(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 727 722 B9

(12) CORRECTED EUROPEAN PATENT SPECIFICATION

(15) Correction information:
Corrected version no 1 (W1 B1)
Corrections, see
Description Paragraph(s) 94

(48) Corrigendum issued on:
11.04.2018 Bulletin 2018/15

(45) Date of publication and mention of the grant of the patent:
11.10.2017 Bulletin 2017/41

(21) Application number: **12803703.3**

(22) Date of filing: **29.06.2012**

(51) Int Cl.:
B32B 27/08 (2006.01) *B32B 7/12* (2006.01)
B60C 5/14 (2006.01) *C09J 7/02* (2006.01)
C08J 5/18 (2006.01) *B60C 1/00* (2006.01)
B29D 30/06 (2006.01) *C09J 161/12* (2006.01)
C08G 69/40 (2006.01) *C08L 77/00* (2006.01)

(86) International application number:
PCT/KR2012/005188

(87) International publication number:
WO 2013/002603 (03.01.2013 Gazette 2013/01)

(54) FILM FOR TIRE INNER LINER AND PREPARATION METHOD THEREOF

FILM FÜR EINE REIFENINNENVERKLEIDUNG UND HERSTELLUNGSVERFAHREN DAFÜR

FILM POUR TOILE D'ENTRAÎNEMENT INTERNE POUR PNEU ET SON PROCÉDÉ DE PRÉPARATION

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **29.06.2011 KR 20110063956**
30.06.2011 KR 20110064870
29.06.2012 KR 20120070633
29.06.2012 KR 20120070634

(43) Date of publication of application:
07.05.2014 Bulletin 2014/19

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Printed by Jouve, 75001 PARIS (FR)

Description

TECHNICAL FIELD

[0001] The present invention relates to a film for a tire inner liner, and more particularly to a film for a tire inner liner that may exhibit an excellent gas barrier property with a thin thickness, thus enabling light weight of a tire and improvement in automobile mileage, and has uniform properties in all directions of the film, thus having excellent formability and improved durability.

BACKGROUND OF THE ART

[0002] A tire withstands the weight of an automobile, reduces impact from the road, and transfers driving force or braking force of an automobile to the ground. In general, a tire is a complex of fiber/steel/rubber, and has a structure as shown in Fig. 2.

Tread (1): a part contacting the road. It should afford frictional force required for driving, have good wear resistance, withstand external impact, and have low heat.
Body ply, or carcass (6): a cord layer in the tire. It should support the weight, withstand impact, and have high fatigue resistance to bending and stretching during vehicle service.
Belt (5): It is located between the body plies, consists of steel wire in most cases, reduces external impact, and maintains wide tread to afford excellent vehicle running stability.
Side wall (3): A rubber layer between a part below a shoulder (2) and bead (9). It protects the inner body ply (6).
Inner liner (7): It is located inside the tire instead of a tube, and prevents air leakage to enable pneumatic tire.
Bead (9): A square or hexagonal wire bundle formed of rubber-coated steel wire. It positions and fixes the tire in a rim.
Cap ply (4): A special cord located on a belt of a radial tire for some cars. It minimizes movement of the belt during running.
Apex (8): A triangular rubber filler used to minimize dispersion of the bead, reduce external impact to protect the bead, and prevent air inflow during forming.

[0003] Recently, a tubeless tire where high pressure air of 30 to 40 psi is injected has been commonly used without using a tube, and to prevent air leakage during automobile running, an inner liner having a high gas barrier property is positioned as the inner layer of the carcass.

[0004] Previously, a tire inner liner including rubber such as butyl rubber or halobutyl rubber and the like having relatively low air permeability as a main ingredient was used, but to achieve a sufficient gas barrier property of the inner liner, the rubber content or inner liner thickness should be increased. Thus, the total weight of the tire was increased, the automobile mileage was degraded, air pockets were generated between the inner rubber of the carcass layer and the inner liner during vulcanization of a tire or during automobile running, or the shape or properties of the inner liner was varied.

[0005] Therefore, various methods have been suggested to decrease the thickness and weight of the inner liner to reduce mileage, and reduce changes in the shape or properties of the inner liner during vulcanization of a tire or running, and the like.

[0006] However, previously-known methods have limitations in maintaining excellent air permeability and formability of a tire while sufficiently decreasing the thickness and weight of the inner liner, and have problems in that additional tie gum rubber and the like is used for strong bonding to a carcass layer inside the tire, which increases the weight of a tire and degrades automobile mileage. Further, the inner liner manufactured by the previously-known method did not have sufficient fatigue resistance, and for example generated cracks due to repeated deformations during a tire manufacturing process or running, and the like.

[0007] Furthermore, it was difficult for the previous inner liner film to be applied in various deformation or elongation processes due to a significant difference between properties in a machine-discharged direction and other directions, and it is non-uniformly deformed according to a film direction during a tire manufacturing process or automobile running, and thus mechanical properties or durability of the inner liner are lowered.

[0008] JP 4 435253 B2 is directed to a polymer mixture containing 99 to 60 mass% of a styrene-isobutyrene-styrene triblock copolymer and 1 to 40 mass% of a polyamide-based polymer having polyamide in a molecule chain with a shore D hardness of 70 or less.

[0009] JP 2005 219 565 A is directed to a pneumatic tire using a film of a thermoplastic elastomer having a specific air permeability and residual elongation percentage.

[0010] JP H09 165469 A is directed to a nylon film sheet having an elongation of 200 to 500% and a thickness of 15 to 100 μm which is dipped in a treatment liquid comprising 40 to 100% VP latex and 60 to 0% SBR latex, is then coated with a rubber paste.

DETAILED DESCRIPTION OF THE INVENTION

TECHNICAL OBJECTIVES

[0011] The present invention provides a film for a tire inner liner that may exhibit an excellent gas barrier property with a thin thickness, thus enabling light weight of a tire and improvement in automobile mileage, and has uniform properties in all directions of the film, thus having excellent formability and improved durability.

[0012] The present invention also provides a method for manufacturing a film for a tire inner liner.

TECHNICAL SOLUTIONS

[0013] The present invention provides a film for a tire inner liner including: a base film layer including polyamide-based resin and a copolymer including polyamide-based segments and polyether-based segments; and an adhesive layer formed on at least one side of the base film layer and including a resorcinol-formalin-latex (RFL)-based adhesive, wherein the content of the polyether-based segments of the copolymer is 15 to 50 wt% based on the total weight of the base film layer, and a ratio of the tensile modulus in the second direction to the tensile modulus in the first direction at initial 2 % elongation of the base film layer is 0.9 to 1.1, the second direction being perpendicular to the first direction.

[0014] The present invention also provides a method for manufacturing a film for a tire inner liner, including: melting a mixture of polyamide-based resin and a copolymer including polyamide-based segments and polyether-based segments at 230 to 300 °C; extruding the molten substance under a die gap condition of 0.3 to 1.5 mm to form a base film layer; and forming an adhesive layer including a resorcinol-formalin-latex (RFL)-based adhesive on at least one side of the base film layer, wherein the content of the polyether-based segments of the copolymer is 15 to 50 wt% based on the total weight of the base film layer, and the ratio of the tensile modulus in the MD (machine direction) to tensile modulus in the TD (transverse direction) at the initial 2 % elongation of the base film layer is 0.9 to 1.1.

[0015] Hereinafter, a film for a tire inner liner and a manufacturing method thereof according to specific embodiments of the invention will be explained in detail.

[0016] According to one embodiment of the invention, there is provided a film for a tire inner liner, as recited in claim 1, including: a base film layer including polyamide-based resin and a copolymer including polyamide-based segments and polyether-based segments; and an adhesive layer formed on at least one side of the base film layer and including resorcinol-formalin-latex (RFL)-based adhesive, wherein the content of the polyether-based segments of the copolymer is 15 to 50 wt% based on total weight of the base film layer, and the ratio of the tensile modulus in the second direction to the tensile modulus in the first direction at the initial 2 % elongation of the base film layer is 0.9 to 1.1, the second direction being perpendicular to the first direction.

[0017] As results of studies, the inventors confirmed that if a base film layer formed using the above-explained copolymer and polyamide-based resin is used, an excellent gas barrier property may be achieved with a thin thickness, thus enabling light weight of a tire and improvement in automobile mileage, and thus a film for a tire inner liner that has excellent mechanical properties including high durability and fatigue resistance and excellent formability while having high heat resistance may be provided.

[0018] Particularly, the film for a tire inner liner has excellent formability enabling application for various deformation or elongation processes in all directions of the film, and prevents non-uniform deformation according to the direction of a film during automobile running, thus exhibiting excellent mechanical properties and improved durability.

[0019] Specifically, as described in the following manufacturing method, by mixing the polyamide-based resin and the above copolymer in a specific ratio and melting, and extruding the molten substance under a specific die gap condition, a base film having uniform properties in all directions of the film may be provided. Moreover, by attaching and folding the extruded molten substance under a specific die gap condition to a cooling roll installed at a horizontal distance of 10 to 150 mm from the die outlet, a base film that does not exhibit orientation due to stretching may be obtained.

[0020] Thereby, the ratio of tensile modulus in the second direction to tensile modulus in the first direction at the initial 2 % elongation of the base film layer is 0.9 to 1.1, preferably 0.92 to 1.08, the second direction being perpendicular to the first direction. The tensile modulus means elastic modulus showing the ratio of stress and strain, and specifically, means the gradient value of a stress-strain graph (S-S curve) measured at the initial 2 % elongation under a room temperature condition.

[0021] Meanwhile, the ratio of yield strength in the second direction to yield strength in the first direction of the base film may be 0.9 to 1.1, preferably 0.92 to 1.08, the second direction being perpendicular to the first direction. The yield strength means critical stress that generates elastic deformation, and specifically, means the maximum value of stress in a 0 to 50 % elongation section.

[0022] Since a difference between yield strength in one direction and yield strength in another direction perpendicular to the one direction of the base film is not large, uniform elongation and deformation toward both directions is enabled during a tire forming process, thus preventing tire forming faults and preventing damage to a tire caused by stress concentrated on one direction during automobile running.

[0023] Further, flat elongation in the first direction and flat elongation in the second direction of the base film layer are respectively 150 % or more, preferably 200 % to 400 %, the second direction being perpendicular to the first direction. The ratio of flat elongation in the second direction to flat elongation in the first direction is 0.9 to 1.1, preferably 0.92 to 1.08.

[0024] The flat elongation means elongation at a time when stress rapidly increases by orientation due to an increase in yield strength/ tensile strain, and specifically, it may be elongation percentage at a point where stress becomes identical to a yield stress point in an elongation section after the yield point (or elongation percentage at a point where a gradient change of the S-S curve is the largest, in the elongation section after the yield point).

[0025] Since flat elongation in the first direction and flat elongation in the second direction which is perpendicular to the first direction are respectively 150 % or more and the difference therebetween is not large, if the film for a tire inner liner is applied, uniform elongation and deformation toward both directions is enabled during a tire forming process, thus preventing a tire forming fault and preventing tire damage caused by stress concentrated in one direction during automobile running.

[0026] Meanwhile, the first direction may be the TD (transverse direction) of the base film, and the second direction which is perpendicular to the first direction may be the MD (machine direction) of the base film.

[0027] The MD (machine direction) may be a direction where a base film is formed during the manufacturing process of the film for a tire inner liner, and it means a direction surrounding the circumferential direction of a tire or a forming drum, during practical tire manufacture. The TD (transverse direction) means a direction perpendicular to the MD, and it may be a direction horizontal to the axis direction of a tire or tire forming drum.

[0028] Meanwhile, the base film may exhibit high reactivity to the above-explained adhesive layer due to the characteristic chemical structure, and the adhesive layer may also exhibit high and uniform adhesion to a tire carcass layer. Thus, the film for an inner liner may be strongly bonded to a tire without applying a vulcanization process or largely increasing the thickness of the adhesive layer, and sever lowering of adhesion between the inner liner film and a tire carcass layer or a break between the base film and the adhesive layer may be prevented in a tire manufacturing process during which high temperature deformation or elongation is applied or in automobile running during which repeated physical deformations are applied for a long time.

[0029] Since the film for a tire inner liner does not considerably require additional additives or rubber ingredients for property improvement, the manufacturing process may be simplified and the tire manufacturing cost may be reduced. Thus, the film for a tire inner liner may enable light weight of a tire to improve automobile mileage, maintains optimum air pressure even after use for a long period thus preventing overturning accidents and mileage degradation caused by low air pressure, has excellent ability to withstand repeated fatigue during running to secure durability, and may manufacture a tire having excellent performance with a simple manufacturing process.

[0030] The above-explained properties of the film for a tire inner liner result from the application of the base film layer having absolute weight average molecular weight, manufactured using a copolymer including specific contents of polyether-based segments and polyamide-based segments together with the polyamide-based resin.

[0031] More specifically, since the base film layer uses a specific copolymer including specific contents of polyether-based segments that afford an elastomeric property to a polyamide-based resin, together with the polyamide-based resin, it may simultaneously have an excellent gas barrier property and a relatively low modulus. The polyamide-based resin included in the base film layer, due to the molecular chain property, exhibits an excellent gas barrier property, for example, 10 to 20 times higher compared to butyl rubber and the like that are commonly used in a tire with the same thickness, and it exhibits a low modulus compared to other resins. The polyether-based segments in the copolymer are bonded or dispersed between the polyamide-based segments or polyamide-based resins, thus further lowering the modulus of the base film layer, preventing an increase in stiffness of the base film layer, and preventing crystallization at a high temperature.

[0032] Since the polyamide-based resin generally exhibits an excellent gas barrier property, it allows the base film layer to have low air permeability while having a thin thickness. Also, since the polyamide-based resin exhibits a relatively low modulus compared to other resins, even if applied together with a copolymer including specific contents of polyether-based segments, an inner liner film exhibiting a relatively low modulus property may be obtained, thus improving tire formability. Further, since the polyamide-based resin has sufficient heat resistance and chemical stability, it may prevent deformation or degeneration of the inner liner film when exposed to chemical substances such as additives and the like or a high temperature condition applied during a tire manufacturing process.

[0033] Furthermore, the polyamide-based resin may be used together with a copolymer including polyamide-based segments and polyether-based segments, to exhibit relatively high reactivity to an adhesive (for example, a resorcinol-formalin-latex (RFL)-based adhesive). Thereby, the inner liner film may be easily attached to a carcass part, and an interface break due to heat or repeated deformations during a tire manufacturing process or running and the like may be prevented to afford sufficient fatigue resistance to the inner liner film.

[0034] The polyamide-based resin may have relative viscosity (96 % sulfuric acid solution) of 3.0 to 3.5, and preferably 3.2 to 3.4. If the viscosity of the polyamide-based resin is less than 3.0, sufficient elongation may not be secured due to a toughness decrease, and thus damage may be generated during a tire manufacturing process or automobile running, and the base film layer may not have properties including a gas barrier property or formability and the like required for a tire inner liner film. If the viscosity of the polyamide-based resin is greater than 3.5, the modulus or viscosity of the manufactured base film layer may become unnecessarily high, and the tire inner liner may not have appropriate formability or elasticity.

[0035] The relative viscosity of the polyamide-based resin is measured using a 96 % sulfuric acid solution at room temperature. Specifically, specimens of a polyamide-based resin (for example, 0.025 g specimen) are dissolved in a 96 % sulfuric acid solution at different concentrations to prepare two or more solutions for measurement (for example, polyamide-based resin specimens are dissolved in a 96 % sulfuric acid solution to concentrations of 0.25 g/dL, 0.10 g/dL, and 0.05 g/dL to prepare 3 solutions for measurement), and then relative viscosity of the solutions for measurement may be calculated using a viscosity tube at 25 °C (for example, a ratio of the average viscosity tube-passing time of the measurement solution to the passing time of the 96 % sulfuric acid solution).

[0036] The polyamide-based resin that can be used in the base film layer may include a polyamide-based resin, for example, nylon 6, nylon 66, nylon 46, nylon 11, nylon 12, nylon 610, nylon 612, a copolymer of nylon 6/66, a copolymer of nylon 6/66/610, nylon MXD6, nylon 6T, a copolymer of nylon 6/6T, a copolymer of nylon 66/PP, and a copolymer of nylon 66/PPS, or an N-alkoxy alkylate thereof, for example, a methoxy methylate of 6-nylon, a methoxy methylate of 6-610-nylon, or a methoxy methylate of 612-nylon, and nylon 6, nylon 66, nylon 46, nylon 11, nylon 12, nylon 610 or nylon 612 may be preferable.

[0037] Meanwhile, as explained above, since the copolymer including polyamide-based segments and polyether-based segments is bonded or dispersed with the polyamide-based resin, it may further decrease the modulus of the base film, prevent an increase in stiffness of the base film layer, and prevent crystallization at a high temperature. As the copolymer is included in the base film layer, the film for a tire inner liner may have high elasticity or elasticity recovery rate while securing excellent mechanical properties including durability, heat resistance, fatigue resistance, and the like. Thereby, the inner liner film may exhibit excellent formability, and a tire using the same may not be physically damaged or the properties or performance thereof may not be deteriorated during automobile running that continuously generates repeated deformations and high heat.

[0038] Meanwhile, if the content of the polyether-based segments of the copolymer is 15 to 50 wt%, preferably 20 to 45 wt%, and more preferably 22 to 40 wt%, based on the total weight of the base film layer, the film for a tire inner liner may exhibit excellent properties and performance. If the content of the polyether-based segments of the copolymer is less than 15 wt% based on the total weight of the base film layer, the modulus of the base film layer or tire inner liner film may increase to lower tire formability, or property deterioration due to repeated deformations may largely occur. If the content of the polyether-based segments of the copolymer is greater than 50 wt% based on the total weight of the base film layer, the gas barrier property required for a tire inner liner may not be good, thus lowering tire performance, the inner liner may not easily adhere to a carcass layer due to lowered reactivity to an adhesive, and a uniform film may not be easily manufactured due to increased elasticity of the base film layer.

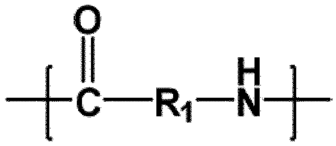
[0039] The polyether-based segments may be bonded to the polyamide-based segments or dispersed between the polyamide-based resins, and may prevent growth of large crystals in the base film layer during a tire manufacturing process or automobile running, or prevent easy breakage of the base film layer.

[0040] The polyether-based segments may further lower the modulus of the tire inner liner film, and thus enables elongation or deformation according to the shape of a tire with low force during tire forming, to allow easy tire forming. The polyether-based segments may prevent an increase in film stiffness at a low temperature and crystallization at a high temperature, prevent damage or tearing of the inner liner film due to repeated deformation and the like, and improve recovery to deformation of the inner liner to prevent wrinkle formation of the film due to permanent deformation, thus improving durability of a tire or inner liner.

[0041] The polyamide-based segments may prevent a large increase in the modulus property while affording mechanical properties beyond a certain level to the copolymer. As the polyamide-based segments are applied, the base film layer may have low air permeability while having a thin thickness, and sufficient heat resistance and chemical stability may be secured.

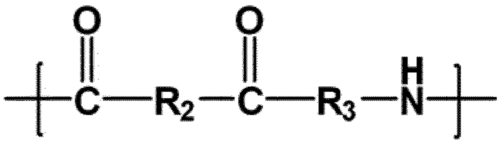
[0042] The polyamide-based segments of the copolymer may include a repeating unit of the following Chemical Formula 1 or Chemical Formula 2.

[Chemical Formula 1]



[0043] In Chemical Formula 1, R_1 is a C1-20 linear or branched alkylene group or a C7-20 linear or branched arylalkylene group.

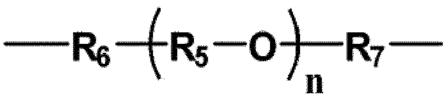
[Chemical Formula 2]



[0044] In Chemical Formula 2, R_2 is a C1-20 linear or branched alkylene group, and R_3 is a C1-20 linear or branched alkylene group or a C7-20 linear or branched arylalkylene group.

[0045] The polyether-based segment of the copolymer may include a repeating unit of the following Chemical Formula 3.

[Chemical Formula 3]



[0046] In Chemical Formula 3, R_5 is a C1-10 linear or branched alkylene group, n is an integer of from 1 to 100, and R_6 and R_7 may be identical or different, and are independently a direct bond, -O-, -NH-, -COO-, or -CONH-.

[0047] The copolymer including polyamide-based segments and polyether-based segments may have an absolute weight average molecular weight of 50,000 to 300,000, preferably 70,000 to 200,000. If the absolute weight average molecular weight of the copolymer is less than 50,000, the manufactured base film layer may not have sufficient mechanical properties required for use in an inner liner film, and the film for a tire inner liner may not have a sufficient gas barrier property. If the absolute weight average molecular weight of the copolymer is greater than 300,000, the modulus or crystallinity of the base film layer may excessively increase during high temperature heating, and the elasticity or elasticity recovery rate required for an inner liner film may not be secured.

[0048] Meanwhile, the copolymer may include the polyamide-based segments and the polyether-based segments in the weight ratio of 6:4 to 3:7, preferably 5:5 to 4:6, while the content of the polyether-based segments is 15 to 50 wt% based on the total weight of the film.

[0049] As explained, if the content of the polyether-based segments is too low, the modulus of the base film layer or tire inner liner film may increase to lower formability of the tire, or properties may be largely degraded due to repeated deformations. If the content of the polyether-based segments is too high, the gas barrier property of the film for a tire inner liner may be lowered, the inner liner may not easily adhere to a carcass layer due to lowered reactivity to adhesive, and a uniform film may not be easily manufactured due to increased elasticity of the base film layer.

[0050] In the base film layer, the polyamide-based resin and the above explained copolymer may be included in the weight ratio of 6:4 to 3:7, and preferably 5:5 to 4:6. If the content of the polyamide-based resin is too low, the density or gas barrier property of the base film layer may be lowered. If the content of the polyamide-based resin is too high, the modulus of the base film layer may become excessively high or formability of the tire may be lowered, the polyamide-based resin may be crystallized under a high temperature environment during a tire manufacturing process or automobile running, and cracks may be generated due to repeated deformations.

[0051] Meanwhile, the base film layer may be an unstretched film. If the base film layer is an unstretched film, it may have a low modulus and high strain, and thus it may be appropriately applied in a tire forming process during which high expansion is generated. Since crystallization hardly occurs in the unstretched film, damage such as cracks and the like may be prevented even if deformations repeatedly occur. Since the unstretched film does not have a large property difference and orientation in a specific direction, an inner liner having uniform properties may be obtained.

[0052] As described in the following manufacturing method of a film for a tire inner liner, the base film may be manufactured in the form of an unstretched or non-oriented film by maximally preventing the orientation of the base film layer, for example, by viscosity control through optimization of melt-extrusion temperature, modification of die standard, control of the installation location of a cooling roller, control of the installation location of an air knife, control of the installation location of a pinning device (electrostatic charging device), control of winding speed, the like.

[0053] As described in the following manufacturing method of a film for a tire inner liner, the base film may be manufactured in the form of an unstretched or non-oriented film by maximally preventing the orientation of the base film layer, for example, by viscosity control through optimization of melt-extrusion temperature, modification of die standard, control of winding speed, or the like.

[0054] If an unstretched film is applied for the base film layer, a film for an inner liner may be easily manufactured in a cylindrical or sheet type in a tire manufacturing process. Particularly, in case an unstretched sheet-type film is applied for the base film layer, film manufacturing facilities need not to be separately constructed according to tire size, and impact and wrinkles may be minimized during transfer and storage. In case the base film is manufactured in a sheet type, a process of adding an adhesive layer may be more easily conducted, and damage, deformation, or the like generated during a manufacturing process due to a standard difference from a forming drum may be prevented.

[0055] The base film layer may have a thickness of 30 to 300 μm, preferably 40 to 250 μm, and more preferably 40 to 200μm. Thus, the film for a tire inner liner according to one embodiment of the invention may have low air permeability, for example oxygen permeability of 200 cc/(m^2 • 24 h • atm) or less, while having a thin thickness, compared to those previously known.

[0056] The base film may further include additives such as a heat resistant oxidant, a heat stabilizer, an adhesion improving agent, or a mixture thereof. Specific examples of the heat resistant oxidant may include N,N'-hexamethylene-bis-(3,5-di-tert-butyl-4-hydroxy-hydrocinnamamide), for example, a commercialized product such as Irganox 1098, tetrakis[methylene(3,5-di-t-butyl-4-hydroxyhydrocinnamate)]methane, for example, a commercialized product such as Irganox 1010), or 4,4'-di-cumyl-di-phenyl-amine, for example, Naugard 445, and the like. Specific examples of the heat stabilizer may include benzoic acid, triacetonediamine, N,N'-bis-(2,2,6,6-tetramethyl-4-piperidyl)-1,3-benzenedicarboxamide, or the like. However, the additives are not limited thereto, and those known to be usable for a tire inner liner film may be used without specific limitations.

[0057] Meanwhile, the adhesive layer including a resorcinol-formalin-latex (RFL)-based adhesive has excellent adhesion and adhesion maintenance to the base film layer and a tire carcass layer, and thus, a break of the interface between the inner liner film and the carcass layer, which is generated due to heat generated during a tire manufacturing process or running, or repeated deformations, may be prevented to afford sufficient fatigue resistance to the inner liner film.

[0058] The above-explained properties of the adhesive layer result from inclusion of a specific resorcinol-formalin-latex (RFL)-based adhesive with a specific composition. As the conventional adhesive for a tire inner liner, a rubber-type tie gum and the like was used, and thus an additional vulcanization process was required. To the contrary, since the adhesive layer includes a resorcinol-formalin-latex (RFL)-based adhesive with a specific composition, it has high reactivity and adhesion to the base film, and the base film and a tire carcass layer may be stably bonded by pressing under a high temperature heating condition without largely increasing the thickness. Thereby, light weight of a tire and improvement in automobile mileage are enabled, and separation between the base film or inner liner layer and a carcass layer may be prevented even if deformations repeatedly occur during a tire manufacturing process or automobile running. Since the adhesive layer may exhibit high fatigue resistance to physical/chemical deformations that may be applied during a tire manufacturing process or automobile running, deterioration of adhesion or other properties may be minimized in a high temperature manufacturing process or automobile running process during which mechanical deformations occur for a long period.

[0059] Furthermore, the resorcinol-formalin-latex (RFL)-based adhesive enables cross-linking between latex and rubber to exhibit adhesion performance, has a low curing degree because it is physically a latex polymerization product and thus is flexible like rubber, and enables chemical bonding between the methylol end group of a resorcinol-formalin polymerization product and the base film. Thus, if the resorcinol-formalin-latex (RFL)-based adhesive is applied to the base film, sufficient adhesion may be achieved.

[0060] The resorcinol-formalin-latex (RFL)-based adhesive may include 2 to 32 wt%, preferably 10 to 20 wt%, of a condensate of resorcinol and formaldehyde, and 68 to 98 wt%, preferably 80 to 90 wt%, of latex.

[0061] The condensate of resorcinol and formaldehyde may be obtained by mixing resorcinol and formaldehyde in the mole ratio of 1:0.3 to 1:3.0, preferably 1:0.5 to 1:2.5, and conducting condensation. The condensate of resorcinol and formaldehyde may be included in the content of 2 wt% or more based on the total weight of the adhesive layer, in terms of a chemical reaction for excellent adhesion, and it may be included in the content of 32 wt% or less to secure optimum fatigue resistance.

[0062] The latex may be selected from the group consisting of natural rubber latex, styrene/butadiene rubber latex, acrylonitrile/butadiene rubber latex, chloroprene rubber latex, styrene/butadiene/vinylpyridine rubber latex, and a mixture thereof. The latex may be included in the content of 68 wt% or more based on the total weight of the adhesive layer for flexibility and effective cross-linking reaction with rubber, and it may be included in the content of 98 wt% or less for a chemical reaction with the base film and stiffness of the adhesive layer.

[0063] The adhesive layer may further include at least one additive such as a surface tension control agent, an antifoaming agent, a filler, and the like. Although the surface tension control agent is applied for uniform coating of the adhesive layer, it may cause a decrease in adhesion when introduced in an excessive amount, and thus it may be included in the content of 2 wt% or less, or 0.0001 to 2 wt%, preferably 1.0 wt% or less, or 0.0001 to 0.5 wt%, based on the total weight of the adhesive layer. The surface tension control agent may be selected from the group consisting of a sulfonic acid salt anionic surfactant, a sulfate ester surfactant, a carboxylic acid salt anionic surfactant, a phosphate ester anionic surfactant, a fluorine-containing surfactant, a silicone-based surfactant, a polysiloxane-based surfactant, and a combination thereof.

[0064] The adhesive layer may have a thickness of 0.1 to 20 μm, preferably 0.1 to 10 μm, more preferably 0.2 to 7 μm, still more preferably 0.3 to 5 μm, and it may be formed on one side or both sides of the film for a tire inner liner. If the thickness of the adhesive layer is too thin, the adhesive layer itself may become thinner during tire expansion, cross-linking adhesion between a carcass layer and the base film may be lowered, and stress may be concentrated on a part of the adhesive layer to lower the fatigue property. If the thickness of the adhesive layer is too thick, it may separate at the interface to lower the fatigue property. To adhere the inner liner film to a carcass layer of a tire, the adhesive layer is generally formed on one side of the base film, but in case a multi-layered inner liner film is applied, or adhesion to rubber on both sides is required according to a tire forming method and construction design, for example when an inner liner film covers a bead part, the adhesive layer may be preferably formed on both sides of the base film.

[0065] Meanwhile, the adhesive layer may exhibit an excellent modulus property and high elasticity recovery and the like by including the specific resorcinol-formalin-latex (RFL)-based adhesive. Thus, even if the adhesive layer is formed on the base layer, the elongation or deformation property of the base film may not be substantially influenced. That is, the film for a tire inner liner including a base film layer and an adhesive layer may have the above-explained elongation property of the base film, and for example, the ratio of tensile modulus in the second direction to tensile modulus in the first direction at the initial 2 % elongation of the tire inner liner film layer may be 0.9 to 1.1, and preferably 0.92 to 1.08, the second direction being perpendicular to the first direction, and the ratio of yield strength in the second direction to yield strength in the first direction of the tire inner liner film may be 0.9 to 1.1, and preferably 0.92 to 1.08.

[0066] Further, flat elongation in the first direction and flat elongation in the second direction of the tire inner liner film layer may be respectively 150 % or more, and preferably 200 % to 400 %, the second direction being perpendicular to the first direction, and the ratio of flat elongation in the second direction to flat elongation in the first direction may be 0.9 to 1.1, 0.92 to 1.08.

[0067] Meanwhile, the film for a tire inner liner may be formed on the adhesive layer, and further include a release film layer including a polymer film having initial modulus of 1500 Mpa at room temperature.

[0068] The initial modulus of the release film may be 1500 Mpa or more, preferably 2000 Mpa or more, or 1500 Mpa to 5000 Mpa. When the release film has the above-explained modulus property, cracks and the like that may be generated by external impact or pressure repeated for a long time may be minimized, an increase in the modulus that is caused by elongation due to externally applied tension during winding of the tire inner liner film or tire manufacture may be prevented, and operability of the tire inner liner film may be increased to allow easy application in a process. The initial modulus refers to the modulus of a release film in a non-elongated state.

[0069] Particularly, in order to install the tire inner liner film so as to enter inside the tire bead part or to exhibit adhesion of the lapped part of the inner liner film, the adhesive layer may be formed on both sides of the base film, wherein the release film layer may prevent fusion of the adhesive layers formed on both sides of the base film.

[0070] The polymer film included in the release film layer may include a polyolefin-based resin, a polyester resin, or a mixture or a copolymer thereof. The polyolefin resin may include a polyethylene resin, a polypropylene resin, and the like, and the polyester resin may include a polyethylene terephthalate resin and the like.

[0071] As the release film layer includes the above-explained polymer resin, the release film layer may have appropriate adhesion to the adhesion layer such that it may be strongly bonded during a product storage process and the like, and may be easily separated without influencing the adhesive layer or the base film in a practical process application, and product damage due to external impact or pressure repeated for a long time or blocking (adhering of film interlayer) may be prevented.

[0072] Further, the release film layer may have a thickness of 5 to 50 um, and preferably 8 to 35 um. If the release film layer is too thin, repeated pressure or external impact may not be prevented, operation may be stopped due to cutting or destruction when it is separated for tire manufacture, it may be easily blown by the air, and it may be attached to other objects due to low modulus. If the release film layer is too thick, manufacturing cost is excessively increased, and it may not be easily removed during a manufacturing process due to a high modulus.

[0073] Meanwhile, according to another embodiment of the invention, there is provided a method for manufacturing a film for a tire inner liner, as recited in claim 17, the method including: melting a mixture of a polyamide-based resin and a copolymer including polyamide-based segments and polyether-based segments at 230 to 300 °C; extruding the molten substance under a die gap condition of 0.3 to 1.5 mm to form a base film layer; and forming an adhesive layer including a resorcinol-formalin-latex (RFL)-based adhesive on at least one side of the base film layer, wherein the content of the polyether-based segments of the copolymer is 15 to 50 wt% based on the total weight of the base film layer, and the ratio of tensile modulus in the MD (machine direction) to tensile modulus in the TD (transverse direction) at the initial 2 % elongation of the base film layer is 0.9 to 1.1.

[0074] The tire inner liner film obtained by the above manufacturing method may exhibit an excellent gas barrier property and high internal pressure retention performance with a thin thickness, have uniform properties in all directions of the film, particularly in machine and transverse directions, and thus may have excellent formability enabling easy application in various deformation or elongation processes, prevent non-uniform deformation along the film direction during a tire manufacturing process or automobile running, and may be uniformly and strongly bonded inside the tire with a thin and light weighted adhesive layer because the base film exhibits high reactivity to a specific adhesive.

[0075] As the product obtained by melting a mixture of a copolymer including polyamide-based segments and polyether-based segments and a polyamide-based resin at 230 to 300 °C is extruded under a die gap condition of 0.3 to 1.5 mm, preferably 0.5 to 1.2 mm, to manufacture a base film, properties in all directions of the base film, for example, in a machine direction and in a transverse direction, may become uniform. Thus, the tire inner liner film has excellent formability enabling easy application in various deformation or elongation processes, and prevents non-uniform deformation along the film direction during a tire manufacturing process or automobile running, to achieve excellent mechanical properties and improved durability.

[0076] In the step of forming the base film, if the die gap is too small, die shear pressure of a melt extrusion process becomes too high, shear stress increases, and thus it may be difficult to form a uniform shape of the extruded film, and productivity may be lowered. If the die gap is too large, stretching of the melt extruded film may largely occur to generate orientation, and a property difference between the machine direction and the transverse direction of the manufactured base film may increase.

[0077] The melting temperature may be 230 to 300 °C, and preferably 240 to 280 °C. The melting temperature should be higher than the melting point of the polyamide-based compound, but if it is too high, carbonization or decomposition may occur to lower properties of a film, and bonding between the polyether-based resins may occur or orientation may be generated toward a fiber arrangement direction, which is unfavorable for manufacturing of an unstretched film.

[0078] As the extrusion die, those known to be usable for extruding a polymer resin may be used without specific limitations, but a T-type die may be preferably used so that the thickness of the base film may become more uniform or orientation may not be generated in the base film.

[0079] Meanwhile, by attaching and folding the molten substance extruded under the specific die gap condition to a cooling part installed at a horizontal distance of 10 to 150 mm from the die outlet, a base film that does not substantially exhibit orientation due to stretching may be obtained.

[0080] If the product obtained by melting and extrusion is stretched before cooling and solidification, orientation may be generated in the manufactured base film. Thus, it is required to maximally attach molten resin to the cooling roll in a film shape and solidify it so as to minimize stretching and orientation. Specifically, as explained above, stretching and orientation may be eliminated by attaching or folding the molten substance extruded under the specific die gap condition to a cooling part installed at a horizontal distance of 10 to 150 mm, preferably 20 to 120 mm, from the die outlet. The horizontal distance from the die outlet to the cooling part may be a distance between the die outlet and a point where discharged molten substance is folded to the cooling part. If the linear distance between the die outlet and the cooling part attaching point of the molten film is too small, uniform flow of melted extruded resin may be disturbed to cause non-uniform film cooling, and if the distance is too large, inhibition of film stretching may not be achieved.

[0081] Specifically, the method for manufacturing the film for a tire inner liner may further include a step of solidifying the base film layer formed through melting and extrusion in a cooling part maintained at a temperature of 5 to 40 °C, and preferably 10 to 30 °C. By solidifying the base film layer formed through melting and extrusion in a cooling part while maintaining a temperature of 5 to 40 °C, a film with a more uniform thickness may be provided. If the base film layer formed through melting and extrusion is folded or attached to a cooling part maintained at an appropriate temperature, orientation may not substantially occur, and the base film layer may be provided as an unstretched film.

[0082] Further, by appropriately controlling the horizontal distance between the die outlet and the cooling part, and rapidly attaching the extrudate discharged from the die to the cooling part and solidifying it using an air knife, an air nozzle, an electrostatic charging device (pinning device), or a combination thereof, the base film may not substantially generate orientation due to stretching. Specifically, the manufacturing method of the tire inner liner film may further include a step of uniformly attaching the extrudate to the cooling part, using at least one device selected from the group consisting of an air knife, an air nozzle, and an electrostatic charging device (pinning device), located at a horizontal distance of 10 to 300 mm from the die outlet.

[0083] In the step of forming the base film, except for the above-explained steps and conditions, film extrusion conditions commonly used for manufacturing of a polymer film, for example, screw diameter, screw rotation speed, line speed, and the like may be appropriately selected.

[0084] Meanwhile, the ratio of tensile modulus in the second direction to tensile modulus in the first direction at the initial 2 % elongation of the base film layer obtained by the above method may be 0.9 to 1.1, preferably 0.92 to 1.08, the second direction being perpendicular to the first direction. The ratio of yield strength in the second direction to yield strength in the first direction of the manufactured base film layer may be 0.9 to 1.1, preferably 0.92 to 1.08, the second direction being perpendicular to the first direction. Flat elongation in the first direction and flat elongation in the second direction of the manufactured base film layer may be respectively 150 % or more, preferably 200 % to 400 %, the second direction being perpendicular to the first direction, and the ratio of flat elongation in the second direction to flat elongation in the first direction may be 0.9 to 1.1, and preferably 0.92 to 1.08.

[0085] The details of the polyamide-based resin and the copolymer including polyamide-based segments and polyether-based segments are as explained above.

[0086] Meanwhile, in the step of forming the base film layer, to extrude a film having a more uniform thickness, the copolymer and the polyamide-based resin may be controlled so as to have a uniform size. By controlling the sizes of the copolymer and the polyamide-based resin, in the step of mixing them, within in a feeder maintained at a constant temperature, or while melting and extruding and the like, the copolymer and the polyamide-based resin may be more uniformly mixed, so agglomeration of the copolymer and the polyamide-based resin to become large may be prevented, and thus, a base film having a more uniform thickness may be formed.

[0087] If the copolymer and the polyamide-based resin have similar sizes, agglomeration of raw material chips or generation of non-uniform shapes or areas may be minimized in the subsequent mixing, melting, or extruding step, thereby forming a base film layer having a uniform thickness over the whole area of the film. The sizes of the copolymer and the polyamide-based resin that can be used in the manufacturing method are not specifically limited.

[0088] Meanwhile, in the step of manufacturing the base film, it may be preferable to maintain an appropriate winding speed of the film to prevent problems of an increase in orientation degree and cooling faults. For example, the winding speed may be maximally inhibited to 100 m/min or less, and preferably 50 m/mine or less.

[0089] Meanwhile, in the step of manufacturing the base film, the thickness of the discharged molten resin sheet may be controlled by the discharge amount of the extruder, die width, or gap, the winding speed of a cooling roll, and the like, or the thickness of the base film may be controlled to 30 to 300 μm by uniformly attaching and cooling it using an air knife, an air nozzle, an electrostatic edge pinning device, and the like.

[0090] The method for manufacturing the film for a tire inner liner may further include mixing the polyamide-based resin and the copolymer in a weight ratio of 6:4 to 3:7. If the content of the polyamide-based resin is too low, the density or gas barrier property of the base film layer may be lowered. If the content of the polyamide-based resin is too high, the modulus of the base film layer may become too high or formability of a tire may be lowered, the polyamide-based resin may be crystallized under a high temperature environment during a tire manufacturing process or automobile running, and cracks may be generated due to repeated deformations. In the mixing step, equipment or methods known to be usable for mixing a polymer resin may be used without specific limitations.

[0091] The polyamide-based resin and the copolymer may be introduced into a feeder after they are mixed, or may be sequentially or simultaneously introduced into a feeder and mixed.

[0092] As explained above, the copolymer may include polyamide-based segments and polyether-based segments in the weight ratio of 6:4 to 3:7.

[0093] The manufacturing method of the film for a tire inner liner may include a step of forming an adhesive layer including a resorcinol-formalin-latex (RFL)-based adhesive on at least one side of the base film layer.

[0094] The adhesive layer including the resorcinol-formalin-latex (RFL)-based adhesive may be formed by coating the resorcinol-formalin-latex (RFL)-based adhesive on one side of the base film layer, or by laminating an adhesive film including the resorcinol-formalin-latex (RFL)-based adhesive on one side of the base film layer.

[0095] Preferably, the step of forming the adhesive layer may be progressed by coating the resorcinol-formalin-latex (RFL)-based adhesive on one side or both sides of the base film, and then drying. The formed adhesive layer may have a thickness of 0.1 to 20 μm, and preferably 0.1 to 10 μm. The resorcinol-formalin-latex (RFL)-based adhesive may include 2 to 32 wt% of a condensate of resorcinol and formaldehyde, and 68 to 98 wt%, preferably 80 to 90 wt%, of latex.

[0096] The details of the resorcinol-formalin-latex (RFL)-based adhesive with the above specific composition are as explained above.

[0097] Commonly used coating method or apparatuses may be used to coat the adhesive without specific limitations, but knife coating, bar coating, gravure coating or spraying, or immersion may be used. However, knife coating, gravure coating, or bar coating may be preferable for uniform coating of the adhesive.

[0098] After forming the adhesive layer on one side or both sides of the base film, drying and adhesive reactions may be simultaneously progressed, but heat treatment may be progressed after drying considering reactivity of the adhesive, and the formation of the adhesive layer and drying and heat treatment may be applied several times for the thickness of the adhesive layer or application of multi-layered adhesive. After coating the adhesive on the base film, heat treatment may be conducted by solidifying and reacting at 100~150 °C for approximately 30 seconds to 3 minutes.

[0099] As explained, since the elongation property of the base film does not significantly change even if the adhesion layer is formed on the base film layer, the film for a tire inner liner may have an elongation property that is identical to that of the base film. For example, the ratio of tensile modulus in the second direction to tensile modulus in the first direction at the initial 2 % elongation of the tire inner liner film may be 0.9 to 1.1, preferably 0.92 to 1.08, and the ratio of yield strength in the second direction to yield strength in the first direction of the tire inner liner film may be 0.9 to 1.1, and preferably 0.92 to 1.08, the second direction being perpendicular to the first direction.

[0100] Further, flat elongation in the first direction and flat elongation in the second direction of the tire inner liner film may be respectively 150 % or more, and preferably 200 % to 400 %, the second direction being perpendicular to the first direction. The of flat elongation in the second direction to flat elongation in the first direction of the tire inner liner film may be 0.9 to 1.1, and preferably 0.92 to 1.08.

[0101] In the step of forming the copolymer or mixture, or in the step of melting and extruding the copolymer, additives such as a heat resistant oxidant or a heat stabilizer and the like may be additionally added. The details of the additives are as explained above.

[0102] The method for manufacturing a film for a tire inner liner may further include a step of forming a release film layer including a polymer film having an initial modulus of 1500 Mpa or more at room temperature on the adhesive layer.

[0103] The release film layer may be formed on the adhesive layer by a commonly known lamination method of a polymer film or application or coating of a polymer resin and the like. In the winding step after coating the adhesive on the base film, the release film layer may be laminated on the adhesive layer by winding the release film layer together.

[0104] Specifically, the step of forming the release film layer may include coating at least one polymer selected form the group consisting of a polyolefin-based resin and polyester resin on the adhesive layer to form a release film layer with a thickness of 5 um to 50 um; or laminating a film including a polymer selected form the group consisting of a polyolefin-based resin and a polyester resin on the adhesive layer to form a release film layer with a thickness of 5 um to 50 um.

[0105] As explained, the release film layer may have an initial modulus of 1500 Mpa or more, and preferably 2000 Mpa or more. The polymer film included in the release film layer may include a polyolefin-based resin, a polyester resin, or a mixture or copolymer thereof. The release film layer may have a thickness of 5 to 50 um, and preferably 8 to 35 um.

ADVANTAGEOUS EFFECT OF THE INVENTION

[0106] According to the present invention, a film for a tire inner liner that may exhibit an excellent gas barrier property with a thin thickness thus enabling light weight of a tire and improvement in automobile mileage has uniform properties in all directions of the film, thus having excellent formability and improved durability, and a method for manufacturing a film for a tire inner liner, are provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0107]

Fig. 1 shows a machine direction stress-strain graph of the films according to examples and comparative examples.
Fig. 2 schematically shows the structure of a tire.

DETAILS FOR PRACTICING THE INVENTION

[0108] Hereinafter, preferable examples are presented, but these examples are only to illustrate the invention and the scope of the invention is not limited thereto.

<Examples: Manufacture of a film for a tire inner liner>

Example 1

(1) Manufacture of a base film

[0109] 40 wt% of a polyamide-based resin (nylon 6) with relative viscosity (96 % sulfuric acid solution) of 3.4 and 60 wt% of a copolymer resin having a weight average molecular weight of 100,000 (including 50 wt% of polyamide-based repeating unit and 50 wt% of polyether-based repeating unit) were mixed, and the mixture was melt-extruded at 260 °C with a T-type die under a 0.6 mm die gap condition. The obtained molten film was fixed to a cooling roll (maintained at 15 °C, rotation speed: 15 m/min) within a horizontal distance of 30 mm from the die outlet, cooled, and solidified, and a discharge amount of the extruder was controlled with G/P to obtain an unstretched base film with a thickness of 70 μm. The thickness of the base film was measured using a gauge tester.

[0110] In the step of folding the molten film to a cooling roll, an air knife was positioned at a horizontal distance at 30 mm from the folding site, and edge pinning was installed within 5 mm from both ends of folding line of the folded sheet so that the molten film may be attached to a cooling roll with air pressure and static electricity.

(2) Coating of adhesive

[0111] Resorcinol and formaldehyde were mixed at a mole ratio of 1:2, and then condensation was conducted to obtain a condensate of resorcinol and formaldehyde. 12 wt% of the condensate of resorcinol and formaldehyde and 88 wt% of styrene/1,3-a butadiene/vinylpyridine latex were mixed to obtain a mixture of resorcinol/formaldehyde-latex with a concentration of 20 %.

[0112] The resorcinol-formalin-latex (RFL)-based adhesive was coated on the base film with a thickness of 1 um using a gravure coater, and dried and reacted at 150 °C for 1 minute to form an adhesive layer.

Example 2

[0113] A film for a tire inner liner was manufactured by the same method as Example 1, except that an unstretched film with a thickness of 100 um was manufactured at a resin extrusion temperature of 270 °C with die gap of 0.8 mm using a cooling roll rotating at 10 m/min.

Example 3

[0114] A film for a tire inner liner was manufactured by the same method as Example 1, except that an unstretched film with a thickness of 120 um was manufactured at a resin extrusion temperature of 280°C with a die gap of 1.0 mm using a cooling roll rotating at 8 m/min.

Example 4

[0115] A polyethylene terephthalate stretched film having initial modulus of 4200 Mpa and thickness of 12 μm was manufactured in the form of roll. In the winding step after coating an adhesive on the base film of Example 1, the polyethylene terephthalate stretched film was wound together to laminate a release film on the adhesive layer.

<Comparative Examples: Manufacture of film for tire inner liner>

Comparative Example 1

[0116] A releasing agent and a finishing agent were introduced into butyl rubber and mixed and then refined to obtain a tire inner liner film with a thickness of 70 μm, and an adhesion rubber (tie gum) with a thickness of 1 μm was formed on the inner liner film.

Comparative Example 2

(1) Manufacture of a base film

[0117] A base film was manufactured by the same method as Example 1, except that 90 wt% of a polyamide-based resin (nylon 6) with relative viscosity (96 % sulfuric acid solution) of 3.4 and 10 wt% of a copolymer resin having a weight average molecular weight of 100,000 (including 50 wt% of a polyamide-based repeating unit and 50 wt% of a polyether-based repeating unit) were mixed.

(2) Coating of adhesive

[0118] A resorcinol-formalin-latex (RFL)-based adhesive was prepared by the same method as Example 1, and was coated on the base film and dried to form an adhesive layer with a thickness of 1 um.

Comparative Example 3

(1) Manufacture of a base film

[0119] A base film was manufactured by the same method as Example 1, except that 20 wt % of a polyamide-based resin (nylon 6) with relative viscosity (96 % sulfuric acid solution) of 3.4 and 80 wt% of a copolymer resin having a weight average molecular weight of 100,000 (including 20 wt% of a polyamide-based repeating unit and 80 wt% of a polyether-based repeating unit) were mixed.

(2) Coating of adhesive

[0120] A resorcinol-formalin-latex (RFL)-based adhesive was prepared by the same method as Example 1, and it was coated on the base film and dried to form an adhesive layer with a thickness of 1 um.

Comparative Example 4

(1) Manufacture of a base film

[0121] 40 wt% of polyamide-based resin (nylon 6) with relative viscosity (96 % sulfuric acid solution) of 3.4 and 60 wt% of a copolymer resin having a weight average molecular weight of 100,000 (including 50 wt% of a polyamide-based repeating unit and 50 wt% of a polyether-based repeating unit) were mixed, and the mixture was melt-extruded at 260 °C with a T-type die under a 2.0 mm die gap condition. The obtained molten film was fixed to a cooling roll (maintained at 15 °C, rotation speed: 15 m/min) within a horizontal distance of 30 mm from the die outlet, cooled, and solidified to obtain an unstretched base film with a thickness of 70 μm. The thickness of the base film was measured using a gauge tester.

[0122] In the step of folding the molten film to a cooling roll, an air knife was positioned at a horizontal distance of 30 mm from the folding site, and edge pinning was installed within 5 mm from both ends of the folding line of the folded sheet so that the molten film may be attached to a cooling roll with air pressure and static electricity.

(2) Coating of adhesive

[0123] An adhesive layer was formed by the same method as Example 1, except for using the above-obtained base film.

<Experimental Examples: Measurement of properties of a film for a tire inner liner>

Experimental Example 1: Measurement of modulus, yield strength, and flat elongation of base film

[0124] Modulus, yield strength, and flat elongation were measured in MD (machine direction) and TD (transverse direction) of the tire inner liner films obtained in the examples and comparative examples. The specific measurement method is as follows.

(1) Measurement apparatus: universal testing machine (Model 4204, Instron Company).
(2) Measurement conditions: 1) Head Speed 300 mm/min, 2) Grip Distance 100 mm, 3) Sample Width 10 mm, 4) Measured under a 25 °C and 60 RH% atmosphere.
(3) Each was measured 5 times, and the average of the obtained results was calculated.

[0125] In the stress-strain curve obtained from the above measured data, 1) the "gradient value of the stress-strain graph" at the initial 2 % elongation was determined as modulus, 2) the "maximum value of the stress appeared in 0 to 50 % elongation section of the stress-strain graph" was determined as yield strength, and 3) in the elongation section beyond the yield point of the stress/strain graph, the elongation percentage at a point where stress becomes identical to the yield strength generating point (or elongation percentage at a point where the gradient change of S-S curve is the largest in the elongation section beyond yield point) was determined as flat elongation.

Experimental Example 2: Measurement of oxygen permeability

[0126] Oxygen permeability of the tire inner liner films obtained in the examples and comparative examples were measured. the specific measurement method is as follows.

(1) Oxygen permeability: measured under a 25 °C and 60 RH% atmosphere using an Oxygen Permeation Analyzer, Model 8000, (Illinois Instruments Inc.) according to ASTM D 3895.

Experimental Example 3: Measurement of internal pressure retention

[0127] Tires were manufactured using the tire inner liner films of the examples and comparative examples applying the 205R/65R16 standard. Further, 90-day IPRs (internal pressure retention) of the manufactured tires were measured and compared at 21 °C under a pressure of 101.3 kPa according to ASTM F1112-06.

[0128] The results of Experimental Examples 1 to 3 are shown in the following Table 1, and the graph of stress generated when the base films of the examples and comparative examples were strained in the MD (machine direction) is shown in Fig. 1.

[Table 1] Results of Experimental Examples 1 to 3

	Example 1	Example 2	Example 3	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4
Modulus MD/TD (MPa)	408/ 398	418/ 405	467/ 432	73/ 71	1620/ 1450	168/ 151	721/ 615
Modulus relative ratio (MD/TD)	1.02	1.03	1.08	1.02	1.11	1.11	1.17
Yield strength MDF-FD (MPa)	14/ 13	15/ 14.5	17/ 16.5	3.1/ 3.0	46/ 38	8/ 7	21/ 17
Yield strength relative ratio (MD/TD)	1.08	1.03	1.03	1.03	1.21	1.14	1.23
Flat elongation MD/TD (%)	215/ 225	210/ 220	200/ 215	-	-	250/ 270	125/ 130
Flat elongation relative ratio (MD/TD)	0.95	0.95	0.93	-	0.91	0.92	0.96
Oxygen permeability (cc/m^2 day atm)	65	50	42	650	30	230	63
Internal pressure retention (%)	96	97	98	75	-	85	-
Internal pressure retention / formability observation	Good	Good	Good	Internal pressure faulty	Forming faulty	Internal pressure faulty	Forming faulty

[0129] As shown in the Table 1, the tire inner liner films of the examples may exhibit oxygen permeability of 200 cc/m^2*24 h*atm or less, thus achieving an excellent gas barrier property with a thin thickness, and may be easily elongated or deformed with a low force in a tire manufacturing process, thus affording excellent formability of a green tire or final tire.

[0130] Further, it was confirmed that the base films obtained in the examples have uniform properties in all directions of the film, and particularly have little property difference between the MD (machine direction) and TD (transverse direction) of the film. Specifically, it was confirmed that when the base film was elongated, the ratio of MD tensile modulus and TD tensile modulus, the ratio of MD yield strength and TD yield strength, and the ratio of MD flat elongation and TD flat elongation are within the range of 0.9 to 1.1. It was also confirmed that the MD flat elongation and the TD flat elongation of the tire inner liner film are respectively 150 % or more.

[0131] Also, as shown in Fig. 1, it was confirmed that the tire inner liner films of Examples 1 to 3 have flat elongation of 150 % or more and relatively small initial gradient in the Strain-Stress graph, thus exhibiting a low modulus property and excellent formability.

[0132] To the contrary, the tire inner liner film of Comparative Example 4 has a small flat elongation section of less than 150 %, a large initial gradient of the graph, and a relatively high yield point, and thus formability of a tire or other properties are insufficient to be applied for a practical tire. The tire inner liner film of Comparative Example 2 has too high a yield point and does not have a flat elongation section, and thus forming is not easy in a general tire manufacturing process. The tire inner liner films of Comparative Examples 1 and 3 have good modulus and flat elongation, but insufficient air barrier property, and thus are not suitable to be applied for a practical tire.

Experimental Example 4: Measurement of formability

[0133] A tire was manufactured using the tire inner liner film of Example 4 applying the 205R/65R16 standard. During the tire manufacturing process, manufacturability and appearance were evaluated after manufacturing a green tire, and then the final appearance of the tire was examined after vulcanization.

[0134] Consequently, the tire inner liner film of Example 4 has optimum modulus property and yield strength, thus exhibiting optimum formability in a tire manufacturing process, and by including a release film, prevents product damage or blocking during storage for a long period and increases operability during a tire manufacturing process.

[0135] Specifically, in case the tire inner liner of Example 4 is used, deformation of a film caused by fusion of an adhesive liquid on both sides may be prevented while unfolding of the film from the roll for manufacture of a tire, and insufficient adhesion to rubber due to sticking of adhesive to one side in the unfolded film from the roll may be prevented.

Claims

1. A film for a tire inner liner comprising:

   a base film layer comprising a polyamide-based resin and a copolymer comprising polyamide-based segments and polyether-based segments; and
   an adhesive layer formed on at least one side of the base film layer and comprising a resorcinol-formalin-latex (RFL)-based adhesive, and
   the ratio of tensile modulus in a second direction to tensile modulus in a first direction at initial 2 % elongation of the base film layer is 0.9 to 1.1, the second direction being perpendicular to the first direction.

2. The film for a tire inner liner according to claim 1,
   wherein the content of the polyether-based segments of the copolymer is 15 to 50 wt% based on total weight of the base film layer.

3. The film for a tire inner liner according to claim 1, wherein a ratio of yield strength in the second direction to yield strength in the first direction of the base film is 0.9 to 1.1, the second direction being perpendicular to the first direction.

4. The film for a tire inner liner according to claim 1, wherein flat elongation in the first direction and flat elongation in the second direction of the base film layer are respectively 150 % or more, the second direction being perpendicular to the first direction, and
   a ratio of flat elongation in the second direction to flat elongation in the first direction is 0.9 to 1.1

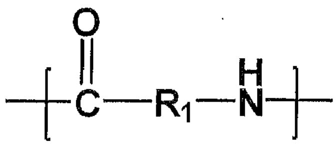
5. The film for a tire inner liner according to claim 1, wherein the first direction is the same as a TD (transverse direction) of the base film, and the second direction is the same as an MD (machine direction) of the base film.

6. The film for a tire inner liner according to claim 1, wherein the polyamide-based resin has relative viscosity (96 % sulfuric acid solution) of 3.0 to 3.5.

7. The film for a tire inner liner according to claim 1, wherein the copolymer comprising polyamide-based segments and polyether-based segments has an absolute weight average molecular weight of 50,000 to 300,000.

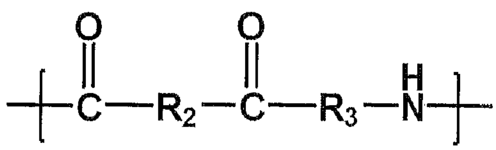
8. The film for a tire inner liner according to claim 1, wherein the polyamide-based segment of the copolymer comprises a repeating unit of the following Chemical Formula 1 or Chemical Formula 2:

[Chemical Formula 1]



in Chemical Formula 1, R_1 is a C1-20 liner or branched alkylene group or a C7-20 liner or branched arylalkylene group,

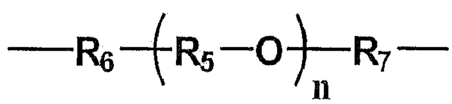
[Chemical Formula 2]



in Chemical Formula 2, R_2 is a C1-20 linear or branched alkylene group, and R_3 is a C1-20 linear or branched alkylene group or a C7-20 liner or branched arylalkylene group.

9. The film for a tire inner liner according to claim 1, wherein the polyether-based segment of the copolymer comprises a repeating unit of the following Chemical Formula 3:

[Chemical Formula 3]



in Chemical Formula 3,

R_5 is a C1-10 linear or branched alkylene group, and n is an integer of from 1 to 100, and
R_6 and R_7 may be identical or different, and are independently a direct bond, -O-, -NH-, -COO-, or -CONH-.

10. The film for a tire inner liner according to claim 1, wherein the copolymer comprises polyamide-based segments and polyether-based segments in a weight ratio of 6:4 to 3:7.

11. The film for a tire inner liner according to claim 1, wherein the base film layer comprises the polyamide-based resin and the copolymer in a weight ratio of 6:4 to 3:7.

12. The film for a tire inner liner according to claim 1, wherein the base film layer has a thickness of 30 to 300 μm, and the adhesive layer has a thickness of 0.1 to 20 μm.

13. The film for a tire inner liner according to claim 1, wherein the base film layer is an unstretched film.

14. The film for a tire inner liner according to claim 1, wherein the resorcinol-formalin-latex (RFL)-based adhesive comprises 2 to 32 wt% of a condensate of resorcinol and formaldehyde, and 68 to 98 wt% of latex.

15. The film for a tire inner liner according to claim 1, further comprising a release film layer formed on the adhesive layer, and comprising a polymer film having an initial modulus of 1500 Mpa or more at room temperature.

16. The film for a tire inner liner according to claim 15, wherein the polymer film included in the release film layer comprises at least one selected from the group consisting of a polyolefin-based resin and a polyester resin.

17. A method for manufacturing a film for a tire inner liner, comprising
melting a mixture of a polyamide-based resin and a copolymer comprising polyamide-based segments and polyether-based segments at 230 to 300 °C;
extruding the molten substance under a die gap condition of 0.3 to 1.5 mm to form a base film layer; and
forming an adhesive layer comprising a resorcinol-formalin-latex (RFL)-based adhesive on at least one side of the base film layer, wherein a ratio of tensile modulus in an MD (machine direction) to tensile modulus in a TD (transverse direction) at initial 2 % elongation of the base film layer is 0.9 to 1.1.

18. The method according to claim 17,
wherein the content of the polyether-based segments of the copolymer is 15 to 50 wt% based on total weight of the base film layer.

19. The method according to claim 17, wherein the step of forming the base film layer further comprises attaching the extrudate to a cooling part located at a horizontal distance of 10 to 150 mm from a die outlet.

20. The method according to claim 19, further comprising the step of uniformly attaching the extrudate to the cooling part, and using at least one device selected from the group consisting of an air knife, an air nozzle, and a electrostatic charging device located at a horizontal distance of 10 to 300 mm from the die outlet.

21. The method according to claim 17, further comprising the step of solidifying the base film layer formed by melting and extrusion in the cooling part maintained at 5 to 40 °C.

22. The method according to claim 17, wherein the polyamide-based resin and the copolymer comprising polyamide-based segments and polyether-based segments are mixed in a weight ratio of 6:4 to 3:7.

23. The method according to claim 17, wherein the copolymer comprises polyamide-based segments and polyether-based segments in a weight ratio of 6:4 to 3:7.

24. The method according to claim 17, wherein the step of forming the adhesive layer comprises coating an adhesive comprising 2 to 32 wt% of a condensate of resorcinol and formaldehyde, and 68 to 98 wt% of latex on at least one side of the base film layer to a thickness of 0.1 to 20 μm.

25. The method according to claim 17, wherein a ratio of yield strength in a TD (transverse direction) and yield strength in an MD (machine direction) of the base film layer is 0.9 to 1.1.

26. The method according to claim 17, wherein flat elongation in a TD (transverse direction) and flat elongation in an MD (machine direction) of the base film layer are respectively 150 % or more, and
a ratio of flat elongation in the MD (machine direction) to flat elongation in the TD (transverse direction) is 0.9 to 1.1

27. The method according to claim 17, further comprising the step of forming a release film layer comprising a polymer film having an initial modulus of 1500 Mpa at room temperature on the adhesive layer.

28. The method according to claim 27, wherein the step of forming the release film layer comprises:

coating at least one polymer selected form the group consisting of a polyolefin-based resin and a polyester resin on the adhesive layer to form a release film layer with a thickness of 5 um to 50 um; or
laminating a film comprising a polymer selected form the group consisting of a polyolefin-based resin and a polyester resin on the adhesive layer to form a release film layer with a thickness of 5 um to 50 um.

Patentansprüche

1. Film für eine Reifeninnenauskleidung, umfassend:

    eine Grundfilmschicht, umfassend ein Polyamid-basiertes Harz und ein Copolymer, umfassend Polyamid-basierte Segmente und Polyether-basierte Segmente; und
    eine Klebstoffschicht, gebildet auf mindestens einer Seite der Grundfilmschicht und umfassend einen Resorcinol-Formalin-Latex(RFL)-basierten Klebstoff, und
    wobei das Verhältnis des Zugmoduls in einer zweiten Richtung zu dem Zugmodul in einer ersten Richtung bei anfänglichen 2 % Dehnung der Grundfilmschicht 0,9 bis 1,1 beträgt, wobei die zweite Richtung senkrecht zu der ersten Richtung ist.

2. Film für eine Reifeninnenauskleidung nach Anspruch 1, wobei der Gehalt der Polyetherbasierten Segmente des Copolymers 15 bis 50 Gew.-% beträgt, basierend auf dem Gesamtgewicht der Grundfilmschicht.

3. Film für eine Reifeninnenauskleidung nach Anspruch 1, wobei ein Verhältnis der Streckgrenze in der zweiten Richtung zu der Streckgrenze in der ersten Richtung des Grundfilms 0,9 bis 1,1 beträgt, wobei die zweite Richtung senkrecht zu der ersten Richtung ist.

4. Film für eine Reifeninnenauskleidung nach Anspruch 1, wobei die Flachausdehnung in der ersten Richtung und die Flachausdehnung in der zweiten Richtung der Grundfilmschicht jeweils 150 % oder mehr betragen, wobei die zweite Richtung senkrecht zu der ersten Richtung ist, und
    ein Verhältnis der Flachausdehnung in der zweiten Richtung zu der Flachausdehnung in der ersten Richtung 0,9 bis 1,1 beträgt.

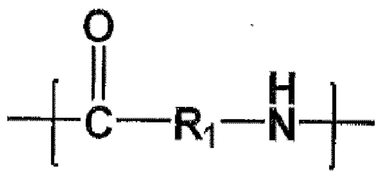
5. Film für eine Reifeninnenauskleidung nach Anspruch 1, wobei die erste Richtung die gleiche ist wie eine TD (Querrichtung) des Grundfilms und die zweite Richtung die gleiche ist wie eine MD (Maschinenrichtung) des Grundfilms.

6. Film für eine Reifeninnenauskleidung nach Anspruch 1, wobei das Polyamid-basierte Harz eine relative Viskosität (96 %ige Schwefelsäurelösung) 3,0 bis 3,5 aufweist.

7. Film für eine Reifeninnenauskleidung nach Anspruch 1, wobei das Copolymer, umfassend Polyamid-basierte Segmente und Polyether-basierte Segmente, ein absolutes gewichtsmittleres Molekulargewicht von 50.000 bis 300.000 besitzt.

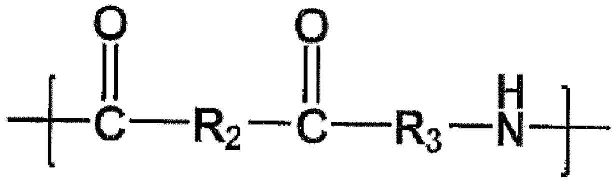
8. Film für eine Reifeninnenauskleidung nach Anspruch 1, wobei das Polyamid-basierte Segment des Copolymers eine wiederkehrende Einheit der folgenden chemischen Formel 1 oder chemischen Formel 2 umfasst:

[Chemische Formel 1]



in der chemischen Formel 1 bedeutet R_1 eine lineare oder verzweigte C1-20-Alkylengruppe oder eine lineare oder verzweigte C7-20 Arylalkylengruppe,

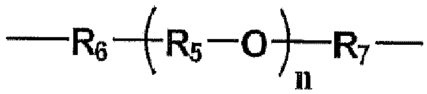
[Chemische Formel 2]



in der chemischen Formel 2 bedeutet R_2 eine lineare oder verzweigte C1-20-Alkylengruppe und R_3 eine lineare oder verzweigte C1-20-Alkylengruppe oder eine lineare oder verzweigte C7-C20-Arylalkylengruppe.

9. Film für eine Reifeninnenauskleidung nach Anspruch 1, wobei das Polyether-basierte Segment des Copolymers eine wiederkehrende Einheit der folgenden chemischen Formel 3 umfasst:

[Chemische Formel 3]



in der chemischen Formel 3 bedeutet

R_5 eine lineare oder verzweigte C1-10-Alkylengruppe, und n ist eine ganze Zahl von 1 bis 100 und
R_6 und R_7 können gleich oder verschieden sein, und sind unabhängig eine direkte Bindung, -O-, -NH-, -COO- oder -CONH-.

10. Film für eine Reifeninnenauskleidung nach Anspruch 1, wobei das Copolymer Polyamid-basierte Segmente und Polyether-basierte Segmente in einem Gewichtsverhältnis von 6:4 bis 3:7 umfasst.

11. Film für eine Reifeninnenauskleidung nach Anspruch 1, wobei die Grundfilmschicht das Poyamid-basierte Harz und das Copolymer in einem Gewichtsverhältnis von 6:4 bis 3:7 umfasst.

12. Film für eine Reifeninnenauskleidung nach Anspruch 1, wobei die Grundfilmschicht eine Dicke von 30 bis 300 μm besitzt und die Klebstoffschicht eine Dicke von 0,1 bis 20 μm besitzt.

13. Film für eine Reifeninnenauskleidung nach Anspruch 1, wobei die Grundfilmschicht ein ungereckter Film ist.

14. Film für eine Reifeninnenauskleidung nach Anspruch 1, wobei der Resorcinol-Formalin-Latex(RFL)-basierte Klebstoff 2 bis 32 Gew.-% eines Kondensats aus Resorcinol und Formaldehyd und 68 bis 98 Gew.-% Latex umfasst.

15. Film für eine Reifeninnenauskleidung nach Anspruch 1, weiterhin umfassend eine Trennfilmschicht, gebildet auf der Klebstoffschicht, und umfassend einen Polymerfilm mit einem anfänglichen Modul von 1.500 Mpa oder mehr bei Raumtemperatur.

16. Film für eine Reifeninnenauskleidung nach Anspruch 15, wobei der in der Trennfilmschicht beinhaltete Polymerfilm mindestens eines umfasst, gewählt aus der Gruppe, bestehend aus einem Polyolefin-basierten Harz und einem Polyesterharz.

17. Verfahren zur Herstellung eines Films für eine Reifeninnenauskleidung, umfassend
Schmelzen einer Mischung aus einem Polyamid-basierten Harz und einem Copolymer, umfassend Polyamid-basierte Segmente und Polyether-basierte Segmente, bei 230 bis 300 °C;
Extrudieren der geschmolzenen Substanz unter der Bedingung eines Düsenspaltes von 0,3 bis 1,5 mm zur Bildung einer Grundfilmschicht; und
Bilden einer Klebstoffschicht, umfassend einen Resorcinol-Formalin-Latex(RFL)-basierten Klebstoff auf mindestens einer Seite der Grundfilmschicht, wobei
ein Verhältnis des Zugmoduls in einer MD (Maschinenrichtung) zum Zugmodul in einer TD (Querrichtung) bei anfänglichen 2 % Dehnung der Grundfilmschicht 0,9 bis 1,1 beträgt.

18. Verfahren nach Anspruch 17, wobei der Gehalt der Polyether-basierten Segmente des Copolymers 15 bis 50 Gew.-% beträgt, basierend auf dem Gesamtgewicht der Grundfilmschicht.

19. Verfahren nach Anspruch 17, wobei der Schritt des Bildens der Grundfilmschicht weiterhin das Anbringen des Extrudats an einem Kühlteil umfasst, das in einem horizontalen Abstand von 10 bis 150 mm von einem Düsenauslass entfernt ist.

20. Verfahren nach Anspruch 19, weiterhin umfassend den Schritt des gleichmäßigen Anbringens des Extrudats an dem Kühlteil und Verwendung mindestens einer Vorrichtung, gewählt aus der Gruppe, bestehend aus einem Luftmesser, einer Luftdüse und einer elektrostatischen Aufladevorrichtung, angeordnet in einem horizontalen Abstand von 10 bis 300 mm von dem Düsenauslass.

21. Verfahren nach Anspruch 17, weiterhin umfassend den Schritt des Verfestigens der durch Schmelzen und Extrusion gebildeten Grundfilmschicht in dem Kühlteil, das bei 5 bis 40 °C gehalten wird.

22. Verfahren nach Anspruch 17, wobei das Polyamid-basierte Harz und das Copolymer, umfassend Polyamid-basierte Segmente und Polyether-basierte Segmente, in einem Gewichtsverhältnis von 6:4 bis 3:7 gemischt werden.

23. Verfahren nach Anspruch 17, wobei das Copolymer Polyamid-basierte Segmente und Polyether-basierte Segmente in einem Gewichtsverhältnis von 6:4 bis 3:7 umfasst.

24. Verfahren nach Anspruch 17, wobei der Schritt des Bildens der Klebstoffschicht das Beschichten eines Klebstoffs, umfassend 2 bis 32 Gew.-% eines Kondensats aus Resorcinol und Formaldehyd und 68 bis 98 Gew.-% Latex, auf mindestens eine Seite der Grundfilmschicht bis zu einer Dicke von 0,1 bis 20 μm umfasst.

25. Verfahren nach Anspruch 17, wobei ein Verhältnis der Streckgrenze in einer TD (Querrichtung) und der Streckgrenze in einer MD (Maschinenrichtung) der Grundfilmschicht 0,9 bis 1,1 beträgt.

26. Verfahren nach Anspruch 17, wobei die Flachausdehnung in einer TD (Querrichtung) und Flachausdehnung in einer MD (Maschinenrichtung) der Grundfilmschicht jeweils 150 % oder mehr beträgt, und
ein Verhältnis der Flachausdehnung in der MD (Maschinenrichtung) zu der Flachausdehnung in der TD (Querrichtung) 0,9 bis 1,1 beträgt.

27. Verfahren nach Anspruch 17, weiterhin umfassend den Schritt des Bildens einer Trennfilmschicht, umfassend einen Polymerfilm mit einem Anfangsmodul von 1.500 Mpa bei Raumtemperatur, auf der Klebstoffschicht.

28. Verfahren nach Anspruch 27, wobei der Schritt des Ausbildens der Trennfilmschicht umfasst:

Beschichten mindestens eines Polymers gewählt aus der Gruppe, bestehend aus einem Polyolefin-basierten Harz und einem Polyesterharz, auf die Klebstoffschicht zur Bildung einer Trennfilmschicht mit einer Dicke von 5 μm bis 50 μm, oder
Laminieren eines Films, umfassend ein Polymer, gewählt aus der Gruppe, bestehend aus einem Polyolefin-basierten Harz und einem Polyesterharz, auf die Klebstoffschicht zur Bildung einer Trennfilmschicht mit einer Dicke von 5 μm bis 50 μm.

Revendications

1. Un film pour une doublure intérieure de pneu comprenant:

une couche de film de base comprenant une résine à base de polyamide et un copolymère comprenant des segments à base de polyamide et des segments à base de polyéther; et
une couche adhésive formée sur au moins un côté de la couche de film de base et comprenant un adhésif à base de résorcinol-formol-latex (RFL), et
le rapport du module de traction dans une seconde direction au module de traction dans une première direction à un allongement initial de 2% de la couche de film de base est de 0,9 à 1,1, la seconde direction étant perpendiculaire à la première direction.

2. Le film pour une doublure intérieure de pneu selon la revendication 1,
dans lequel le contenu des segments à base de polyéther du copolymère est de 15% en poids à 50% en poids du poids total de la couche de film de base.

3. Le film pour une doublure intérieure de pneu selon la revendication 1,
dans lequel un rapport de la limite d'élasticité dans la seconde direction à la limite d'élasticité dans la première direction du film de base est de 0,9 à 1,1, la seconde direction étant perpendiculaire à la première direction.

4. Le film pour une doublure intérieure de pneu selon la revendication 1,
dans lequel l'allongement plat dans la première direction et l'allongement plat dans la seconde direction de la couche de film de base sont respectivement de 150% ou plus, la seconde direction étant perpendiculaire à la première direction, et
un rapport de l'allongement plat dans la seconde direction à l'allongement plat dans la première direction est de 0,9 à 1,1.

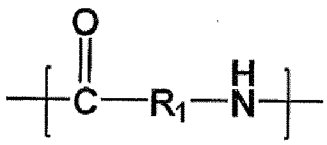
5. Le film pour une doublure intérieure de pneu selon la revendication 1,
dans lequel la première direction est identique à une TD (direction transversale) du film de base, et la seconde direction est identique à une MD (direction de la machine) du film de base.

6. Le film pour une doublure intérieure de pneu selon la revendication 1,
dans lequel la résine à base de polyamide a une viscosité relative (solution à 96% d'acide sulfurique) de 3,0 à 3,5.

7. Film pour une doublure intérieure de pneu selon la revendication 1,
dans lequel le copolymère comprenant des segments à base de polyamide et des segments à base de polyéther a un poids moléculaire moyen en poids absolu de 50.000 à 300.000.

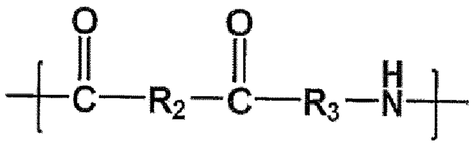
8. Le film pour une doublure intérieure de pneu selon la revendication 1,
dans lequel le segment à base de polyamide du copolymère comprend une unité récurrente selon la suivante formule chimique 1 ou formule chimique 2:

[formule chimique 1]



dans la formule chimique 1, R_1 représente un groupe alkylène linéaire ou ramifié en C_1-C_{20} ou un groupe arylalkylène linéaire ou ramifié en C_7-C_{20}

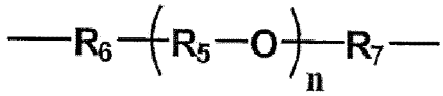
[formule chimique 2]



dans la formule chimique 2, R_2 représente un groupe alkylène linéaire ou ramifié en C_1-C_{20}, et R_3 représente un groupe alkylène linéaire ou ramifié en C_1-C_{20} ou un groupe arylalkylène linéaire ou ramifié en C_7-C_{20}.

9. Le film pour une doublure intérieure de pneu selon la revendication 1,
dans lequel le segment à base de polyéther du copolymère comprend une unité récurrente selon la formule chimique 3 suivante:

[formule chimique 3]



dans la formule chimique 3, R_5 représente un groupe alkylène linéaire ou ramifié en C_1-C_{10}, et n est un nombre entier de 1 à 100, et
R_6 et R_7 peuvent être identiques ou différents et représentent indépendamment une liaison directe, -O-, -NH-, -COO- ou -CONH-.

10. Le film pour une doublure intérieure de pneu selon la revendication 1,
dans lequel le copolymère comprend des segments à base de polyamide et des segments à base de polyéther dans un rapport pondéral de 6:4 à 3:7.

11. Le film pour une doublure intérieure de pneu selon la revendication 1,
dans lequel la couche de film de base comprend la résine à base de polyamide et le copolymère dans un rapport pondéral de 6:4 à 3:7.

12. Le film pour une doublure intérieure de pneu selon la revendication 1,
dans lequel la couche de film de base a une épaisseur de 30 à 300 μm, et la couche adhésive a une épaisseur de 0,1 à 20 μm.

13. Le film pour une doublure intérieure de pneu selon la revendication 1,
dans lequel la couche de film de base est un film non étiré.

14. Le film pour une doublure intérieure de pneu selon la revendication 1,
dans lequel l'adhésif à base de résorcinol-formol-latex (RFL) comprend de 2% en poids à 32% en poids d'un condensat de résorcinol et de formaldéhyde et de 68% en poids à 98% en poids de latex.

15. Le film pour une doublure intérieure de pneu selon la revendication 1,
comprenant en outre une couche de film de libération formée sur la couche adhésive, et comprenant un film polymère ayant un module initial de 1500 MPa ou plus à température ambiante.

16. Le film pour une doublure intérieure de pneu selon la revendication 15,
dans lequel le film de polymère inclus dans la couche de film de libération comprend au moins un élément choisi parmi le groupe constitué par une résine à base de polyoléfine et une résine de polyester.

17. Un procédé de fabrication d'un film pour une doublure intérieure de pneu, comprenant
la fusion d'un mélange d'une résine à base de polyamide et d'un copolymère comprenant des segments à base de polyamide et des segments à base de polyéther à 230 à 300 °C;
l'extrusion de la substance fondue dans une condition d'écartement de filière de 0,3 à 1,5 mm pour former une couche de film de base; et
la formation d'une couche adhésive comprenant un adhésif à base de résorcinol-formol-latex (RFL) sur au moins un côté de la couche de film de base,
dans lequel le rapport du module de traction dans une MD (direction de la machine) au module de traction dans une TD (direction transversale) à un allongement initial de 2% de la couche de film de base est de 0,9 à 1,1.

18. Le procédé selon la revendication 17,
dans lequel le contenu des segments à base de polyéther du copolymère est de 15% en poids à 50% en poids sur la base du poids total de la couche de film de base.

19. Le procédé selon la revendication 17,
dans lequel l'étape de formation de la couche de film de base comprend en outre la fixation de l'extrudat à une partie de refroidissement située à une distance horizontale de 10 à 150 mm à partir d'une sortie de filière.

20. Le procédé selon la revendication 19,
comprenant en outre l'étape consistant à attacher uniformément l'extrudat à la partie de refroidissement et à utiliser au moins un dispositif choisi parmi le groupe constitué par un couteau à air, une buse d'air, et un dispositif de charge électrostatique situé à une distance horizontale de 10 à 300 mm à partir de la sortie de filière.

21. Le procédé selon la revendication 17,
comprenant en outre l'étape consistant à solidifier la couche de film de base formée par fusion et extrusion dans la partie de refroidissement maintenue entre 5 et 40 °C.

22. Le procédé selon la revendication 17,
dans lequel la résine à base de polyamide et le copolymère comprenant des segments à base de polyamide et des segments à base de polyéther sont mélangés dans un rapport pondéral de 6:4 à 3:7.

23. Le procédé selon la revendication 17,
dans lequel le copolymère comprend des segments à base de polyamide et des segments à base de polyéther dans un rapport pondéral de 6:4 à 3:7.

24. Le procédé selon la revendication 17,
dans lequel l'étape de formation de la couche adhésive comprend le revêtement d'un adhésif comprenant de 2% en poids à 32% en poids d'un condensat de résorcinol et de formaldéhyde, et de 68% en poids à 98% en poids de latex sur au moins un côté de la couche de film de base jusqu'à une épaisseur de 0,1 à 20 µm.

25. Le procédé selon la revendication 17, dans lequel un rapport de la limite d'élasticité dans une TD (direction transversale) et de la limite d'élasticité dans un MD (direction de la machine) de la couche de film de base est de 0,9 à 1,1.

26. Le procédé selon la revendication 17,
dans lequel l'allongement plat dans une TD (direction transversale) et l'allongement plat dans une MD (direction de la machine) de la couche de film de base sont respectivement de 150% ou plus, et
un rapport d'allongement plat dans la MD (direction de la machine) à l'allongement plat dans la TD (direction transversale) est de 0,9 à 1,1.

27. Le procédé selon la revendication 17,
comprenant en outre l'étape consistant à former une couche de film de libération comprenant un film polymère ayant un module initial de 1500 MPa à température ambiante sur la couche adhésive.

28. Le procédé selon la revendication 27,
dans lequel l'étape de formation de la couche de film de libération comprend:

le revêtement d'au moins un polymère choisi parmi le groupe constitué par une résine à base de polyoléfine et une résine de polyester sur la couche adhésive pour former une couche de film de libération avec un épaisseur de 5 µm à 50 µm; ou
la stratification d'un film comprenant un polymère choisi parmi le groupe constitué par une résine à base de polyoléfine et une résine de polyester sur la couche adhésive pour former une couche de film de libération d'une épaisseur de 5 µm à 50 µm.

Figure 1

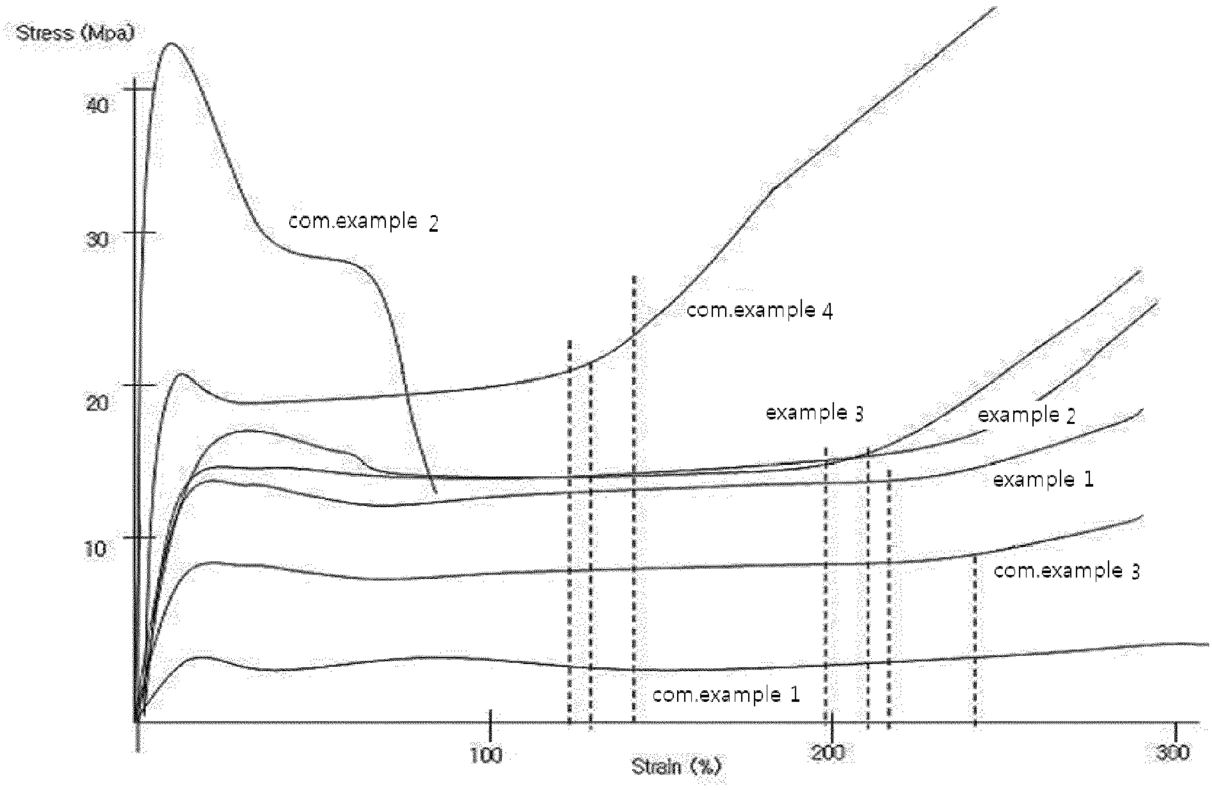
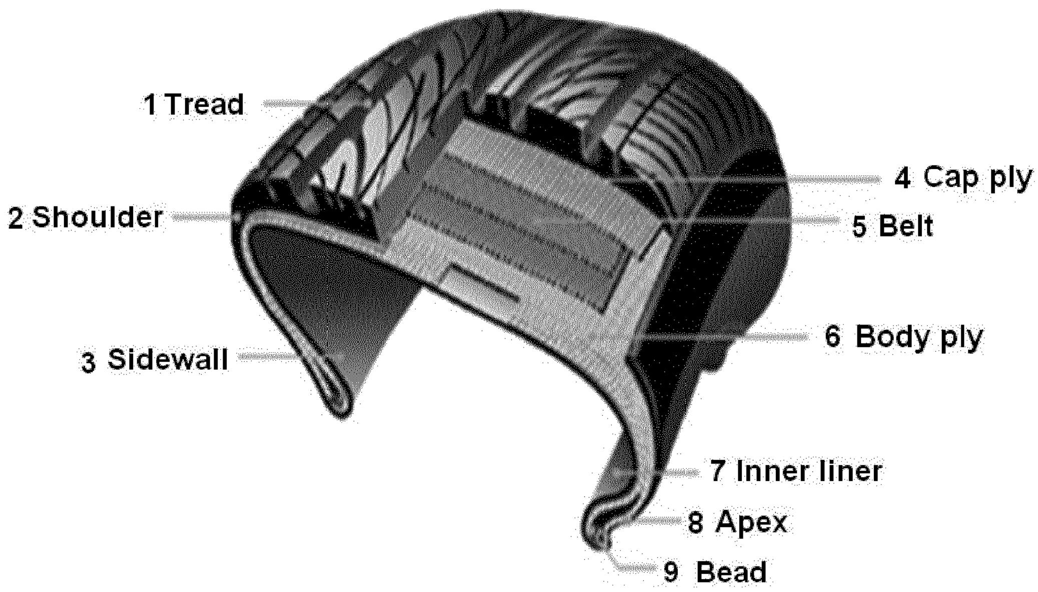

Stress (Mpa)
40
30
20
10
com.example 2
com.example 4
example 3
example 2
example 1
com.example 3
com.example 1
100
200
300
Strain (%)

Figure 2


1 Tread
2 Shoulder
3 Sidewall
4 Cap ply
5 Belt
6 Body ply
7 Inner liner
8 Apex
9 Bead

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 4435253 B **[0008]**
- JP 2005219565 A **[0009]**
- JP H09165469 A **[0010]**