

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization

International Bureau



(10) International Publication Number

WO 2015/088773 A1

(43) International Publication Date

18 June 2015 (18.06.2015)

WIPO | PCT

(51) International Patent Classification:

B26F 1/31 (2006.01) B32B 38/04 (2006.01)
B29C 47/06 (2006.01) B32B 37/15 (2006.01)
B32B 38/06 (2006.01)

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.

(21) International Application Number:

PCT/US2014/067294

(22) International Filing Date:

25 November 2014 (25.11.2014)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/915,196 12 December 2013 (12.12.2013) US

(71) Applicant: 3M INNOVATIVE PROPERTIES COMPANY [US/US]; 3M Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US).

(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).

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

Published:

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

(74) Agents: ALLEN, Gregory D., et al.; 3M Center Office of Intellectual Property Counsel, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

(54) Title: METHOD OF MAKING POLYMERIC MULTILAYER FILMS

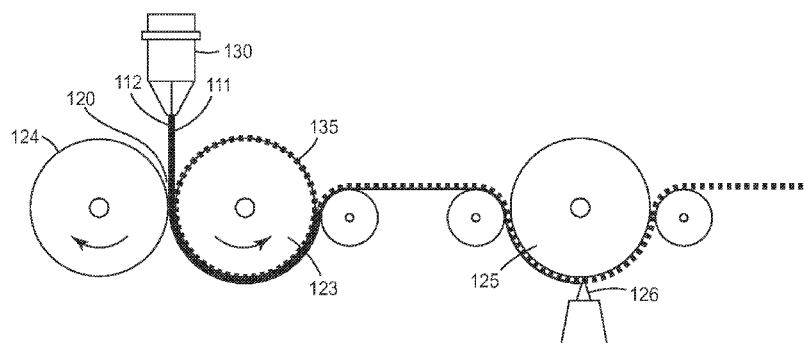


FIG. 1

(57) Abstract: Method of making a polymeric multilayer films (115) having an array of openings by coextrusion. Embodiments of polymeric multilayer films made as described herein are useful, for example, filtration and acoustic absorption.

METHOD OF MAKING POLYMERIC MULTILAYER FILMS

Cross Reference To Related Application

5 This application claims the benefit of U.S. Provisional Patent Application Number 61/915196, filed December 12, 2013, the disclosure of which is incorporated by reference herein in its entirety.

Background

10 [0001] Perforated films are typically used in the personal hygiene field providing a fluid transfer film allowing the fluid to be removed from areas near to the skin and into the absorbent area. Other common applications are in the food packaging industry and more recently acoustics absorption. Perforated films for these applications are usually less than 100 micrometers (0.004 inch) thick (more typically less than 50 micrometers (0.002 inch) thick) and are made, for example, of olefins, polypropylene, or polyethylene.

15 [0002] Typical processing methods to produce perforated films include; vacuum drawing of film into a perforated panel or roll, use of pressurized fluid to form and puncture the film, needle punching with either cold or hot needles, or lasers to melt holes in the film. These processes, however, tend to have processing limitations such a hole size, hole density, and/or film thickness of film.

20 [0003] Vacuum or pressurized fluid forming of perforated films tends to be limited to relatively thin films (i.e., films less than 100 micrometers thick) due to the forces available to deform and puncture the film. Also materials used in this type of forming process tend to be limited to olefin-based polymers. Another characteristic of this type of process is the creation of a protrusion in the film where the film is stretched until a perforation is created. This protrusion can be an advantage in the case of fluid control where the protrusion can act as a directional flow control feature. However, it can also be a disadvantage 25 in applications where a low pressure drop is desired. The protrusion creates an elongated hole thereby increasing the surface area and increase fluid drag.

[0004] Needle punching processes are also largely used for relatively thin films, but film thicknesses up to about 254 micrometers (0.010 inch) are sometimes seen. Limitations with this process tend to include perforation diameter holes per unit area, and protrusions in the film.

30 [0005] Laser perforation processes can provide relatively small holes (i.e., less than 50 micrometers), can perforate a wide range of thicknesses, can create perforations that are planar with the film surfaces (i.e., without the protrusions associated, for example, with needle punching processes). Limitations of laser perforation processes include the types of materials that suitable for the process, and processing speeds and costs. Laser perforation processes tend to be best suited for processing films from

polyethylene terephthalate (PET), polyethylenenaphthalate (PEN), polycarbonate (PC), or other higher glass transition temperature materials. Lasers are often not very effective, for example, in perforating olefin-based materials.

5 Summary

[0006] In one aspect, the present disclosure describes a method of making a polymeric multilayer film, the method comprising:

extruding at least first and second polymeric layers into a nip to provide a polymeric multilayer film, wherein the nip comprises a first roll having a structured surface that imparts indentations through a first major surface of the polymeric multilayer film, wherein the first layer comprises a first polymer having a first melting point, wherein the second layer comprises a second polymer having a second melting point, wherein the absolute difference between the first and second melting point is at least 20°C (in some embodiments, at least 30°C, 40°C, 50°C, 60°C, or even at least 70°C), and wherein the first major surface of the polymeric multilayer film is a major surface of the first layer and the second major surface of the polymeric multilayer film is a major surface of the second layer; and

passing the first major surface having the indentations over a chill roll while applying a heat source to a generally opposed second major surface of the polymeric multilayer film, wherein the application of heat from the heat source results in formation of openings to provide a polymeric multilayer film having first and second generally opposed major surfaces, an array of openings extending between the first and second major surfaces, and at least first and second layers, wherein the first layer comprises the first polymer, wherein the second layer comprises the second polymer, and wherein the first major surface of the polymeric multilayer film is a major surface of the first layer and the second major surface of the polymeric multilayer film is a major surface of the second layer.

25 [0007] Embodiments of polymeric multilayer film described herein are useful, for example, for filtration and acoustic absorption.

Brief Description of the Drawings

[0008] FIG. 1 is a schematic of an exemplary method for making exemplary polymeric multilayer film described herein.

[0009] FIGS. 1A and 1B are schematics of exemplary polymeric multilayer film made from exemplary method for making exemplary polymeric multilayer film shown in FIG. 1 described herein.

Detailed Description

[0010] Referring to FIG. 1, a schematic of an exemplary method is shown. FIGS. 1A and 1B are schematics of exemplary polymeric multilayer film made from exemplary method for making exemplary polymeric multilayer film shown in FIG. 1 described herein.

[0011] First and second polymeric layers 111 and 112 are extruded into nip 120 to provide polymeric multilayer film 115. Nip 120 has first roll 123 having structured surface 135 that imparts indentations through first major surface 121 of polymeric multilayer film 115. First layer 111A comprises a first polymer having a first melting point. Second layer 112A comprises a second polymer having a second melting point. The absolute difference between the first and second melting point is at least 20°C (in some embodiments, at least 30°C, 40°C, 50°C, 60°C, or even at least 70°C). First major surface 121 of polymeric multilayer film 115 is a major surface of first layer 111A. Second major surface 122 of polymeric multilayer film 115 is a major surface of second layer 112A. First major surface 121 having the indentations is passed over chill roll 125 while applying heat source 126 (e.g., a flame) to second major surface of the polymeric multilayer film 122. The application of heat from heat source 126 results in formation of openings 129 to provide polymeric multilayer film 150 having first and second generally opposed major surfaces 131, 132 and an array of openings 129 extending between first and second major surfaces 131, 132.

[0012] Suitable extrusion apparatuses (including materials for making components of the apparatuses) for making multilayer films described herein should be apparent to those skilled in the art after reviewing the instant disclosure, including the working examples. For examples, the rolls (e.g., 123, 124, 125) can be made of metals such as steel. In some embodiments the surface of rolls contacting the polymeric material(s) are chrome plated, copper plated, or aluminum. Rolls can be chilled, for example using conventional techniques such as water cooling. Nip force can be provided, for example, by pneumatic cylinders.

[0013] Exemplary extrusion speeds include those in a range from 3-15 m/min. (in some embodiments, in a range from 15-50 m/min, 50-100 m/min., or more).

[0014] Exemplary extrusion temperatures are in range from 200°C-230°C (in some embodiments, in a range from 230°C-260°C, 260-300°C, or greater).

[0015] Exemplary polymeric materials for making the polymeric multilayer films include polypropylene and polyethylene. In some embodiments of polymeric multilayer films described herein at least one of the layers comprises polypropylene and at least another of the layers comprises polyethylene.

[0016] Exemplary polymeric materials for making the polymeric multilayer films include polyamide 6, polyamide 66, polyethyleneterephthalate (PET), copolyester (PETg), polymethylmethacrylate (PMMA), acrylonitrile butadiene styrene (ABS), polyolefin copolymers, polyethylene, and polystyrene (PS), ethylene vinyl alcohol (EVOH), polycarbonate (PC), polybutyleneterephthalate (PBT),

polyethylenenaphthalate (PEN), polypropylene, polyethylene, ethylene-acrylic acid (EAA), ethylene butyl-acrylate (EBA), ethylene vinyl acetate (EVA), ethylene methyl-acrylate (EMA), propylene-based interpolymers and ethylene-based interpolymers.

[0017] Examples of suitable material combinations include: polyethyleneterephthalate (PET) and

5 ethylene-acrylic acid (EAA); polyethyleneterephthalate (PET) and ethylene vinyl acetate (EVA);

polyethyleneterephthalate (PET) and ethylene butyl-acrylate (EBA); polyethyleneterephthalate (PET)

and ethylene methyl-acrylate (EMA); polyethyleneterephthalate (PET) and propylene-based

interpolymers; polyethyleneterephthalate (PET) and ethylene-based interpolymers; copolyester

(coPETg) and ethylene-acrylic acid (EAA); copolyester (PETg) and ethylene vinyl acetate (EVA);

10 copolyester (PETg) and ethylene butyl-acrylate (EBA); copolyester (PETg) and ethylene methyl-

acrylate (EMA); copolyester (PETg) and propylene-based interpolymers; copolyester (PETg) and

ethylene-based interpolymers; ethylene vinyl alcohol (EVOH) and ethylene-acrylic acid (EAA); ethylene

vinyl alcohol (EVOH) and ethylene vinyl acetate (EVA); ethylene vinyl alcohol (EVOH) and ethylene

butyl-acrylate (EBA); ethylene vinyl alcohol (EVOH) and ethylene methyl-acrylate (EMA); ethylene

15 vinyl alcohol (EVOH) and propylene-based interpolymers; ethylene vinyl alcohol (EVOH) and ethylene

-based interpolymers; polyamide 6 and ethylene-acrylic acid (EAA); polyamide 6 and ethylene vinyl

acetate (EVA); polyamide 6 and ethylene butyl-acrylate (EBA); polyamide 6 and ethylene methyl-

acrylate (EMA); polyamide 6 and propylene-based interpolymers; polyamide 6 and ethylene -based

interpolymers; polyamide 66 and ethylene-acrylic acid (EAA); polyamide 66 and ethylene vinyl acetate

20 (EVA); polyamide 66 and ethylene butyl-acrylate (EBA); polyamide 66 and ethylene methyl-acrylate

(EMA); polyamide 66 and propylene-based interpolymers; polyamide 66 and ethylene -based

interpolymers; linear low density polyethylene (LLDPE) and ethylene-acrylic acid (EAA); linear low

density polyethylene (LLDPE) and ethylene vinyl acetate (EVA); linear low density polyethylene

(LLDPE) and ethylene butyl-acrylate (EBA); linear low density polyethylene (LLDPE) and ethylene

25 methyl-acrylate (EMA); linear low density polyethylene (LLDPE) and propylene-based interpolymers;

linear low density polyethylene (LLDPE) and ethylene -based interpolymers; low density polyethylene

(LDPE) and ethylene-acrylic acid (EAA); low density polyethylene (LDPE) and ethylene vinyl acetate

(EVA); low density polyethylene (LDPE) and ethylene butyl-acrylate (EBA); low density polyethylene

(LDPE) and ethylene methyl-acrylate (EMA); low density polyethylene (LDPE) and propylene-based

30 interpolymers; low density polyethylene (LDPE) and ethylene -based interpolymers; medium density

Polyethylene (MDPE) and ethylene-acrylic acid (EAA); medium density polyethylene (MDPE) and

ethylene vinyl acetate (EVA); medium density polyethylene (MDPE) and ethylene butyl-acrylate (EBA);

medium density polyethylene (MDPE) and ethylene methyl-acrylate (EMA); medium density

Polyethylene (MDPE) and propylene-based interpolymers; medium density polyethylene (MDPE) and

35 ethylene -based interpolymers; high density polyethylene (HDPE) and ethylene-acrylic acid (EAA); high

density polyethylene (HDPE) and ethylene vinyl acetate (EVA); high density polyethylene (HDPE) and

ethylene butyl-acrylate (EBA); high density polyethylene (HDPE) and ethylene methyl-acrylate (EMA);

high density polyethylene (HDPE) and propylene-based interpolymers; high density polyethylene (HDPE) and ethylene -based interpolymers; acrylonitrile butadiene styrene (ABS) and ethylene-acrylic acid (EAA); acrylonitrile butadiene styrene (ABS) and ethylene vinyl acetate (EVA); acrylonitrile butadiene styrene (ABS) and ethylene butyl-acrylate (EBA); acrylonitrile butadiene styrene (ABS) and propylene-based interpolymers; acrylonitrile butadiene styrene (ABS) and ethylene -based interpolymers; polycarbonate (PC) and ethylene-acrylic acid (EAA); polycarbonate (PC) and ethylene vinyl acetate (EVA); polycarbonate (PC) and ethylene butyl-acrylate (EBA); polycarbonate (PC) and ethylene methyl-acrylate (EMA); polycarbonate (PC) and propylene-based interpolymers; polycarbonate (PC) and ethylene -based interpolymers; polybutyleneterephthalate (PBT) and ethylene-acrylic acid (EAA); polybutyleneterephthalate (PBT) and ethylene vinyl acetate (EVA); polybutyleneterephthalate (PBT) and ethylene butyl-acrylate (EBA); polybutyleneterephthalate (PBT) and ethylene methyl-acrylate (EMA); polybutyleneterephthalate (PBT) and propylene-based interpolymers; polybutyleneterephthalate (PBT) and ethylene -based interpolymers; polymethylmethacrylate (PMMA) and ethylene-acrylic acid (EAA); polymethylmethacrylate (PMMA) and ethylene vinyl acetate (EVA); polymethylmethacrylate (PMMA) and ethylene butyl-acrylate (EBA); polymethylmethacrylate (PMMA) and ethylene methyl-acrylate (EMA); polymethylmethacrylate (PMMA) and propylene-based interpolymers; polymethylmethacrylate (PMMA) and ethylene -based interpolymers; polypropylene and ethylene-acrylic acid (EAA); polypropylene and ethylene vinyl acetate (EVA); polypropylene and ethylene butyl-acrylate (EBA); polypropylene and ethylene methyl-acrylate (EMA); polypropylene and propylene-based interpolymers; and polypropylene and ethylene -based interpolymers.

[0018] Suitable polypropylene materials include homo polypropylene and modified polypropylene such as block copolymers, impact copolymer, and random copolymers.

[0019] In some embodiments, the first layer comprises at least one of polycarbonate, polyamide 6, polyamide 66, polyethyleneterephthalate (PET), copolymers (PETg), polymethylmethacrylate (PMMA), acrylonitrile butadiene styrene (ABS), polybutyleneterephthalate (PBT), polypropylene or polyethylene and the second layer comprises at least one of ethylene-acrylic acid (EAA), ethylene vinyl acetate (EVA), ethylene butyl-acrylate (EBA), ethylene methyl-acrylate (EMA), propylene-based interpolymers, or ethylene -based interpolymers.

[0020] Exemplary ethylene interpolymers are available, for example, under the trade designation "EXACT" from ExxonMobil, Irving, TX; and "ENGAGE" from Dow Chemical Company, Midland, MI. Exemplary propylene interpolymers are available, for example, under the trade designation "VISTAMAXX" from ExxonMobil and "VERSIFY" from Dow Chemical Company.

[0021] Optionally, any of the polymeric materials comprising an article described herein may comprise additives such as inorganic fillers, pigments, slip agents, and flame retardants.

[0022] In some embodiments, the absolute difference between the first and second melting point is at least 30°C, 40°C, 50°C, 60°C, or even at least 70°C). In some embodiments, the first melting point is greater than the second melting point. In some embodiments, the second melting point is greater than the first melting point.

5 [0023] In some embodiments, the first polymer has a first vicat temperature, wherein the second polymer has a second vicat temperature, and wherein the first and second vicat temperatures are different. In some embodiments, the first and second glass vicat temperatures are at least 20°C (in some embodiments, at least 30°C, 40°C, 50°C, or even at least 60°C) different.

10 [0024] In some embodiments, the polymeric multilayer film has a thickness greater than 50 micrometers (in some embodiments, at least than 75 micrometers, 100 micrometers, 150 micrometers, 200 micrometers, 250 micrometers, 500 micrometers, 750 micrometers, 1000 micrometers, 1500 micrometers, 2000 micrometers, or 2500 micrometers; in some embodiments, in a range from 125 micrometers to 1500 micrometers, or even 125 micrometers to 2500 micrometers).

15 [0025] The openings may be in any of a variety of shapes, including circles and ovals. In some embodiments, the polymeric multilayer film has at least 30 openings/cm² (in some embodiments, at least 100 openings/cm², at least 200 openings/cm², at least 250 openings/cm², at least 300 openings/cm², at least 400 openings/cm², at least 500 openings/cm², at least 600 openings/cm², at least 700 openings/cm², at least 750 openings/cm², at least 800 openings/cm², at least 900 openings/cm², at least 1000 openings/cm², at least 2000 openings/cm², at least 3000 openings/cm² or even at least 4000 openings/cm²; in some embodiments, in a range from 30 openings/cm² to 200 openings/cm², 200 openings/cm² to 500 openings/cm², or even 500 openings/cm² to 4000 openings/cm²).

20 [0026] In some embodiments, the openings have diameters of greater than 25 micrometers (in some embodiments, greater than 50 micrometers, 75 micrometers, 100 micrometers, 150 micrometers, 200 micrometers, 250 micrometers, 500 micrometers, 750 micrometers, 1000 micrometers, 1500 micrometers, 2000 micrometers, or 2500 micrometers; in some embodiments, in a range from 25 micrometers to 1500 micrometers, or even 25 micrometers to 2500 micrometers).

25 [0027] Embodiments of polymeric multilayer film described herein are useful, for example, for filtration and acoustic absorption.

30 [0028] Exemplary Embodiments

1. A method of making a polymeric multilayer film, the method comprising:

extruding at least first and second polymeric layers into a nip to provide a polymeric multilayer film, wherein the nip comprises a first roll having a structured surface that imparts indentations through a first major surface of the polymeric multilayer film, wherein the first layer comprises a first polymer having a first melting point, wherein the second layer comprises a second

polymer having a second melting point, wherein the absolute difference between the first and second melting point is at least 20°C (in some embodiments, at least 30°C, 40°C, 50°C, 60°C, or even at least 70°C), and wherein the first major surface of the polymeric multilayer film is a major surface of the first layer and the second major surface of the polymeric multilayer film is a major surface of the second layer; and

5 passing the first major surface having the indentations over a chill roll while applying a heat source to a generally opposed second major surface of the polymeric multilayer film, wherein the application of heat from the heat source results in formation of openings to provide a polymeric multilayer film having first and second generally opposed major surfaces, an array of openings extending 10 between the first and second major surfaces, and at least first and second layers, wherein the first layer comprises the first polymer, wherein the second layer comprises the second polymer, and wherein the first major surface of the polymeric multilayer film is a major surface of the first layer and the second major surface of the polymeric multilayer film is a major surface of the second layer.

15 2. The method of Exemplary Embodiment 1, wherein the first melting point is greater than the second melting point.

3. The method of Exemplary Embodiment 1, wherein the second melting point is greater than the first melting point.

20 4. The method of any preceding Exemplary Embodiment, wherein the first polymer has a first vicat temperature, wherein the second polymer has a second vicat temperature, and wherein the first and second vicat temperatures are different.

25 5. The method of Exemplary Embodiment 4, wherein the first and second glass vicat temperatures are at least 20°C (in some embodiments, at least 30°C, 40°C, 50°C, or even at least 60°C) different.

30 6. The method of any preceding Exemplary Embodiment, wherein the polymeric multilayer film has a thickness greater than 50 micrometers (in some embodiments, at least than 75 micrometers, 100 micrometers, 150 micrometers, 200 micrometers, 250 micrometers, 500 micrometers, 750 micrometers, 1000 micrometers, 1500 micrometers, 2000 micrometers, or 2500 micrometers; in some embodiments, in a range from 125 micrometers to 1500 micrometers, or even 125 micrometers to 2500 micrometers).

35 7. The method of any preceding Exemplary Embodiment, wherein the polymeric multilayer film has at least 30 openings/cm² (in some embodiments, at least 100 openings/cm², at least 200 openings/cm², at least 250 openings/cm², at least 300 openings/cm², at least 400 openings/cm², at least 500 openings/cm², at least 600 openings/cm², at least 700 openings/cm², at least 750 openings/cm², at

least 800 openings/cm², at least 900 openings/cm², at least 1000 openings/cm², at least 2000 openings/cm², at least 3000 openings/cm² or at even least 4000 openings/cm²; in some embodiments, in a range from 30 openings/cm² to 200 openings/cm², 200 openings/cm² to 500 openings/cm², or even 500 openings/cm² to 4000 openings/cm²).

5

8. The method of any preceding Exemplary Embodiment, wherein the openings have diameters of greater than 25 micrometers (in some embodiments, greater than 50 micrometers, 75 micrometers, 100 micrometers, 150 micrometers, 200 micrometers, 250 micrometers, 500 micrometers, 750 micrometers, 1000 micrometers, 1500 micrometers, 2000 micrometers, or 2500 micrometers; in some embodiments, in a range from 25 micrometers to 1500 micrometers, or even 25 micrometers to 2500 micrometers).

10

9. The method of any preceding Exemplary Embodiment, further comprising separating at least the first and second layers of the polymeric multilayer film having the openings.

15

10. The method of any preceding Exemplary Embodiment, wherein the first polymer at least one of polyethyleneterephthalate (PET), copolyester (coPETg), ethylene vinyl alcohol (EVOH), polyamide 6, polyamide 66, linear low density polyethylene (LLDPE), low density polyethylene (LDPE), medium density polyethylene (MDPE), high density polyethylene (HDPE), acrylonitrile butadiene styrene (ABS), polycarbonate (PC), polybutyleneterephthalate (PBT), polymethylmethacrylate (PMMA), or polypropylene; and wherein the second polymer at least one of ethylene-acrylic acid (EAA), ethylene butyl-acrylate (EBA), ethylene vinyl acetate (EVA), ethylene methyl-acrylate (EMA), propylene-based interpolymers, or ethylene-based interpolymers.

20

25 [0029] Advantages and embodiments of this invention are further illustrated by the following examples, but the particular materials and amounts thereof recited in these examples, as well as other conditions and details, should not be construed to unduly limit this invention. All parts and percentages are by weight unless otherwise indicated.

30

Example 1

35

[0030] A perforated multilayer polymeric film was prepared using the following procedures. A two layer polymeric film consisting of layers A, and B was prepared using two extruders to feed a 25 cm wide 3 layer multi-manifold die (obtained under the trade designation “CLOEREN” from Cloeren, Inc., Orange TX). The center port was closed off on the die and not used. The extrusion process was done vertically downward into a nip consisting of a tooling roll (123) and a smooth steel backup roll (124). The extrusion process was configured such that layer A contacted the tooling roll (123) and layer B

contacted the backup roll (124) as shown schematically in FIG. 1. The polymeric multilayer film made as generally shown in FIG. 1 is shown in FIGS. 1A and 1B. The polymer for layer A was provided with a 3.2 cm single screw extruder. The polymer for layer B was provided with a 5.1 cm single screw extruder. Heating zone temperatures for the three extruders is shown in Table 1, below.

5

Table 1

Heating Zones	3.2 cm (1.25 inch) Layer A, °C	5.1 cm (2.0 inch) Layer B, °C	Die, °C
Zone 1	196	188	218
Zone 2	210	199	218
Zone 3	218	204	218
Zone 4	218	218	N/A
End cap	218	218	N/A
Neck Tube	218	218	N/A

[0031] The rpms of the extruders are listed in Table 2, below.

10

Table 2

	3.2 cm (1.25 inch) Layer A	5.1 cm (2.0inch) Layer B
Extruder rpm	53	16

[0032] Layers A (111A) was extruded using a polypropylene impact copolymer resin (obtained under the trade designation “DOW C700-35N 35 MFI” from Dow Chemical Company, Midland, MI). Layers B (112A) was extruded using a ethylene -based interpolymers (obtained under the trade designation

15 “DOW ENGAGE 8401” from Dow Chemical Company). The basis weight for the combined layers AB (111A, 112A) was 220 g/m².

20 [0033] The two rolls comprising the nip were water cooled rolls (123, 124) with a nominal 30.5 cm in diameter and 40.6 cm face widths. Nip force was provided by pneumatic cylinders. The smooth steel backup roll (124) temperature set point of 52°C. The tooling roll (123) had male post features (135) cut into the surface of the roll. The male post features were chrome plated. The male features (defined as posts) (135) on the tool surface were flat square topped pyramids with a square base. The top of the posts were 94 micrometers square and the bases were 500 micrometers square. The overall post height was 914 micrometers. The center to center spacing of the posts was 820 micrometers in both the radial and cross roll directions. The tooling roll (123) had a temperature set point of 65°C. The tooling roll

(123) and backup rolls (124) were directly driven. The nip force between the two nip rolls was 490 Newton per linear centimeter. The extrudate takeaway line speed was 3.0 m/min.

[0034] The polymers for the two layers were extruded from the die (130) directly into the nip (120) between the tooling (123) and backup roll (124). The male features (135) on the tooling roll (123) created indentations (127) in the extrudate. A thin layer of polymer (128) remained between the tooling (123) and backup roll (124). Typically this layer (128) was less than 20 micrometer thick. The extrudate remained on the tooling roll (123) for 180 degrees of wrap to chill and solidify the extrudate into a multi-layer polymeric film. Layers AB (111A, 112A) were then wound into roll form.

[0035] The multi-layer polymeric film containing indentations was then converted into a perforated film using the following procedure. A flame perforation system as described in U.S. Pat. No. 7,037,100 (Strobel et. al.), the disclosure of which is incorporated herein by reference, and utilizing the burner design from U.S. Pat. No. 7,635,264 (Strobel et. al.), the disclosure of which is incorporated herein by reference was used to melt and remove the thin layer (128).

[0036] Specific modifications to the equipment and process conditions for this experiment were as follows:

The chill roll (125) was a smooth surface roll without an etched or engraved pattern.

The burner (126) was a 30.5 centimeter (12 inch) eight port burner, anti howling design as described in U.S. Pat. No 7,635,264 (Strobel et. al.), the disclosure of which is incorporated by reference, and was obtained from Flynn Burner Corporation, New Rochelle, NY.

Unwind Tension: 22 Newton total tension

Winder Tension: 22Newton total tension

Burner (126) BTU's 2165 BTU/cm/hour

1% excess oxygen

Gap between burner (126) and the film surface: 4.4 mm

Line Speed: 30.5 m/min.

Chill roll (125) cooling water set point: 15.5°C

[0037] The multilayer polymeric film was processed through the apparatus schematically shown in FIG. 1 at the above conditions. The web orientation was such that the side of the film (120) with the thin polymer layer (128) was closest to the burner (126) and opposite of the chill roll (125). The chill roll (125) cooled the main body of the film, keeping the majority of the film below the softening point of the polymer. Heat from the burner flame (126) caused the remaining thin polymer layer (128) to melt thereby creating the perforations (129) in the film.

[0038] Foreseeable modifications and alterations of this disclosure will be apparent to those skilled in the art without departing from the scope and spirit of this invention. This invention should not be restricted to the embodiments that are set forth in this application for illustrative purposes.

What is claimed is:

1. A method of making a polymeric multilayer film, the method comprising:

5 extruding at least first and second polymeric layers into a nip to provide a polymeric multilayer film, wherein the nip comprises a first roll having a structured surface that imparts indentations through a first major surface of the polymeric multilayer film, wherein the first layer comprises a first polymer having a first melting point, wherein the second layer comprises a second polymer having a second melting point, wherein the absolute difference between the first and second melting point is at least 20°C, and wherein the first major surface of the polymeric multilayer film is a major surface of the first layer and the second major surface of the polymeric multilayer film is a major surface of the second layer; and

10 15 passing the first major surface having the indentations over a chill roll while applying a heat source to a generally opposed second major surface of the polymeric multilayer film, wherein the application of heat from the heat source results in formation of openings to provide a polymeric multilayer film having first and second generally opposed major surfaces, an array of openings extending between the first and second major surfaces, and at least first and second layers, wherein the first layer comprises the first polymer, wherein the second layer comprises the second polymer, and wherein the first major surface of the polymeric multilayer film is a major surface of the first layer and the second major surface of the polymeric multilayer film is a major surface of the second layer.

20

2. The method of claim 1, wherein the first melting point is greater than the second melting point.

3. The method of claim 1, wherein the second melting point is greater than the first melting point.

25

4. The method of any preceding claim, wherein the first polymer has a first vicat temperature, wherein the second polymer has a second vicat temperature, and wherein the first and second vicat temperatures are different.

30

5. The method of claim 4, wherein the first and second glass vicat temperatures are at least 20°C different.

6. The method of claim 4, wherein the first and second glass vicat temperatures are at least 30°C different.

35

7. The method of any preceding claim, wherein the first and second melt point temperatures have an absolute difference of at least 50°C.

8. The method of any preceding claim, wherein the polymeric multilayer film has a thickness greater than 50 micrometers.

9. The method of any preceding claim, wherein the polymeric multilayer film has at least 30 5 openings/cm².

10. The method of any preceding claim, wherein the openings have diameters of greater than 25 micrometers.

10 11. The method of any preceding claim, further comprising separating at least the first and second layers of the polymeric multilayer film having the openings.

12. The method of any preceding claim, wherein the first polymer is at least one of polyethyleneterephthalate, copolyester, ethylene vinyl alcohol, polyamide 6, polyamide 66, linear low 15 density polyethylene, low density polyethylene, medium density polyethylene, high density polyethylene, acrylonitrile butadiene styrene, polycarbonate, polybutyleneterephthalate, polymethylmethacrylate or polypropylene; and wherein the second polymer at least one of ethylene-acrylic acid, ethylene butyl-acrylate, ethylene vinyl acetate, ethylene methyl-acrylate, propylene-based interpolymers, or ethylene-based interpolymers.

1/2

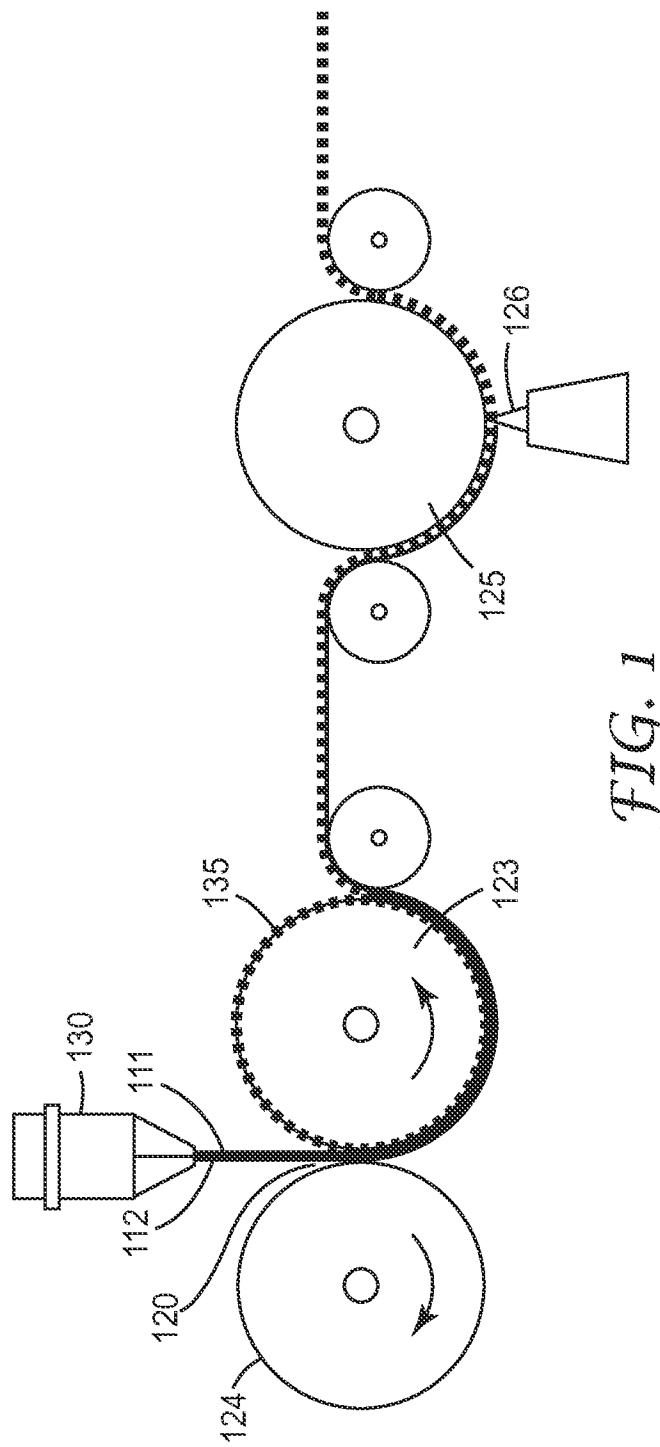
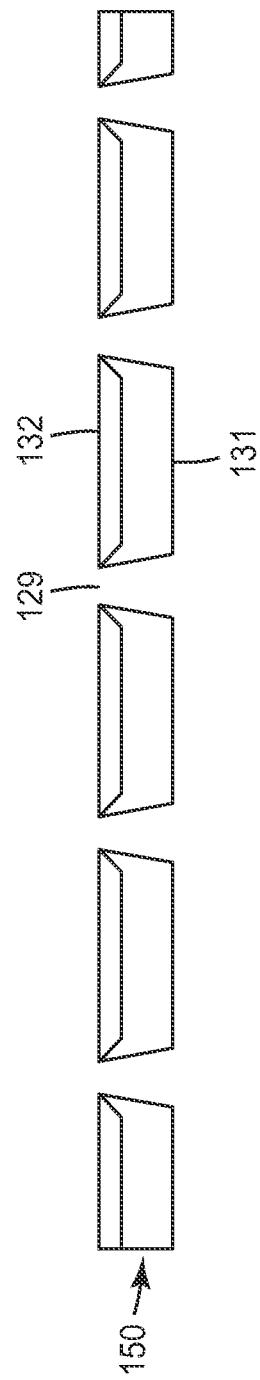
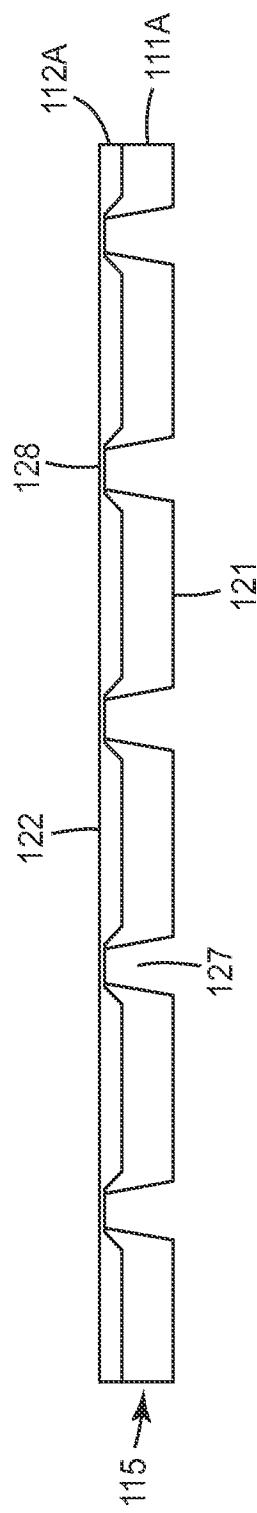


FIG. 1



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/067294

A. CLASSIFICATION OF SUBJECT MATTER
 INV. B26F1/31 B29C47/06
 ADD. B32B38/06 B32B38/04 B32B37/15

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 B29C B26F

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2005/127541 A1 (SPURGEON KATHRYN M [US] ET AL) 16 June 2005 (2005-06-16) paragraphs [0002], [0027] - [0029]; figure 2 ----- EP 1 004 412 A1 (PROCTER & GAMBLE [US]) 31 May 2000 (2000-05-31) paragraphs [0034], [0041]; figures 1,2 -----	1-12
A		1-12



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

Date of mailing of the international search report

13 February 2015

05/03/2015

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

Golombok, Gregor

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2014/067294

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US 2005127541	A1 16-06-2005	CN	1894625 A	10-01-2007
		EP	1700158 A1	13-09-2006
		JP	2007519034 A	12-07-2007
		MX	PA06006525 A	23-08-2006
		TW	200531822 A	01-10-2005
		US	2005127541 A1	16-06-2005
		WO	2005062117 A1	07-07-2005
<hr/>				
EP 1004412	A1 31-05-2000	AU	1627500 A	13-06-2000
		CA	2351328 A1	02-06-2000
		EP	1004412 A1	31-05-2000
		EP	1133383 A1	19-09-2001
		JP	2002530215 A	17-09-2002
		WO	0030818 A1	02-06-2000
<hr/>				