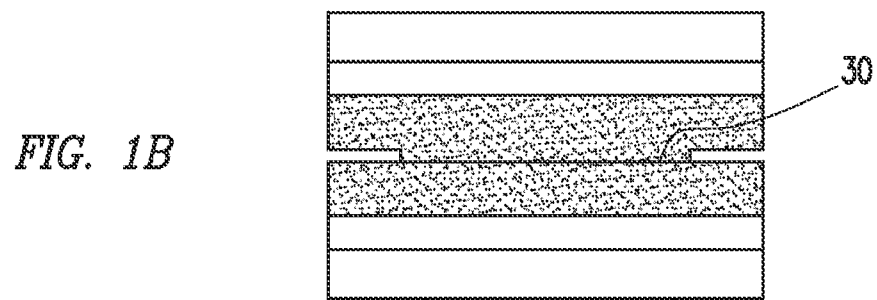
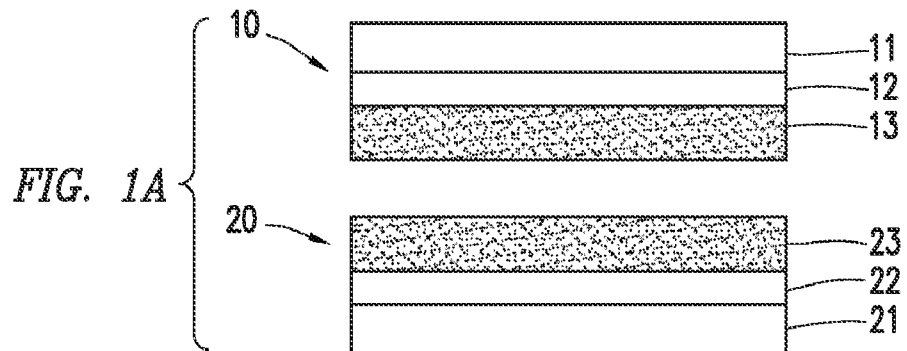
Peak seal strength/force was measured according to ASTM F88 and using the equipment schematically illustrated in Fig. 3. As can be seen in Fig. 3a, a film having a top layer 40 and a bottom layer 45 is provided as well as two sealing bars 50. The sealing bars are heated and pressed against opposite sides of the film to form a sealed area 55, as seen in Fig. 3b. Fig. 3c illustrates the process of opening the sealed area 55 using pulling mechanisms 60 one each on the top layer 40 and bottom layer 45.

The present invention may be embodied in other forms without departing from the spirit and the essential attributes thereof, and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification, as indicating the scope of the invention.

We Claim:

1. A multilayer structure comprising:
 - a first layer;
 - a sealant layer formed from one or more ethylene-based polymers; and
 - a cohesive failure layer adjacent to the sealant layer and formed from a polymer blend which comprises an elastomeric propylene based polymer and a second polymer, wherein the second polymer is selected from the group consisting of high pressure low density polyethylene, high density polyethylene, ethylene acrylic acid copolymers, ethylene (meth) acrylic acid copolymers and combinations thereof.
2. The multilayer structure according to claim 1, wherein the seal force does not substantially increase (will define this term in the description) with increasing sealing temperature.
3. The multilayer structure according to any one of the preceding claims, wherein the sealant layer is made from one or more materials selected from the group consisting of ethylene-based polymers, polar ethylene based copolymers, and ionomers.
4. The multilayer structure according to any one of the preceding claims, wherein the sealant layer has a thickness equal to or less than 50 microns.
5. The multilayer structure according to any one of the preceding claims, wherein the multilayer structure has 3 or more layers.
6. The multilayer structure according to any one of the preceding claims, wherein the sealant layer consists of low density polyethylene.
7. The multilayer structure according to any one of claims 1-5, wherein the sealant layer is formed from 1 to 100 wt% one or more polymers selected from LLDPE, olefin-based plastomers and ionomers and, optionally, from 1 to 50 wt% one or more materials selected from COC, HDPE and PP.
8. The multilayer structure according to any one of claims 1-5, wherein the sealant layer is formed from 1 to 100 wt% one or more polymers selected from LLDPE, olefin-based plastomers and ionomers and, optionally, from 20 to 99 wt% one or more materials selected from LDPE.
9. The multilayer structure according to any one of the preceding claims wherein the multilayer structure further comprises one or more additional layers selected from the group consisting of barrier layers and tie layers.

10. The multilayer structure according to claim 9 wherein the barrier layer is formed from one or more of polyamide, ethylene vinylalcohol and polyvinylidene chloride.
11. A first film comprising the multilayer structure according to any one of the preceding claims.
12. A second film comprising the multilayer structure according to any one of claims 1-10 laminated onto a substrate selected from the group consisting of monolayer and multilayer films using one or more adhesives.
13. A package comprising one or more components formed from the multilayer structure according to any one of the preceding claims.
14. The package according to claim 13 wherein the package is a pouch.
15. The package according to claim 13, wherein the package is a food or beverage container.
16. A lid for a package, wherein the lid is formed from the multilayer structure according to any one of claims 1-10.



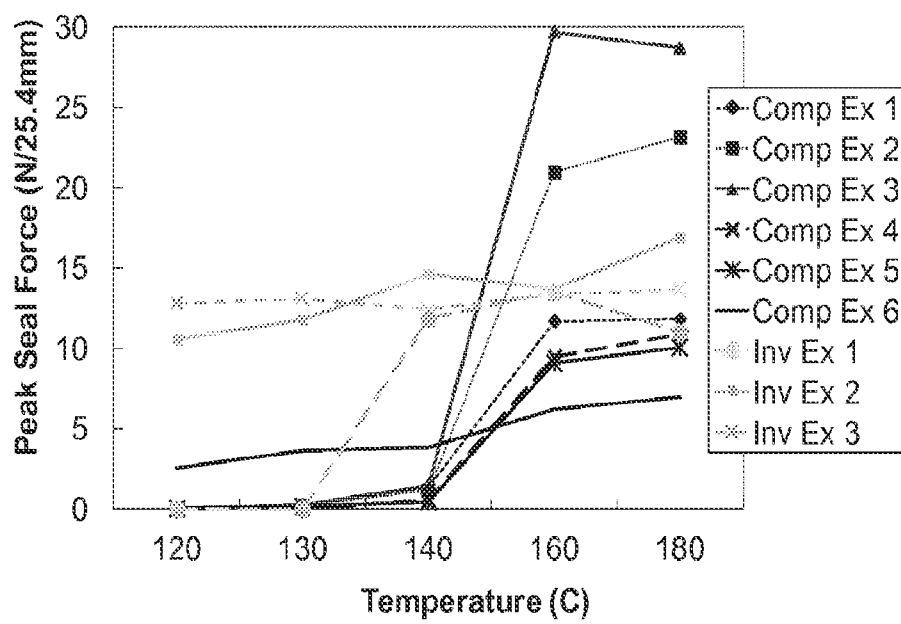
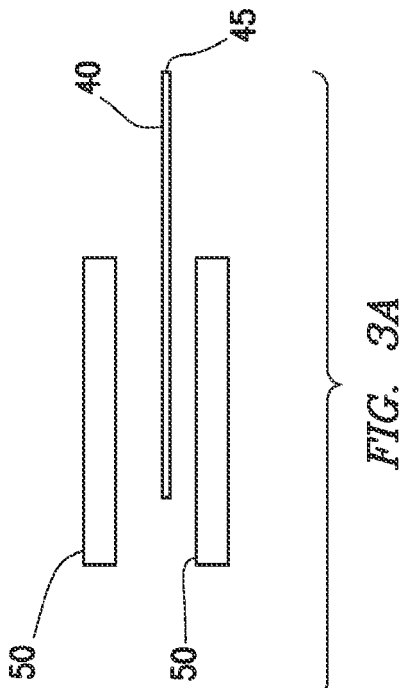
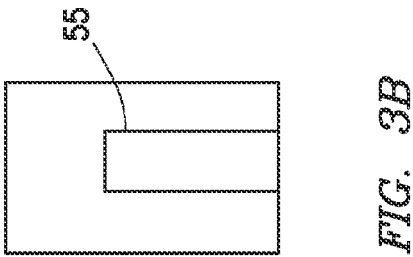
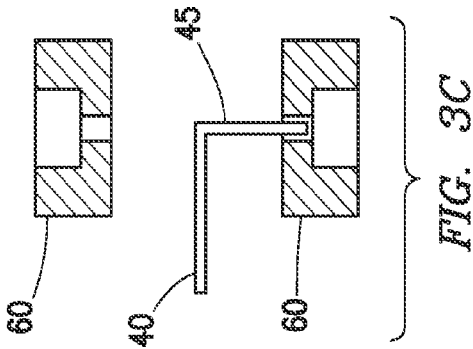
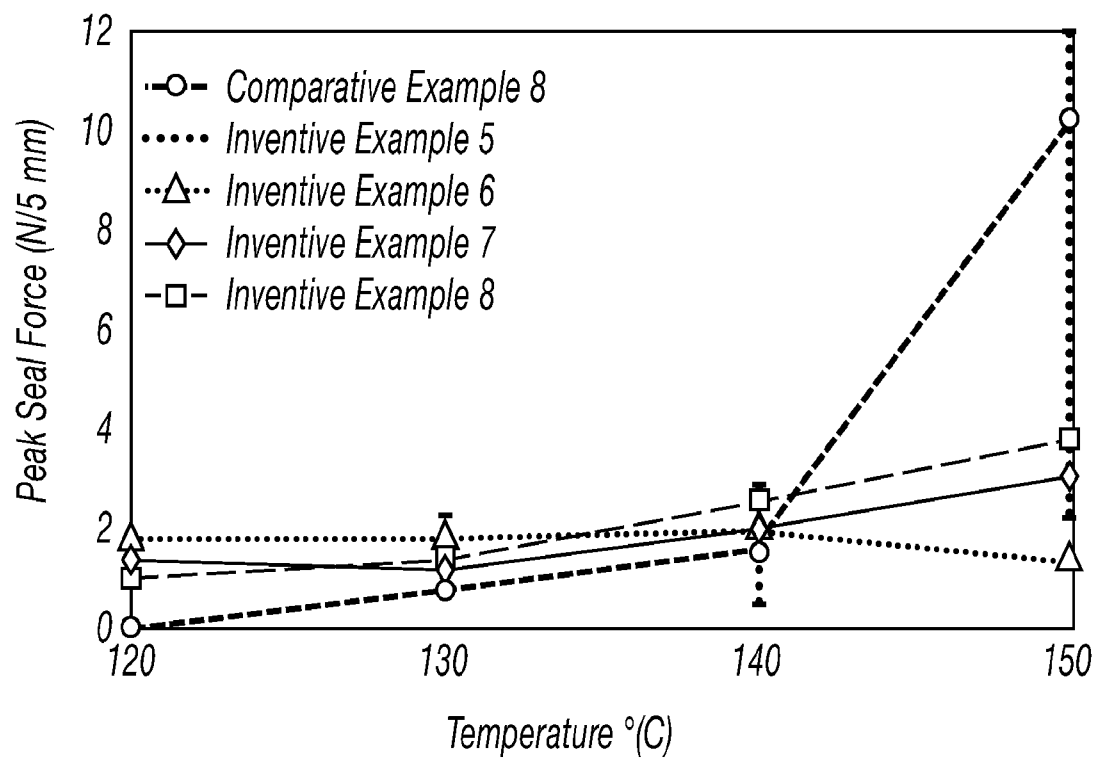
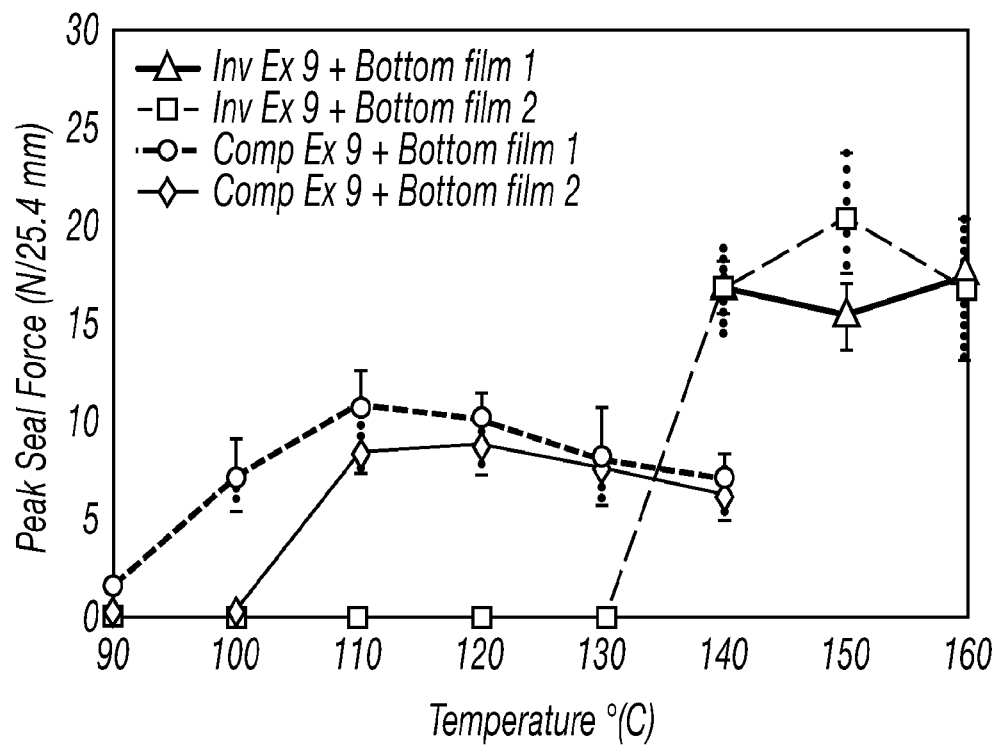


FIG. 2



**FIG. 4**

**FIG. 5**

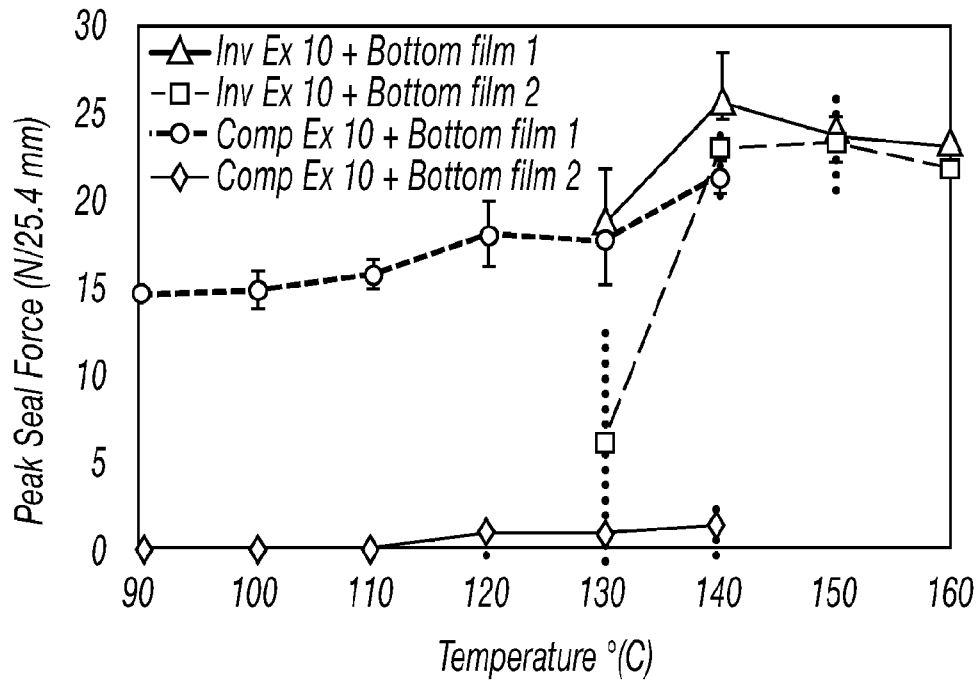


FIG. 6

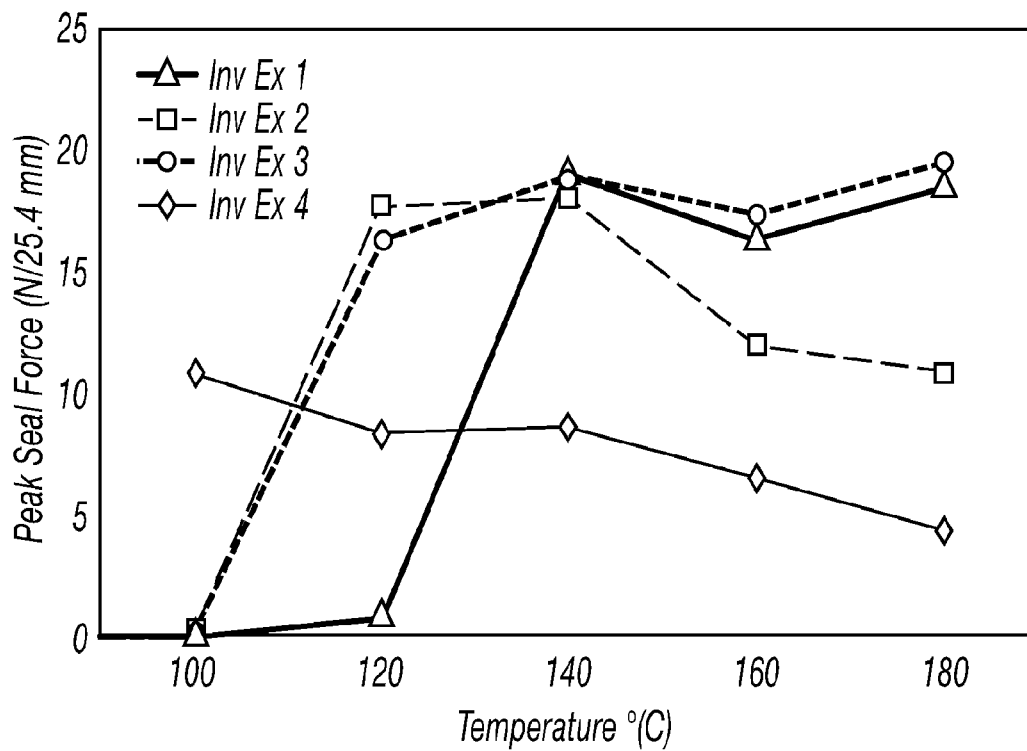


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/053920

A. CLASSIFICATION OF SUBJECT MATTER				
INV.	B32B7/00	B32B7/02	B32B7/04	B32B7/06
	B32B27/00	B32B27/06	B32B27/08	B32B27/28
	B32B27/32	B32B27/34	B32B1/00	B32B1/02
				B32B7/12
				B32B27/30
				B32B3/00
According to International Patent Classification (IPC) or to both national classification and IPC				
B. FIELDS SEARCHED				
Minimum documentation searched (classification system followed by classification symbols) B32B				
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched				
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data, PAJ				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category*	Citation of document, with indication, where appropriate, of the relevant passages			Relevant to claim No.
X	US 2004/151932 A1 (GALLOWAY DEANE [US]) 5 August 2004 (2004-08-05) abstract figures 5-7 paragraph 39 - "adjacent layer may comprise a resin or blend of....polyethylenes, polypropylenes, ethylene methyl acrylic acid, ethylene acrylic acid,..." figures 1-4 paragraph [0048] - paragraph [0051] paragraph [0010] - paragraph [0059] claims 1-32 ----- -/--			1-16
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.				
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family				
Date of the actual completion of the international search 12 November 2015			Date of mailing of the international search report 23/11/2015	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016			Authorized officer Hammond, Andrew	

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/053920

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013/101931 A1 (DOW GLOBAL TECHNOLOGIES LLC [US]) 4 July 2013 (2013-07-04) abstract claims 1-20 page 9, line 1 - line 15 figures 1,2 page 1, line 12 - page 13, line 1 -----	1-16
X	US 5 874 139 A (BOSIERS LUC [BE] ET AL) 23 February 1999 (1999-02-23) abstract claims 1, 11 column 16 lines 15-18 - "ethylene acrylic acid copolymers" column 16, line 55 - column 17, line 39 column 1, line 20 - column 25, line 7 -----	1-16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2015/053920

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004151932 A1	05-08-2004	US 2004151932 A1	05-08-2004
		US 2008063821 A1	13-03-2008
		WO 2004071754 A2	26-08-2004

WO 2013101931 A1	04-07-2013	CN 104136215 A	05-11-2014
		EP 2797742 A1	05-11-2014
		JP 2015507565 A	12-03-2015
		US 2014377548 A1	25-12-2014
		WO 2013101931 A1	04-07-2013

US 5874139 A	23-02-1999	AT 240988 T	15-06-2003
		AU 685331 B2	15-01-1998
		BR 9510388 A	23-12-1997
		CA 2203128 A1	02-05-1996
		CN 1167496 A	10-12-1997
		CO 4440533 A1	07-05-1997
		DE 69530854 D1	26-06-2003
		DE 69530854 T2	11-03-2004
		EP 0787167 A1	06-08-1997
		ES 2194061 T3	16-11-2003
		FI 972169 A	21-05-1997
		JP 3118759 B2	18-12-2000
		JP H10507786 A	28-07-1998
		MY 121203 A	28-01-2006
		NO 971819 A	18-06-1997
		NZ 295837 A	29-06-1999
		PE 24096 A1	16-07-1996
		RU 2171263 C2	27-07-2001
		TW 381098 B	01-02-2000
		US 5747594 A	05-05-1998
		US 5773106 A	30-06-1998
		US 5792534 A	11-08-1998
		US 5874139 A	23-02-1999
		WO 9612762 A1	02-05-1996
		ZA 9508897 A	21-04-1997
