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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 October 2010 (21.10.2010)

PCT

(10) International Publication Number
WO 2010/119449 A2

(51) International Patent Classification:
B32B 15/02 (2006.01)

(21) International Application Number:
PCT/IN2009/000322

(22) International Filing Date:
5 June 2009 (05.06.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
964/MUM/2009 13 April 2009 (13.04.2009) IN

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(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, 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, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, 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, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (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, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, 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))*

— *of inventorship (Rule 4.17(iv))*

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

WO 2010/119449 A2

(54) **Title**: A POLYMER FILM AND PROCESS THEREOF

(57) **Abstract**: Polymer film with uniform thickness wherein polymer are thermally laminated to metal layer in vacuum to form axially oriented, laminated polymer film, which are in better reflectance of light, better attractive glossy or matte surfaces on film, impact resistance, resistance to pinhole generation and process ability and excellent heat resistance. Metal layer is selected from silver, silver alloy, mixture of other metal with silver for better reflectance, polymer film are constructed from 100 to 350 micron thick polymer layers selected from polyester, polyethylene preferably from polyester film such as poly ethylene terephthalate.

A POLYMER FILM AND PROCESS THEREOF

FIELD OF THE INVENTION

The present invention is related to polymer film with uniform thickness wherein polymer layers are thermally laminated to metal layer in vacuum to form axially oriented, laminated polymer film, and more particularly, this invention relates to a flexible polyester film having excellent characteristics such as better reflectance of light, better attractive glossy or matte surfaces on film, impact resistance, resistance to pinhole generation and process ability and excellent heat resistance.

Polemer films such as polyester are widely used and increasingly expanding in diversified field. Consequently, polyester film is required to meet even a wider scope of property requirements and better arrangement of the layers in polymer film.

Polyester films such as polyethylene terephthalate (PET) film has excellent mechanical strength, heat resistance, dimensional stability, electrical insulation, chemical resistance and optical properties, which are almost all film properties required to possess. Therefore, polyester film is ranked between general-purpose film and engineering plastic film, and is used for many applications as a high-quality film.

Thus metallised polymer film are resistance to pinhole generation, however, these films which axially oriented have mostly been used in structural materials because PET films have a relatively large hardness which comes out as a turned-over property of a toughness. For example, in package materials, particularly in package materials for liquids (for example, a retort package), impact resistance and resistance to crumpling, which are represented by the strength in dropping of a package, and further low-temperature performances thereof are required, and in most cases axially oriented nylon films are used. In packages for liquids, a film made by laminating a sealant layer such as

polyethylene or polypropylene layer on an axially oriented film is served for bag-making and a liquid is charged into the bag formed.

BACKGROUND OF THE INVENTION

Laminated polymer film materials which are metallised with metal layer such as metallised film are a well known and well documented technique. The resultant laminates have many applications such as for example in the manufacture of can bodies and can ends for containers for foodstuffs and beverages, and aerosol containers.

Polyester coatings are frequently used to coat metal sheet in order to impart good corrosion resistance to the metal sheet. It is usual to try to coat the metal sheet with a polyester resin which has a crystalline and oriented structure since such polyester films have low permeability to oxygen, water and steam. However, it has been found that it is not easy to achieve adhesion of such crystalline, axially oriented polyester film to a metal sheet.

Laminated polymer film materials which are metallised with metal layer are also being used in decorating the articles such as used as decorating mirror-like surface on some book covers, T-shirts,other flexible cloths and forming Protective covering over buttons, pins, badges.

As excellent adhesivenenss to metal-depositing layer, better of light reflecting, better attractive glossy or matte surfaces on film, the axially oriented laminated polyester film is suited for a packaging material, a decorative material, a material for gold or silver threads, silver and gold decorative button, silver spots on material, an identification material material, a window attachment, etc.

Thus according to the present invention, multilayer polymer film with uniform thickness is with better property requirements and better arrangement of the layers in multilayer

polymer film having used for many applications as a high-quality film. This better arranged film can be formed in articles for containers for foodstuffs and beverages, and aerosol container and also being used in decorating the articles such as used as decorating mirror-like surface.

In U.S. granted Pat. No. 4822451 shows that surface modification process of semicrystalline polymers wherein said polymers can have predetermined amounts of their surfaces rendered quasi-amorphous by irradiation with high energy pulses, such as for example an excimer laser. This process essentially teaches energy transfer alone.

In U.S. granted Pat. No. 4822451 shows that process for directing pulses of plasma or ions or a scanned beam of plasma or ions including a plasma of high intensity, high fluence ions and charged and neutral particles to impact a thin surface layer of an object, to thus alter the chemistry, crystal morphology, topography, or density of said surface layer, employing plasma generated from a gas, liquid, or solid source. This surface modification process provides a means of rapidly heating a thin layer of polymer surface or a thin coating on a substrate, and it utilizes a pulsed ion or pulsed plasma source, one such source, never before used in this type of process, is referred to as a coaxial plasma gun.

In UK patent No. GB 1566422 disclosed that the laminates described therein are suitable for deep drawing applications. But the polyesters used to form the laminates described in GB 1566422 are polyesters of a very specific class in that they have an intrinsic viscosity of 1.2 to 1.8 and a crystallinity in the laminated film which is below 30%. This class of polyester has an intrinsic viscosity range which is such as to exclude conventional, commercially available polyethylene terephthalate homopolymer materials such as the axially oriented polyethylene terephthalate materials which are the materials generally considered to be materials of choice for laminating to metal sheet when it is desired to impart good corrosion resistance to metal sheet by virtue of the low permeability to oxygen, water and steam of such biaxially oriented polyesters.

In US 4822451 shows container or a component for a container formed from a laminated metal sheet having a polymer film adhered to each of its major surfaces, the polymer films having been adhered to the metal sheet by simultaneous thermal lamination, the polymer film adhered to each major surface of the metal sheet being a composite polyester film.

Oriented PET to metal strip is known from GB No. 2123746. Similarly, thermal lamination of polypropylene films to metal strip is disclosed in GB No. 1324952 .

In US 3679513 discloses thermal lamination of polyethylene films to metal strip is also described in EP No. 0062385 and U.S. 4452375. However, the conditions described in these documents for thermal lamination of polymer films having such varied properties are not suitable for the simultaneous thermal lamination of a polyester film, especially biaxially oriented polyethylene terephthalate film, to one side of a metal strip, while at the same time thermally laminating to the other side of the metal strip a polyolefin or polyamide-containing film of a thickness which is economically or technically viable for can stock usage.

In US 3431135 discloses vacuum metallizing of polyethylene terephthalate film in which the film is first subjected to a reducing flame to improve its affinity for the subsequently applied metal. In the present invention level of bond strength between the film and metal which is higher than that resulting from treatment of the film surface by neutral and oxidizing flame treatment or electrical discharge treatment.

In US 4211811 describes the vacuum metallizing of an oriented, i.e., stretched, crystalline polyolefin film whose surface has been treated by corona discharge to improve its receptivity for the subsequently applied metal film. Similar procedures are described in US 4345005 and US 4604322 the metal-adherent film surface being fabricated from an ethylene-propylene copolymer.

In US 4357383 disclosed a layered metallized film comprising a polyolefin copolymer substrate layer and a metal-adherent random ethylene copolymer layer for improved metal adhesion

OBJECTIVE OF INVENTION

Layered Laminated polymer film materials which are metallised with metal layer such as metalized film have many applications.

The objective of the present invention to give an economic advantage over the standard metallised film and to provide more economical process for manufacturing polymer film, but it is not necessary to go through any steps of process in same manner described herein for construction adopted for polymer film. It has been proposed that polymer film prepared herein is with thickness of each layer varies with presence of uniform highly glossy layer to form uniform polymer layer film.

The another objective of the present invention to provide polymer film which has a crystalline and oriented structure since such polyester films have low permeability to oxygen, water and steam.

The another objective of the present invention to provide polymer film with excellent mechanical strength, heat resistance, dimensional stability, chemical resistance and optical properties, which are almost all film properties required to possess in better manner.

The another objective of the present invention to provide polymer film with resistance to crumpling, which are represented by the strength in dropping of a package.

The another objective of the present invention to provide polymer film for decorating the articles such as used as decorating mirror-like surface on some book covers, T-

shirts,other flexible cloths and forming Protective covering over buttons, pins, badges, glitter powder, yarn, sequence etc.

The another objective of the present invention to provide polymer film for decorative material, a material for gold or silver threads, silver and gold decorative button, silver spots on material, an identification material, a window attachment, etc.

The another objective of the present invention to provide polymer film with better arrangement of the layers in polymer film having used for many applications as a high-quality film.

The another objective of the present invention to provide polymer film with thermal lamination after contacting non uniform glass layer with metal layer.

The another object of the invention to protect the silver from oxidation.

The another objective of the present invention to provide polymer film with metal layer is with or without substrate layer which is one of polymer layer.

The another objective of the present invention to provide polymer film with non uniform glass layer is attached to metal layer and is in the decorative shape for better reflectance where in glass later may be optional.

The another objective of the present invention to provide polymer film with metal layer selected from silver, silver alloy, mixture of other metal with silver for better reflectance which is above 95 %.

The another objective of the present invention to process for manufacture of provide polymer film with metallised polymer layer which is metalised by silver or its alloy metal in specific proportion for better reflectance of light in axial orientation.

SUMMARY OF THE INVENTION

In accordance with the present invention a polymer film comprising polymer layers of polyester etc material, metal layer, Uniform highly gloss layer and film protecting layers are attached thermally wherein thickness of each layer varies with presence of non uniform glass layer to form uniform multilayer polymer layer film.
The Uniform highly gloss layer is attached to metal layer and is in the decorative shape for better reflectance may be in situated in very specific region of the metal layer.

Thus when uniform highly gloss layer is not present, thickness of other layers except metal layers varies from 100 to 350 micron for each layer to form uniform polymer layer film. The polymer film, polymer layers are adhered to the metal layer by simultaneous thermal lamination after contacting non uniform glass layer with metal layer. But metal layer can be with or without substrate layer which is one of polymer layer depending on the strength of metal layer which is made from silver or its alloy in proportions.

In the present invention of polymer film, protecting layers are attached above the polymer layers on both side to increase the strength of metallised layer and protect it from any damaged with rough handling or machine handling.

The polymer film, wherein metal layer can be silver alloy and mixture of silver with other metal are in ratio of 97.2 % to on words of silver to 1.5 % to 2.8 % of other metals by weight such as aluminum, chromium, brass preferably in ratio of 76 to 97.2 % of silver to 5 to 24 % of other metals, more preferably in ratio of 94 to 95 % of silver to 5 to 6 % of other metals.

A process for producing polymer film comprises heating metal for metallising, metallizing polymer layer by thermal lamination, coating of thus form metallised polymer layer by another polymer layer to protect and Cutting/slitting the polymer film. And metalizing of silver products.

DETAILED DESCRIPTION OF THE INVENTION

Polymer films are made from polymer layer. These polymer layers are of polyester, polyethylene, polypropylene, polyisobutilene, Polynorbornen, Polymethylpentene, Polypropylene P.V.C and etc material. But Polyester film such as poly ethylene terephthalate are found better as it has very good barrier action with respect to gases, such as oxygen and flavors and excellent mechanical strength, heat resistance, dimensional stability, electrical insulation, chemical resistance and optical properties, which are almost all film properties required to possess.

Metal layer is selected from silver, silver alloy, mixture of other metal with silver for better reflectance. Thus better the reflectance is possible by using pure silver or silver alloy and mixture of silver with other metal are in ratio of 92.5 % to on words of silver to 4.3 to 40 % of other metals by weight such as aluminum, chromium, brass.

Metal layer is with or without substrate layer which is one of polymer layer. Thus substrate layers are polymers such as polyesters and polyethylene layers. Thus use of substrate layer depend on type of metal use as discussed or percentage of other metal use. Thus such proportions of silver metal decides the use of substrate layers.

uniform high gloss layer is attached to metal layer and is in the decorative shape for better reflectance in specific portion of polymer film. Thus non uniform glass layer is in direct contact with metal layer and can be on both side of metal layer. Thus it give better decorating look to the articles such as used as decorating mirror-like surface on some book covers, T-shirts,other flexible cloths and forming Protective covering over buttons, pins, badges, glitter powder, yarn, fabric and sequence.

Protecting layers are attached above the polymer on both side to increase the strength of metallised layer and protect it from any damaged with rough handling or machine handling. Protecting layers are made up of polymers layers such as polyester,

polyethylene, The Protecting layers are present on both side of the polymer films. Thus forming high reflecting and high glazesed polymer film.

Polymer film are constructed from 100 to 350 micron thick polymer layers selected from polyester, polyethylene preferably from polyester film such as poly ethylene terephthalate.

Metal Layer is formed with the help of heating metal such as silver, silver alloy, mixture of other metal in graphite Crucible on substrate layer . Depending on the strength of metal, use of substrate layer is decided. Thus such proportions of silver metal decides the use of substrate layers. If pure silver is used then substrate layer may not be use or can be used with minimum thickness of substrate layer.

Uniform highly gloss layer is attached to metal layer with decorative shape for better reflectance in specific portion of polymer film. Thus non uniform glass layer is in direct contact with metal layer and can be on both side of metal layer. Thus non-uniform glass layer as name suggested is not uniform in the in polymer film. It is present in one portion of the film and may not be present in other portion of the polymer film and can be present in it even in for of small dot for better decorative and reflective purpose.

In polymer films, at least one polymer layer are present on each side of metal. These polymer layers are of are selected from polyester, polyethylene preferably polyester such as poly ethylene terephthalate is thermally laminated on each side to metal layer over uniform highly gloss layer under vacuum. When uniform highly gloss layer is not present then polymer layer is directly laminated to metal layer or metal layer with substrate layer. Substrate layer is optional depending on the strength of metal layer.

Protecting layers are in direct contact with polymer layers on both side by coating method by coating machine to increase the strength of metallised layer and protect it from any damaged with rough handling or machine handling. Protecting layers are made up of

polymers layers such as polyester, polyethylene, The Protecting layers are present on both side of the polymer films

On other hand, thickness substrate layer to metal layer will be will be always less than polymer layer. In some case substrate layer may be absent or very minimum depending on the strength of metal layer. Thus final multilayer polymer film formed id of uniform thickness.

Polymer film is manufactured by process heating metal at just below of evaporation temperature which is above 1500 degree Celsius in induction heating graphite crucible for formation of melt. Heating of metal in crucible can be done above 1800 degree Celsius depending on type of metal or metal alloy. Thus metal is selected from silver, silver alloy, mixture of other metal with silver for better reflectance.

Thus better the reflectance is possible by using pure silver or silver alloy and mixture of silver with other metal are in ratio of 97.2 % to on words of silver to 2.8 % of other metals by weight such as aluminum, chromium, brass preferably in ratio of 97.2 % to on words of silver to 5 to 24 % of other metals, more preferably in ratio of 95 to 98 % of silver to 3 to 5 % of other metals in induction heating graphite crucible.

Then metal is drown in layer of metal over substrate layer which is polymer layer or directly drawn in layer and then non-uniform glass layer is formed on metal layer. Non uniform Glass layer can be formed on both side metal layer. Such a layer is thermally laminated in vacuum chamber in vacuum at 10 E-5 TORR and above to form metalized on polymer layer.

Thus metallised polymer layer is coated by protective layer which polymer layer to protect and improve life of metallised polymer layer to form final polymer film. Then final polymer film is formed in different shapes and articles by Cutting/slitting the multilayer polymer film with slitting/ forming machine.

Number of examples of the present invention can be given but these are not limited to following example

Example 1

Polyester film used as polymer layer which is 150 micron is metailised with metal layer of metal alloy of 97.2% silver and other 2.8% of film. Metal layer is substrates on 100 micron substrate layer of polymer film. To metal layer non uniform glass layer id attached on both side having discrete layer of below 100 micron. The formed metalised polymer layer is coated with 250 micron protective layer of polymer on both sides. Polymer film is formed by thermal lamination to provide Protective Layer/Polyester/non-uniform glass layer/silver alloy metal layer/substrate layer/ non-uniform glass layer/ Polyester/ Protective Layer laminated construction.

Example 2

Polyester film used as polymer layer which is 100 micron is metailised with metal layer of metal alloy of 97.2 % silver and other 2.8% of aluminum. Metal layer is subtracted on 100 micron substrate layer of polymer film. To metal layer non uniform glass layer id attached on both side having discrete layer of below 100 micron. The formed metalised polymer layer is coated with 150 micron protective layer of polymer on both sides. Polymer film is formed by thermal lamination to provide Protective Layer/Polyester/non-uniform glass layer/silver alloy metal layer/substrate layer/ non-uniform glass layer/ Polyester/ Protective Layer laminated construction.

Example 3

When Substrate layer is not required then, Polyester film used as polymer layer which is 250 micron is metailised with silver. To metal layer uniform highly gloss layer id attached on both side having discrete layer of below 100 micron. The formed metalised

polymer layer is coated with 150 micron protective layer of polymer on both sides. Polymer film is formed by thermal lamination to provide Protective Layer/Polyester/non-uniform glass layer/silver alloy metal layer/non-uniform glass layer/ Polyester/ Protective Layer laminated construction.

Example 4

When glass layer is not present, Polyester film used as polymer layer which is 250 micron is metailised with metal layer of metal alloy of 97.2 % silver and other 2.8% of aluminum. Metal layer is subtracted on 100 micron substrate layer of polymer film. To metal layer non uniform glass layer id attached on both side having discrete layer of below 100 micron. The formed metalised polymer layer is coated with 150 micron protective layer of polymer on both sides. Polymer film is formed by thermal lamination to provide Protective Layer/Polyester/ silver alloy metal layer/substrate layer/ Polyester/ Protective Layer laminated construction.

Example 5

When Substrate layer and glass layer is not present, Polyester film used as polymer layer which is 250 micron is metailised with metal layer of metal alloy of 75 % silver and other 25 % of aluminum. The formed metalised polymer layer is coated with 100 micron protective layer of polymer on both sides. Polymer film is formed by thermal lamination to provide Protective Layer/Polyester/ silver alloy metal layer/Polyester/ Protective Layer laminated construction.

Example 6

One side lamination of metalised film then and When Substrate layer and glass layer is not present, Polyester film used as polymer layer which is 350 micron is metailised with metal layer of pure silver. The formed metalised polymer layer is coated with 135 micron

protective layer of polymer on both sides. Polymer film is formed by thermal lamination to provide Protective Layer/Polyester/ silver metal layer/ Protective Layer laminated construction.

Example 7

Both sides lamination of metalised film then and When Substrate layer and glass layer is not present, Polyester film used as polymer layer which is 250 micron is metailised with metal layer of pure silver. The formed metalised polymer layer is coated with 100 micron protective layer of polymer on both sides. Polymer film is formed by thermal lamination to provide Protective Layer/Polyester/silver metal layer/Polyester layer/Protective Layer laminated construction.

Example 8

Both sides lamination of metalised film then and When Substrate layer and glass layer is not present, Polyester film used as polymer layer which is 135,150 and 250 micron are metailised with metal layer of pure silver under vacuum. The formed metalised polymer layer is coated with protective layer of polymer on both sides. Polymer film is formed by thermal lamination to provide Protective Layer/Polyester/silver metal layer/Polyester layer/Protective Layer laminated construction.

Example 9

Silver alloy Metal is drawn in layer of metal over substrate layer which is polymer layer or directly drawn in layer and then uniform protective layer is formed on metal layer. Uniform protective layer is formed on both side metal layer. Such a layer is thermally laminated in vacuum chamber in vacuum at about 10 E-5 TORR and above to form metallised polymer layer.

Thus metallised polymer layer is coated by protective layer which polymer layer to protect and improve life of metallised polymer layer to form final multilayer polymer film. Then final polymer film is formed in different shapes/size or different thickness and articles by Cutting/slitting the polymer film with slitting/ forming machine.

Comparative reflection of different Polymer Film

Table: 1

Polymer layer thickness in micron	**Metal layer composition in alloy**	**Glass Layer**	**Substrate layer**	**% Reflectance**
150	97.2 % to on words of silver	Present	Present	98.5
250	92.7 % to on words of silver	Present	Present	98.5
250	Pure silver	Absent	Present	99
350	Pure silver	Absent	Absent	99
250	92.7 % on words of silver	Absent	Absent	98.5
135,150 and 250	Pure silver	Absent	Absent	99

I Claim:

1) A polymer film comprising
   a) at least one polymer layers such as polyester material
   b) a metal layer
   c) at least one non-uniform glass layer and
   d) at least two film protecting layers

   wherein thickness of each layer varies with presence of non uniform glass layer to form uniform polymer layer film

2) The polymer film of claim 1 wherein polymer layers having been adhered to the metal layer by simultaneous thermal lamination after contacting non uniform glass layer with metal layer.

3) The polymer film of claim 1, wherein metal layer is with or without substrate layer which is one of polymer layer.

4) The polymer film of claim 1, wherein non uniform glass layer is attached to metal layer and is in the decorative shape for better reflectance.

5) The polymer film of claim 1, wherein film protecting layers are attached above the polymer layers on both side

6) The polymer film of claim 1, wherein metal layer is selected from silver, silver alloy, mixture of other metal with silver for better reflectance.

7) The polymer film of claim 6, wherein silver alloy and mixture of silver with other metal are in ratio of 97.5 % to on words of silver to 2.5 to 40 % of other metals by weight such as aluminum, chromium, brass preferably in ratio of 76 to 95 % of

silver to 5 to 24 % of other metals, more preferably in ratio of 94 to 95 % of silver to 5 to 6 % of other metals.

8) The polymer film of claim 4, wherein non-uniform glass layer is not present thickness of other layers except metal layers varies from 100 to 350 micron for each layer to form uniform multilayer polymer layer film.

9) A process for producing polymer film as claimed in claims 1 to 8 comprises

a) heating metal at just below of evaporation temperature of metal in induction heating graphite crucible to form melt
b) metallizing polymer layer by thermal lamination in vacuum chamber at high vacuum at 10 E-5 TORR and above to form metallised polymer layer
c) coating of thus form metallised polymer layer by another polymer layer to protect and improve life of metallised polymer layer to form final polymer film
d) Cutting/slitting the polymer film with slitting/ forming machine to give different shape

10. A process for producing polymer film as claimed above wherein before metallizing polymer layer formed metal layer is formed optionally on substrate layer.