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(54) Title: FILM WEB MATERIAL COMPRISING LINEAR OR BRANCHED, ISOTACTIC POLYMERS

(57) Abstract: The present invention provides an article comprising a first element and a second element joined to the first element, the first element comprising a film web material. The article is characterized, in that the film web material comprises a polyolefinic homopolymer having an isotacticity of less than 60 % of [mmmm] pentad concentration. The present invention further provides a method for manufacturing a film web material comprising a step of processing the aforementioned polymeric material, the step of processing selected from the group of casting, extruding, blowing, and combinations thereof. The present invention further provides a method for processing a film web material comprising the aforementioned polymer, the process comprising a step selected from the group of orienting, bi-axially stretching, crazing, stretching, shrinking, and combinations thereof.

FILM WEB MATERIAL COMPRISING LINEAR OR BRANCHED, ISOTACTIC POLYMERS

FIELD OF THE INVENTION

The present invention relates to film web materials used for example in hygienic articles, packaged articles, as construction elements. Specifically, the present invention relates to elastic film web materials.

BACKGROUND

Film web material and in particular film web materials comprising olefinic are well known in the art and enjoy widespread usage throughout the industry. Typical areas of application of such film web material include hygienic articles and in particular disposable absorbent articles, packaging materials.

Film web materials made from commonly used polyolefins such as PP, PE, PS, PIB have a number of useful properties. They are bio-compatible and food compatible, chemically stabile, inert, non toxic materials. However, most of them have poor mechanical properties including insufficient strength/tear resistance, insufficient stretchability/elasticity and the like.

Several approaches have been proposed in the prior art to provide elastic properties to such film web materials. The most commonly used approach is based on changing the chemical structure of the polymer by introducing hinged joints/moieties into the main chain of the polymer. These hinges provide more flexibility to the polymeric backbone preventing crystallization of polymer,

lowering the glass transition temperature (Tg) and improving the elasticity of the resulting material. Usually, the hinge groups contain heteroatoms providing flexibility such as oxygen, nitrogen or chlorine placed into the main chain or into bulky side groups. Another approach is mastication of the polymer by blending with special plasticizing agents. Both approaches, however, require heteroatoms to be introduced into the molecule or into the bulk of the coating material.

The third approach proposed in the prior art to provide elastic properties to such film web materials, which is more close to the present invention, is to exploit the formation of hetero-phases which reinforce the bulk material by forming a physical net. To do this the block-co-polymerization of two or more different monomers has been used leading to polymeric backbones comprising blocks with different Tg. This results in micro-phase separation in the bulk with formation of reinforcing crystalline domains of one co-polymer linked with each other by flexible chains of the second co-polymer.

In essence, conventional film web materials carry a wide variety of inherent disadvantages including but not being limited to insufficient strength/tear resistance, insufficient stretchability/elasticity, not being bio-compatible, not being food compatible, comprising heteroatoms such as chlorine and hence leading to toxic residues when burnt, and the like.

It is an object of the present invention to provide articles comprising film web materials which over come the disadvantages of the prior art film web materials.

It is an further object of the present invention to provide articles which comprise elastic film web materials.

It is an further object of the present invention to provide a method for manufacturing film web material of the present invention.

It is a further object of the present invention to provide a method processing a film web material of the present invention.

SUMMARY OF THE INVENTION

The present invention provides an article comprising a first element and a second element joined to the first element, the first element comprising a film web material. The article is characterized in that the film web material comprises a polyolefinic homopolymer having a an isotacticity of less than 60% of [mmmm] pentad concentration.

The present invention further provides a method for manufacturing a film web material comprising a step of processing the aforementioned polymeric material, the step of processing selected from the group of casting, extruding, blowing, and combinations thereof.
The present invention further provides a method for processing a film web material comprising the aforementioned polymer, the process comprising a step selected from the group of orienting, bi-axially stretching, crazing, stretching, shrinking, and combinations thereof.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides articles comprising film web materials comprising a polyolefinic homopolymer.

The term "polyolefinic homopolymer" as used herein refers to those polyolefins which comprise only one phase of molecules all of which exhibiting a similar stereochemical configuration. For example, blends of atactic and isotactic polymers where the two phases have polymerized simultaneously are excluded when this term is used. The term homopolymer includes copolymers where all molecules exhibit a similar stereochemical configuration.

The polyolefinic homopolymer of the present invention may comprise linear isotactic polymers having a structure of one or several C_3 to C_{20} olefinic monomers, having an isotacticity of less than 60%, preferably less than 55%, more preferably less than 50%, and most preferably less than 45% of [mmmm] pentad concentration, and having an isotacticity of more 15%, preferably more than 20%, more preferably more than 25%, and most preferably more than of [mmmm] pentad concentration. Preferably, the polyolefinic homopolymer is polypropylene.

The isotacticity of the homopolymers may be reduced compared to the isotactic polypropylenes of the prior art due to a statistic distribution of stereoscopic errors in the polymer chain. The term "stereoscopic error" refers to a stereoscopic sequence characterized by a [mrrm] pentad. In this case, the central monomer has a stereo configuration opposed to the other four monomers in this pentad. The [mrrm] pentad concentration of this polymer therefore is above the statistical probability of $p^2 (1-p)^2$ where p=[m] and hence 1-p=[r] and p^4=[mmmm]. Preferably, the pentad concentration is at least $[p (1-p)]^q p (1-p)$ with q being 0.8, more preferably q being 0.6, yet more preferably q being 0.4, yet more preferably q being 0.2, most preferably q being 0.1.

In some embodiments of the homopolymer and in particular in those embodiments where the crystallinity is reduced by means of single stereo errors, a low content of atactic sequences has proven beneficial to the properties of the film of the present invention. Preferably, the [rmrm] pentad concentration is below 6%, more preferably below 5%, yet more preferably below 4%, yet more preferably below 3%, most preferably below 2.5%.

In some embodiments of the homopolymer and in particular in those embodiments where the crystallinity is reduced by means of single stereo errors, a low content of syndiotactic sequences has proven beneficial to the properties of

the film of the present invention. Preferably, the [rrrr] pentad concentration is below 6%, more preferably below 5%, yet more preferably below 4%, yet more preferably below 3%, most preferably below 2.5%.

Alternatively, the homopolymer of the present invention may include sequences of atactic and isotactic blocks of polymer.

Preferably, the mean molecular weight M_w of the polymer is above 100000 g/mol, more preferably above 200000 g/mol, yet more preferably above 250000 g/mol, yet more preferably more than 300000 g/mol, most preferably more than 350000 g/mol.

The glass temperature T_g is between -50 and +30 °C. Preferably the glass temperature is below 10°C, more preferably below 5°C, yet more preferably below 0°C, most preferably below -6°C. The melt temperature of the polymer is obtained after heating the sample 150°C and subsequently cooling the polymer to –50°C.

Without wishing to be bound by this theory, the polyolefinic polymers exhibit a semi-crystalline structure. The structure contains elastic amorphous areas of nano-scale-size reinforced with self arranged crystalline domains of nano-crystals. The formation of brittle macro-crystalline material from the polymer is achieved by introducing the defects into the polymeric backbone. Isolated monomer units with opposite stereo configuration have been used as the defects, i.e. single stereo errors.

Suitable polymers and a process for manufacturing such polymers are described in PCT patent application EP99/02379 incorporated herein by reference. A catalyst combination suitable for the preparation of such polymers is described in PCT patent application EP99/02378 incorporated herein by reference. Preferably, the process of PCT patent application EP99/02378 is carried out by temperatures

of less than 30°C, more preferably less than 25°C, yet more preferably less than 20°C, most preferably less than 15°C to increase the molecular weight of the resulting polymer. In order to increase the molecular weight, the polymerization is preferably carried out in liquid monomer such as in liquid propene. In order to increase the molecular weight, the catalyst is preferably used in combination with the boron activators mentioned in PCT patent application EP99/02378.

Other suitable polymers and a process for manufacturing such polymers is described in WO99/20664 incorporated herein by reference.

It is preferred to use homopolymers for the films of the present invention since during manufacture of homopolymers the batch to batch variability is greatly reduced in comparison to multi phase polymers where the phases are polymerized in a single reaction.

Preferably, the polymers used in manufacturing the film materials of the present invention have a distinctive rubber-elastic plateau in their tensile-strength curves.

The polymers used for the film of the present invention are bio-compatible may be burnt without toxic residues since they contain no heteroatoms such as chlorine. The further do not contain toxic monomer residues.

The film materials of the present invention have been found to be able exhibit superior softness. Preferably, the film material has a Shore hardness on the A scale of less than 30, more preferably, of less than 25, yet more preferably of less than 20, yet more preferably of less than 15, most preferably of less than 10. The softness of the film material of the present invention can be increased by manufacturing the film by low density filming and by reducing the isotacticity ([mmmm] pentad concentration).

The film material has been found to exhibit increased temperature stability compared to prior art film materials. This is partly due to the fact that for the films of the present invention a homopolymer is used and is partly due to the high molecular weight of the homopolymer. Preferably, the film material of the present invention has a melting point of at least 100°C, more preferably of at least 110°C, more preferably of at least 120°C, most preferably of at least 130°C. The melt temperature of the polymer is obtained after heating the sample 150°C and subsequently cooling the polymer to –50°C. Higher melting point may be achieved my blending the homopolymer for example with conventional isotactic polymer such as polypropylene.

The film of the present invention have been found to be stretchable as well as elastic. The stretchability of the film versus its elastic behavior can be adjusted by means of the tacticity of the homopolymer of the present invention. The film material of the present invention has been found to be stretchable without tearing to at least 500% of its original length, more preferably 1000% of its original length, yet more preferably to at least 1500% of its original length, most preferably to at least 2000% of its original length. In addition, the film material of the present invention preferably recovers within 10 minutes after being stretched and held for 1 minute to 500% of its original length back to less than 300% its original length, preferably less than 200% its original length, most preferably less than 150% of its original length. In addition, the film of the present invention has been found to exhibit a low compressive set. The film of the present invention recovers within 10 minutes after a compression to 50% of its original thickness for 1 minute to at least 60% of its original thickness, more preferably at least 70% of its original thickness, yet more preferably to at least 80% of its original thickness, yet more preferably to at least 90% of its original thickness, most preferably to at least 95% of its original thickness. The compressibility of the film of the present invention can be adjusted by increasing

the tacticity of the homopolymer or by blending the low tacticity homopolymer with conventional isotactic polymer such as polypropylene.

The film of the present invention has been found to exhibit a relative low tackiness at room temperature due to the high molecular weight of the polymer.

The film of the present invention has been found to exhibit a relatively low amount of inclusions of non-melted material. This leads to substantial improvements of the ultimate elongation properties of the film of the present invention.

The films of the present invention and in particular those where the polymer has relatively low tacticity have been found to be relatively transparent. In other words, the transparency of the films of the present invention can be adjusted by means of changing the tacticity of the polymer. It has also been found that the polymer of the present invention is miscible with certain colorants known I the art so that the films of the present invention can be given any desired color.

Various additives may be added to the homopolymer of the present invention to change the properties of the polymer such as is well known in the art. For example, blending the polymer with between 2% and 6% by weight of talc and optionally with between 0.1% and 0.25% by weight of phenol/phosphite stabilizer, the processability of the film material of the present invention can be greatly enhanced.

Compared to processing of conventional, isotactic polypropylene, the addition of the low isotacticity homopolymer of the present invention reduces the requires forces, pressures, or torques respectively to process the polymer.

In the prior art, a wide variety of suitable techniques to manufacture film web materials are known including but not being limited to casting, extruding,

blowing, and combinations thereof. In addition, there are known a wide variety of techniques for further processing of film web materials including but nor being limited to orienting, bi-axially stretching, crazing, stretching, shrinking, and combinations thereof. The aforementioned methods for manufacturing and processing film web materials all have specific advantages which are known to the skilled person. Hence, the skilled person will be able to select a suitable method for manufacturing and processing the film web material of the present invention depending on the specific requirement of the respective application of the film web material.

In order to reduce shrinkage in the transverse direction, it may be useful to place air jets at the die exit to add additional cooling.

When storing the film of the present invention on a take-up roll, the use of a release paper may improve the downstream handling of the film.

In order to render the film of the present invention breathable, the polymer may be mixed with a particulate filler material such as calcium carbonate prior to manufacturing the film and be stretched subsequent to manufacturing the film in order to create micro pores at the location of the included filler material by stretching the film material. Preferably, the breathable film material of the present invention has a moisture vapor transmission rate (MVTR) of at least 1000 g per 24 hours per square meter, more preferably at least 2000 g/24hours/m^2, yet more preferably at least 3000 g/24h/m^2, most preferably at least 4000 g/24h/m^2. The method of determining MVTR is well known in the art and should be applied accordingly.

The article according to the present invention may be a hygienic article. The term "hygienic article" as used herein refers to articles which are intended to be used in contact with or in proximity to the body of a living being. Such hygienic articles may absorbent or non-absorbent. Such hygienic articles may be disposable or

intended for multiple or prolonged use. Such hygienic articles include but are not limited to disposable absorbent article (diapers, sanitary napkins, adult incontinence devices such as briefs, bed mats, wound plasters, underarm sweat pads, medical films, and the like), medical supply items (coverings, gowns, gloves, face masks, blood bags, and the like), and other hygienic articles such as toys, bed covers, contraceptives, and the like. Having regard to the specific advantages of the polymers used for the articles of the present invention, it will be readily apparent to the skilled practitioner to apply the film web materials according to the present invention in the above and similar hygienic articles.

The film web material according to the present invention may also be used as a construction element in an article. Thereby, the functionalities of the film web material includes but is not limited to supporting, carrying, fixing, protecting other elements of the article and the like. Such articles include but are not limited to adhesive tapes, video/audio/data storage tapes, cables, and complex constructions such as buildings (floor coverings, house wraps, and the like), cars, household appliances, horticultural and agricultural constructions, and the like. Having regard to the specific advantages of the polymers used for the articles of the present invention, it will be readily apparent to the skilled practitioner to apply and to optionally modify the film web materials according to the present invention as construction elements in the above and similar articles.

The article of the present invention may also be a packaging article such as produce bags, trash bags, ice bags, shipping sacks, containers, pouches, and the like. The term "packaging article" as used herein refers to articles which are intended to at least partially envelope other articles. The first element of such an article is a specifically contoured piece of the film web material and the second element may be a sealing such as a thermobond seal of the film web material onto itself.

The article of the present invention may also be a package article where the first element of the article is the wrap material used for packaging the second element.

CLAIMS

1. An article comprising a first element and a second element joined to said first element, said first element comprising a film web material
characterized in that
said film web material comprises a polyolefinic homopolymer having a an isotacticity of less than 60% of [mmmm] pentad concentration.

2. An article according to Claim 1
wherein
said film web material is stretchable.

3. An article according to Claim 2
wherein
said film web material is elastically extendible.

4. An article according to any of the preceding claims
wherein
said linear or branched, isotactic polymer is polypropylene.

5. An article according to any of the preceding claims
wherein
said article is a hygienic article.

6. A hygienic article according to Claim 5
wherein
said article is a disposable absorbent article.

7. An article according to any of Claim 1 through Claim 4
wherein
said first element is a construction element of the article.

8. An article according to any of Claim 1 through Claim 4
wherein
said article is a packaging article.

9. An article according to Claim 8
wherein
said article is a package article and said first element is the wrap material.

10. A method for manufacturing a film web material comprising a step of processing a polymeric material, said step of processing selected from the group of casting, extruding, blowing, and combinations thereof
characterized in that
said polymeric material comprises a polyolefinic homopolymer having a an isotacticity of less than 60% of [mmmm] pentad concentration.

11. A method for processing a film web material comprising a step selected from the group of orienting, bi-axially stretching, crazing, stretching, shrinking, and combinations thereof
characterized in that
said film web material comprises a polyolefinic homopolymer having a an isotacticity of less than 60% of [mmmm] pentad concentration.

INTERNATIONAL SEARCH REPORT

Intern al Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C08J5/18 D04H13/00 //C08L23:02

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)
IPC 7 C08J D04H B29C

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 practical, search terms used)
WPI Data, PAJ, EPO-Internal, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 888 607 A (ROGERS JOHN J ET AL) 30 March 1999 (1999-03-30) claim 1 column 1, line 5 - line 8	1,4-11
A	WO 95 25757 A (COATES GEOFFREY W ;UNIV LELAND STANFORD JUNIOR (US); WAYMOUTH ROBE) 28 September 1995 (1995-09-28) claims 31,32 page 14, line 22 -page 15, line 28	1
A	WO 94 28066 A (SHELL OIL CO) 8 December 1994 (1994-12-08) claim 1	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

....ormation on patent family members

Intern: ...al Application No
PCT/US 00/27133

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