

DESCRIPTION

THERMOPLASTIC RESIN FIBER, PRODUCTION METHOD THEREFOR, AND FABRIC THEREOF

TECHNICAL FIELD

[0001]

The present invention relates to a thermoplastic resin fiber and a method for producing the same and a fabric using the same. More specifically, the present invention relates to a thermoplastic resin fiber having excellent extensibility and a method for producing the same, as well as a fabric using the same.

BACKGROUND ART

[0002]

Fibers such as polyester fibers and nylon fibers are conventionally widely used. However, such general-purpose fibers are not recognized as fibers having excellent extensibility. Polyurethane-based elastic fibers are known as fibers that can exhibit high extensibility, but in reality, highly-extensible fibers made of materials other than polyurethane are not widely used. Therefore, there has been a demand for general-purpose highly-extensible fibers whose materials can be more widely selected. The following Patent Literatures 1 to 4 show attempts to obtain highly-extensible fibers.

CITATIONS LIST

PATENT LITERATURES

[0003]

Patent Literature 1: JP 2004-107818 A

Patent Literature 2: JP 2012-036519 A

Patent Literature 3: JP 2013-067920 A

Patent Literature 4: JP 2014-037642 A

SUMMARY OF INVENTION

TECHNICAL PROBLEMS

[0004]

Patent Literature 1 discloses a polyamide fiber drawn by thermally softening a polyamide original fiber composed of an aliphatic diamine structural unit and a dicarboxylic acid structural unit by irradiation with infrared light beams to achieve high extensibility. However, its fracture elongation is only about 20%.

Patent Literature 2 discloses a polyamide resin fiber using a thermoplastic polyamide-based elastomer, but its fracture elongation is only about 20%.

Patent Literature 3 discloses a polyimide fiber having a degree of extensibility as high as 35 to 40% and a predetermined structure. However, there has been a demand for fibers having a higher elongation and made of a more versatile material.

Patent Literature 4 discloses a polyether polyamide fiber having a fracture elongation as high as 341 to 434% and containing a polyether polyamide having a predetermined structure. However, it is hard to say that this material is versatile, and therefore there is a problem that the range of use of this fiber is limited.

[0005]

In view of the above circumstances, it is an object of the present invention to provide a thermoplastic resin fiber that uses highly versatile raw materials such as a polyamide resin, a polyolefin resin, and a modified elastomer but has high extensibility that is conventionally unknown. It is also an object of the present invention to provide a method for producing such a thermoplastic resin fiber and a fabric using such a fiber.

SOLUTIONS TO PROBLEMS

[0006]

The present invention is as follows.

A thermoplastic resin fiber according to claim 1 includes a thermoplastic resin containing a polyolefin resin, a polyamide resin, and a compatibilizer, and has a fracture elongation of 50% or more, wherein

the compatibilizer is a modified elastomer having a reactive group that reacts with the polyamide resin.

A thermoplastic resin fiber according to claim 2 is the thermoplastic resin fiber according to claim 1, which has a breaking strength of 0.5 cN/dtex or more but 3.0 cN/dtex or less.

A thermoplastic resin fiber according to claim 3 is the thermoplastic resin fiber according to claim 1 or 2, wherein when a breaking strength before drawing is defined as S_0 (cN/dtex) and a breaking strength after drawing is defined as S_1 (cN/dtex), a ratio between them (S_0/S_1) is 0.3 or more but 1.15 or less.

A thermoplastic resin fiber according to claim 4 is the thermoplastic resin fiber according to any one of claims 1 to 3, wherein when a fiber diameter before drawing is defined as D_0 (mm) and a fiber diameter after drawing is defined as D_1 (mm), D_0 is larger than D_1 .

A thermoplastic resin fiber according to claim 5 is the thermoplastic resin fiber according to any one of claims 1 to 4, wherein the polyolefin resin forms a continuous phase (A), and

the polyamide resin and the modified elastomer form a dispersed phase (B) dispersed in the continuous phase (A).

A thermoplastic resin fiber according to claim 6 is the thermoplastic resin fiber according to claim 5, wherein the dispersed phase (B) has a fine dispersed phase (B_2) dispersed in the dispersed phase (B).

A fabric according to claim 7 includes the thermoplastic resin fiber according to any one of claims 1 to 6.

A method for producing a thermoplastic resin fiber according to claim 8 includes a spinning step in which a thermoplastic resin composition obtained by melt-kneading a melt-kneaded product of the polyamide resin and the modified elastomer and the polyolefin resin is spun into a fiber.

ADVANTAGEOUS EFFECTS OF INVENTION

[0007]

According to the present invention, it is possible to provide a thermoplastic resin fiber that uses highly versatile raw materials such as a polyamide resin, a polyolefin resin, and a modified elastomer but exhibits high extensibility that is conventionally unknown.

According to the present invention, it is possible to provide a fabric that effectively utilizes high extensibility of the thermoplastic resin fiber according to the present invention.

According to the present invention, it is possible to provide a method for producing a thermoplastic resin fiber that uses highly versatile raw materials such as a polyamide resin, a polyolefin resin, and a modified elastomer but exhibits high extensibility that is conventionally unknown.

BRIEF DESCRIPTION OF DRAWINGS

[0008]

FIG. 1 is a diagram for explaining the phase structure of a thermoplastic resin fiber according to the present invention.

FIG. 2 is a chart that shows a correlation between strength and elongation in Examples 1 to 3 and Comparative Examples 1 and 2.

FIG. 3 is a chart that shows a correlation between strength and elongation in Examples 1 to 3.

DESCRIPTION OF EMBODIMENTS

[0009]

The particulars shown herein are by way of example and for the purposes of illustrative discussion of the embodiments of the present invention only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the present invention. In this regard, no attempt is made to show structural details of the present invention in more detail than is necessary for a fundamental understanding of the present invention, the description taken with the drawings making apparent to those skilled in the art how the several forms of the present invention may be embodied in practice.

[0010]

[1] Thermoplastic resin fiber

A thermoplastic resin fiber according to the present invention (hereinafter also simply referred to as a “present fiber”) includes a thermoplastic resin containing a polyolefin resin, a polyamide resin, and a compatibilizer, and has a fracture elongation of 50% or more, wherein the compatibilizer is a modified elastomer having a reactive group that reacts with the polyamide resin.

[0011]

The present fiber has a fracture elongation of 50% or more. Such a thermoplastic resin fiber has not heretofore been known at all which uses highly versatile materials such as a polyolefin resin, a polyamide resin, and a compatibilizer (the thermoplastic resin fiber may include only these three materials) but exhibits significantly high extensibility, that is, has a fracture elongation as high as 50% or more. The present inventors disclose thermoplastic resins (JP 2013-129800 A, JP 2013-147648 A, JP 2013-147645 A, JP 2013-147646 A, JP 2013-147647 A, and JP 2014-025060 A) that have excellent impact resistance when molded into molded bodies, but do not state and suggest that when the

thermoplastic resins are spun into fibers, the fibers exhibit significantly high extensibility that is conventionally unknown.

[0012]

The lower limit of the fracture elongation of the present fiber is not limited, but may further be 55% or more, 60% or more, 65% or more, 70% or more, or 75% or more. On the other hand, the upper limit of the fracture elongation is not limited, either, but is usually 200% or less and may be 180% or less, 160% or less, 140% or less, or 120% or less.

It is to be noted that the fracture elongation used in the present invention is defined as a maximum elongation percentage determined by measurement performed on 10 fibers in accordance with “8.5 Tensile strength and elongation percentage” described in JIS L1013 (2010) “Testing methods for man-made filament yarns” using a constant-rate-of-traverse type tester under conditions of a length of specimen between grips of 50 cm and a tension rate of 30 ± 2 cm/min.

[0013]

The breaking strength of the present fiber is not particularly limited, but may be 0.5 cN/dtex or more but 3.0 cN/dtex or less. The breaking strength may further be 0.6 cN/dtex or more but 2.8 cN/dtex or less, 0.7 cN/dtex or more but 2.6 cN/dtex or less, 0.8 cN/dtex or more but 2.4 cN/dtex or less, or 1.0 cN/dtex or more but 2.2 cN/dtex or less.

It is to be noted that the breaking strength used in the present invention is defined as a value determined by dividing a maximum tensile strength determined by measurement performed on 10 fibers in accordance with “8.5 Tensile strength and elongation percentage” described in JIS L1013 (2010) “Testing methods for man-made filament yarns” using a constant-rate-of-traverse type tester under conditions of a length of specimen between grips of 50 cm and a tension rate of 30 ± 2 cm/min by the average fineness of the test fibers used for the measurement.

[0014]

Further, when the breaking strength before drawing of the present fiber is defined as S_0 (cN/dtex) and the breaking strength after drawing of the present fiber is defined as S_1 (cN/dtex), the ratio between them (S_0/S_1) may be 0.3 or more but 1.15 or less. That is, the present fiber can have a unique property such that a difference between its breaking strength before drawing and its breaking strength after drawing is very small. This ratio (S_0/S_1) may further satisfy the relation $0.31 \leq S_0/S_1 \leq 1.00$, $0.32 \leq S_0/S_1 \leq 0.90$, $0.33 \leq S_0/S_1 \leq 0.80$, $0.34 \leq S_0/S_1 \leq 0.70$, or $0.35 \leq S_0/S_1 \leq 0.60$.

[0015]

When the fiber diameter before drawing of the present fiber is defined as D_0 (mm) and the fiber diameter after drawing of the present fiber is defined as D_1 (mm), D_0 may be larger than D_1 . That is, the thickness of the present fiber may be reduced by drawing. Therefore, as described above, when having a property such that the ratio (S_0/S_1) is 0.85 or more but 1.15 or less, the present fiber can have a unique property that a thin fiber that exhibits a large elongation can be produced by drawing.

The ratio between D_0 and D_1 (D_1/D_0) is not limited to a specific value, but for example, may satisfy the relation $1.05 \leq D_0/D_1 \leq 10$, $1.1 \leq D_0/D_1 \leq 8$, $1.2 \leq D_0/D_1 \leq 6$, $1.3 \leq D_0/D_1 \leq 4$, or $1.4 \leq D_0/D_1 \leq 2$.

It is to be noted that D_0 and D_1 are each the average of thickness values actually measured using a micrometer at randomly-selected 10 points on a fiber to be measured.

[0016]

The polyolefin resin constituting the present fiber is an olefin homopolymer and/or an olefin copolymer. The phase structure of the present fiber is not particularly limited, but when the present fiber has a phase structure having a continuous phase (A) and a dispersed phase (B) as will be described later, the polyolefin resin is preferably contained in the continuous phase (A).

An olefin constituting the polyolefin is not particularly limited, but examples thereof include ethylene, propylene, 1-butene, 3-methyl-1-butene, 1-pentene, 3-methyl-1-pentene, 4-methyl-1-pentene, and 1-hexene, and 1-octene. These olefins may be used singly or in combination of two or more of them.

Specific examples of the polyolefin resin include a polyethylene resin, a polypropylene resin, poly-1-butene, poly-1-hexene, poly-4-methyl-1-pentene. These polymers may be used singly or in combination of two or more of them. That is, the polyolefin resin may be a mixture of two or more of the above polymers.

[0017]

Examples of the polyethylene resin include an ethylene homopolymer and a copolymer of ethylene and another olefin. Examples of the latter include an ethylene-1-butene copolymer, an ethylene-1-hexene copolymer, an ethylene-1-octene copolymer, and an ethylene-4-methyl-1-pentene copolymer (the content of an ethylene-derived structural unit is 50% or more of the total structural units).

[0018]

Examples of the polypropylene resin include a propylene homopolymer and a copolymer of propylene and another olefin.

Examples of another olefin constituting the copolymer of propylene and another olefin include the above-mentioned various olefins (except for propylene). Among them, for example, ethylene and 1-butene are preferred. That is, the copolymer of propylene and another olefin is preferably a propylene-ethylene copolymer or a propylene-1-butene copolymer.

The copolymer of propylene and another olefin may be either a random copolymer or a block copolymer. Among them, a block copolymer is preferred from the viewpoint of obtaining a fiber having excellent extensibility. Particularly, a propylene-ethylene block copolymer having ethylene as another olefin is preferred. Such a propylene-ethylene block copolymer is also called, for example, an impact copolymer, a polypropylene impact copolymer, a heterophasic polypropylene, or a heterophasic block polypropylene. This block copolymerized polypropylene is preferred from the viewpoint of obtaining a fiber having excellent extensibility.

It is to be noted that the content of a propylene-derived structural unit of the copolymer of propylene and another olefin is 50% or more of the total structural units.

[0019]

The weight-average molecular weight (based on polystyrene standards) of the polyolefin resin measured by gel permeation chromatography (GPC) is not particularly limited, and may be, for example, 10,000 or more but 500,000 or less, but is preferably 100,000 or more but 450,000 or less, more preferably 200,000 or more but 400,000 or less.

[0020]

It is to be noted that the polyolefin resin is a polyolefin that has no affinity for the polyamide resin that will be described later, and that has no reactive group capable of reacting with the polyamide resin,

either. In this point, the polyolefin resin is different from an olefin-based component as the modified elastomer that will be describe later.

[0021]

The polyamide resin constituting the present fiber is a polymer having a chain-like skeleton formed by polymerizing a plurality of monomers via amide bonds (-NH-CO-). The phase structure of the present fiber is not particularly limited, but when the present fiber has a phase structure having a continuous phase (A) and a dispersed phase (B) as will be described later, the polyamide resin is preferably contained in the dispersed phase (B) together with the modified elastomer.

[0022]

Examples of a monomer constituting the polyamide resin include amino acids such as 6-aminocaproic acid, 11-aminoundecanoic acid, 12-aminododecanoic acid, and para-aminomethyl benzoic acid, and lactams such as ϵ -caprolactam, undecane lactam, and ω -lauryl lactam. These olefins may be used singly or in combination of two or more of them.

[0023]

Further, the polyamide resin can be obtained also by copolymerization of a diamine and a dicarboxylic acid. In this case, examples of the diamine as a monomer include: aliphatic diamines such as ethylene diamine, 1,3-diaminopropane, 1,4-diaminobutane, 1,6-diaminohexane, 1,7-diaminoheptane, 1,8-diaminooctane, 1,9-diaminononane, 1,10-diaminodecane, 1,11-diaminoundecane, 1,12-diaminododecane, 1,13-diaminotridecane, 1,14-diaminotetradecane, 1,15-diaminopentadecane, 1,16-diaminohexadecane, 1,17-diaminoheptadecane, 1,18-diaminooctadecane, 1,19-diaminononadecane, 1,20-diaminoeicosane, 2-methyl-1,5-diaminopentane, and 2-methyl-1,8-diaminooctane; alicyclic diamines such as cyclohexane diamine and bis-(4-aminocyclohexyl)methane; and aromatic diamines such as xylylene diamines (e.g., p-phenylenediamine and m-phenylenediamine). These olefins may be used singly or in combination of two or more of them.

[0024]

Examples of the dicarboxylic acid as a monomer include: aliphatic dicarboxylic acids such as oxalic acid, malonic acid, succinic acid, glutaric acid, adipic acid, pimelic acid, suberic acid, azelaic acid, sebacic acid, undecanedioic acid, dodecanedioic acid, brasylic acid, tetradecanedioic acid, pentadecanedioic acid, and octadecanedioic acid; alicyclic dicarboxylic acids such as cyclohexanedicarboxylic acid; and aromatic dicarboxylic acids such as phthalic acid, terephthalic acid, isophthalic acid, and naphthalenedicarboxylic acid. These olefins may be used singly or in combination of two or more of them.

[0025]

Specific examples of the polyamide resin include polyamide 6, polyamide 66, polyamide 11, polyamide 610, polyamide 612, polyamide 614, polyamide 12, polyamide 6T, polyamide 6I, polyamide 9T, polyamide M5T, polyamide 1010, polyamide 1012, polyamide 10T, polyamide MXD6, polyamide 6T/66, polyamide 6T/6I, polyamide 6T/6I/66, polyamide 6T/2M-5T, and polyamide 9T/2M-8T. These polyamides may be used singly or in combination of two or more of them.

[0026]

In the present invention, among the above-mentioned various polyamide resins, plant-derived polyamide resins can be used. Plant-derived polyamide resins are preferred from the viewpoint of

environmental protection (particularly from the viewpoint of carbon neutral) because they are resins using monomers derived from plant-derived components such as vegetable oils.

Examples of the plant-derived polyamide resins include polyamide 11 (hereinafter also simply referred to as “PA11”), polyamide 610 (hereinafter also simply referred to as “PA610”), polyamide 612 (hereinafter also simply referred to as “PA612”), polyamide 614 (hereinafter also simply referred to as “PA614”), polyamide 1010 (hereinafter also simply referred to as “PA1010”), polyamide 1012 (hereinafter also simply referred to as “PA1012”), and polyamide 10T (hereinafter also simply referred to as “PA10T”). These olefins may be used singly or in combination of two or more of them.
[0027]

Among the above-mentioned polyamide resins, PA11 has a structure in which monomers having 11 carbon atoms are linked via amide bonds. PA11 can be obtained using aminoundecanoic acid derived from castor oil as a monomer. The content of a structural unit derived from the monomer having 11 carbon atoms in PA11 is preferably 50% or more or may be 100% of all the structural units of PA11.

PA610 has a structure in which monomers having 6 carbon atoms and monomers having 10 carbon atoms are linked via amide bonds. PA610 can be obtained using sebacic acid derived from castor oil as a monomer. The total content of a structural unit derived from the monomer having 6 carbon atoms and a structural unit derived from the monomer having 10 carbon atoms in PA610 is preferably 50% or more or may be 100% of all the structural units of PA610.

PA1010 has a structure in which a diamine having 10 carbon atoms and a dicarboxylic acid having 10 carbon atoms are copolymerized. PA1010 can be obtained using 1,10-decanediamine (decamethylene diamine) and sebacic acid, which are derived from castor oil, as monomers. The total content of a structural unit derived from the diamine having 10 carbon atoms and a structural unit derived from the dicarboxylic acid having 10 carbon atoms in PA1010 is preferably 50% or more or may be 100% of all the structural units of PA1010.
[0028]

PA614 has a structure in which a monomer having 6 carbon atoms and a monomer having 14 carbon atoms are linked via amide bonds. PA614 can be obtained using a plant-derived dicarboxylic acid having 14 carbon atoms as a monomer. The total content of a structural unit derived from a monomer having 6 carbon atoms and a structural unit derived from a monomer having 14 carbon atoms in PA614 is preferably 50% or more but may be 100% of all the structural units of PA614.

PA10T has a structure in which a diamine having 10 carbon atoms and terephthalic acid are linked via amide bonds. PA10T can be obtained using 1,10-decanediamine (decamethylene diamine) derived from castor oil as a monomer. The total content of a structural unit derived from the diamine having 10 carbon atoms and a structural unit derived from terephthalic acid in PA10T is preferably 50% or more or may be 100% of all the structural units of PA10T.
[0029]

Among the above five plant-derived polyamide resins, PA11 is superior to the other four plant-derived polyamide resins in terms of low water absorbability, low specific gravity, and high biomass degree.

Polyamide 610 is inferior to PA11 in water absorption rate, chemical resistance, and impact strength, but is excellent in heat resistance (melting point) and strength. Further, polyamide 610 is superior to polyamide 6 or polyamide 66 in terms of low water absorbability and size stability, and therefore can be used as an alternative to polyamide 6 or polyamide 66.

Polyamide 1010 is superior to PA11 in heat resistance and strength. Further, the biomass degree of polyamide 1010 is comparable to that of PA11, and therefore polyamide 1010 can be used for parts required to have higher durability.

Polyamide 10T has an aromatic ring in its molecular skeleton, and therefore has a higher melting point and higher strength than polyamide 1010. Therefore, the use of polyamide 10T makes it possible to use the present fiber in a harsher environment.

[0030]

The modified elastomer constituting the present fiber is an elastomer having a reactive group that reacts with the polyamide resin. The phase structure of the present fiber is not particularly limited, but when the present fiber has a phase structure having a continuous phase (A) and a dispersed phase (B) as will be described later, the modified elastomer is preferably contained in the dispersed phase (B) together with the polyamide resin.

Moreover, the modified elastomer preferably has an affinity for the polyolefin resin. More specifically, the modified elastomer preferably has compatibilizing effect on the polyamide resin and the polyolefin resin. In other words, the modified elastomer is preferably a compatibilizer for the polyamide resin and the polyolefin resin.

[0031]

Examples of the reactive group include an acid anhydride group ($-\text{CO}-\text{O}-\text{OC}-$), a carboxyl group ($-\text{COOH}$), an epoxy group ($-\text{C}_2\text{O}$ (a three-membered ring structure composed of two carbon atoms and one oxygen atom)), an oxazoline group ($-\text{C}_3\text{H}_4\text{NO}$), and an isocyanate group ($-\text{NCO}$). These olefins may be used singly or in combination of two or more of them.

The amount of modification of the modified elastomer is not limited, and the modified elastomer only needs to have one or more reactive groups per molecule. Further, the modified elastomer preferably has 1 or more but 50 or less reactive groups, more preferably 3 or more but 30 or less reactive groups, particularly preferably 5 or more but 20 or less reactive groups per molecule.

[0032]

Examples of the modified elastomer include: a polymer using any monomer capable of introducing a reactive group (a modified elastomer obtained by polymerization using monomers capable of introducing a reactive group); an oxidative degradation product of any polymer (a modified elastomer having a reactive group formed by oxidative degradation); and a graft polymer obtained by graft polymerization of an organic acid on any polymer (a modified elastomer having a reactive group introduced by graft polymerization of an organic acid). These olefins may be used singly or in combination of two or more of them. These olefins may be used singly or in combination of two or more of them.

[0033]

Examples of the monomer capable of introducing a reactive group include a monomer having a polymerizable unsaturated bond and an acid anhydride group, a monomer having a polymerizable

unsaturated bond and a carboxyl group, and a monomer having a polymerizable unsaturated bond and an epoxy group.

Specific examples of the monomer capable of introducing a reactive group include: acid anhydrides such as maleic anhydride, itaconic anhydride, succinic anhydride, glutaric anhydride, adipic anhydride, citraconic anhydride, tetrahydrophthalic anhydride, and butenyl succinic anhydride; and carboxylic acids such as maleic acid, itaconic acid, fumaric acid, acrylic acid, and methacrylic acid. These compounds may be used singly or in combination of two or more of them. Among these compounds, acid anhydrides are preferred, maleic anhydride and itaconic anhydride are more preferred, and maleic anhydride is particularly preferred.

[0034]

The type of resin constituting the skeleton of the modified elastomer (hereinafter referred to as a “skeletal resin”) is not particularly limited, and various thermoplastic resins may be used. As the skeletal resin, one or two or more of the above-mentioned various polyolefin resins may be used.

In addition, other examples of the skeletal resin include an olefin-based thermoplastic elastomer and a styrene-based thermoplastic elastomer. These olefins may be used singly or in combination of two or more of them.

[0035]

Among them, the olefin-based thermoplastic elastomer may be a copolymer of two or more olefins.

Examples of the olefin include ethylene, propylene, and an α -olefin having 4 to 8 carbon atoms. Examples of the α -olefin having 4 to 8 carbon atoms include 1-butene, 3-methyl-1-butene, 1-pentene, 3-methyl-1-pentene, 4-methyl-1-pentene, 1-hexene, and 1-octene. The olefin-based thermoplastic elastomer is particularly preferably a copolymer of ethylene and an α -olefin having 3 to 8 carbon atoms or a copolymer of propylene and an α -olefin having 4 to 8 carbon atoms.

[0036]

Specific examples of the copolymer of ethylene and an α -olefin having 3 to 8 carbon atoms include an ethylene/propylene copolymer (EPR), an ethylene/1-butene copolymer (EBR), an ethylene/1-pentene copolymer, and an ethylene/1-octene copolymer (EOR). Examples of the copolymer of propylene and an α -olefin having 4 to 8 carbon atoms include a propylene-1-butene copolymer (PBR), a propylene-1-pentene copolymer, and a propylene-1-octene copolymer (POR). These olefins may be used singly or in combination of two or more of them.

[0037]

Examples of the styrene-based thermoplastic elastomer include a block copolymer of a styrene-based compound and a conjugated diene compound and a hydrogenated product thereof.

Examples of the styrene-based compound include styrene, alkyl styrenes such as α -methyl styrene, p-methyl styrene, and p-t-butyl styrene, p-methoxy styrene, and vinyl naphthalene. These olefins may be used singly or in combination of two or more of them.

Examples of the conjugated diene compound include butadiene, isoprene, piperylene, methyl pentadiene, phenyl butadiene, 3,4-dimethyl-1,3-hexadiene, and 4,5-diethyl-1,3-octadiene. These olefins may be used singly or in combination of two or more of them.

[0038]

Specific examples of the styrene-based thermoplastic elastomer include a styrene-butadiene-styrene (SBS) copolymer, a styrene-isoprene-styrene (SIS) copolymer, a styrene-ethylene/butylene-styrene (SEBS) copolymer, and a styrene-ethylene/propylene-styrene (SEPS) copolymer. These olefins may be used singly or in combination of two or more of them. Among them, SEBS is preferred.

[0039]

The molecular weight of the modified elastomer is not particularly limited, but the weight-average molecular weight of the modified elastomer is preferably 10,000 or more but 500,000 or less, more preferably 35,000 or more but 500,000 or less, particularly preferably 35,000 or more but 300,000 or less. It is to be noted that the weight-average molecular weight is measured by GPC (based on polystyrene standards).

[0040]

The present fiber may contain, in addition to the polyolefin resin, the polyamide resin, and the modified elastomer, various additives such as another thermoplastic resin, a flame retardant, a flame retardant aid, a filler, a colorant, an antimicrobial agent, and an antistatic agent. These olefins may be used singly or in combination of two or more of them.

[0041]

Examples of another thermoplastic resin include polyester-based resins (polybutylene terephthalate, polyethylene terephthalate, polycarbonate, polybutylene succinate, polyethylene succinate, and polylactic acid). These olefins may be used singly or in combination of two or more of them.

Examples of the flame retardant include halogen-based flame retardants (halogenated aromatic compounds), phosphorus-based flame retardants (e.g., nitrogen-containing phosphate compounds, phosphoric acid esters), nitrogen-based flame retardants (e.g., guanidine, triazine, melamine, and derivatives thereof), inorganic flame retardants (e.g., metal hydroxides), boron-based flame retardants, silicone-based flame retardants, sulfur-based flame retardants, and red phosphorus-based flame retardants. These olefins may be used singly or in combination of two or more of them.

Examples of the flame retardant aid include various antimony compounds, metal compounds containing zinc, metal compounds containing bismuth, magnesium hydroxide, and clayey silicate. These olefins may be used singly or in combination of two or more of them.

Examples of the filler include: glass components (e.g., glass fibers, glass beads, glass flakes); silica; inorganic fibers (glass fibers, alumina fibers, carbon fibers), graphite, silicate compounds (e.g., calcium silicate, aluminum silicate, kaolin, talc, clay), metal oxides (e.g., iron oxide, titanium oxide, zinc oxide, antimony oxide, alumina), carbonates and sulfates of metals such as calcium, magnesium, and zinc, and organic fibers (e.g., aromatic polyester fibers, aromatic polyamide fibers, fluororesin fibers, polyimide fibers, and vegetable fibers). These olefins may be used singly or in combination of two or more of them.

Examples of the colorant include pigments and dyes. These olefins may be used singly or in combination of two or more of them.

[0042]

The phase structure of the present fiber is not limited. However, it is preferred that the polyolefin resin forms a continuous phase (A) and the polyamide resin and the modified elastomer form a

dispersed phase (B) dispersed in the continuous phase (A) (see FIG. 1). This phase structure can be obtained by melt-kneading the polyolefin resin and a melt-kneaded product obtained by melt-kneading the polyamide resin and the modified elastomer. The dispersed phase (B) may be formed as a particle elongated in the longitudinal direction of the present fiber.

Further, in the present fiber, the polyamide resin constituting the dispersed phase (B), which is composed of the polyamide resin and the modified elastomer, forms a continuous phase (B_1) in the dispersed phase (B), and at least the modified elastomer out of the polyamide resin and the modified elastomer can form a fine dispersed phase (B_2) in the dispersed phase (B). That is, a fine dispersed phase (B_2) can be formed so as to be dispersed in a continuous phase (B_1) in the dispersed phase (see FIG. 1). When having such a multiple phase structure having a fine dispersed phase (B_2), the present fiber can have more excellent extensibility.

[0043]

Further, when a block copolymerized polyolefin resin having an ethylene block as a dispersed phase is used as the polyolefin resin of the present fiber, at least part of the ethylene block constituting the block copolymerized polyolefin resin can be aggregated at the interface between the continuous phase (A) and the dispersed phase (B) (see FIG. 1). That is, the present fiber can have an interfacial phase (C). The interfacial phase (C) is an area thickly formed at the interface between the continuous phase (A) and the dispersed phase (B), and can be formed by accumulation of the compatibilizer or a reaction product thereof at the phase interface. The fine dispersed phase (B_2) and the interfacial phase (C) may have the same composition or different compositions. When having such an interfacial phase (C), the present fiber can have more excellent extensibility.

[0044]

The size of the dispersed phase (B) contained in the continuous phase (A) of the present fiber is not particularly limited. Further, the arrangement density of the dispersed phase (B) is not particularly limited, either, but the number of particles of the dispersed phase (B) per 10- μ m square is preferably 50 or more but 450 or less. The number of particles of the dispersed phase (B) is more preferably 80 or more but 400 or less, even more preferably 100 or more but 350 or less, particularly preferably 150 or more but 300 or less, more particularly preferably 200 or more but 300 or less.

The size of the fine dispersed phase (B_2) contained in the dispersed phase (B) of the present fiber is not particularly limited, either, but the average diameter (average particle diameter) of the fine dispersed phase (B_2) is preferably 5 nm or more but 1000 nm or less, more preferably 5 nm or more but 600 nm or less, even more preferably 10 nm or more but 400 nm or less, particularly preferably 15 nm or more but 350 nm or less.

[0045]

It is to be noted that the phase structure of the present fiber is observed in an FE-SEM image obtained by subjecting the cross section of the fiber (which may be either parallel or perpendicular to the longitudinal direction) to oxygen plasma etching at 100 W for 1 minute and then to osmium coating and observing the cross section with a field-emission scanning electron microscope. The component constituting each of the phases can be identified by energy dispersive X-ray analysis (EDS) performed when the FE-SEM image is obtained.

The density of the dispersed phase (B) and the average particle diameter of the fine dispersed phase are also determined from the FE-SEM image. More specifically, the arrangement density of the dispersed phase (B) is defined as the average of arrangement densities actually measured in five 10- μ m square areas randomly selected in the FE-SEM image.

The average diameter of the fine dispersed phase (B_2) is defined as follows. In each of five different areas in the FE-SEM image, the longest diameter (major-axis dispersion diameter) of each of randomly-selected 20 particles of the fine dispersed phase (B_2) is measured, the average of the measured longest diameters is determined as a first average value, and the average of the first average values measured in the five different areas is further determined as the average diameter of the fine dispersed phase (B_2).

[0046]

When the polyolefin resin content of the present fiber is defined as W_A , the total content of the polyamide resin and the modified elastomer of the present fiber is defined as W_B , and the total of W_A and W_B is taken as 100% by mass, the ratio of W_B is preferably 70% by mass or less. That is, when the present fiber has the above-described phase structure and the total of the continuous phase (A) and the dispersed phase (B) is taken as 100% by mass, the content of the dispersed phase (B) is preferably 70% by mass or less. When the ratio of W_B is within the above range, the present fiber can have excellent extensibility. The ratio of W_B is preferably 0.5% by mass or more but 50% by mass or less, more preferably 2% by mass or more but 48% by mass or less, particularly preferably 4% by mass or more but 45% by mass or less.

[0047]

When the total of the polyamide resin and the modified elastomer is taken as 100% by mass, the content of the polyamide resin is preferably 10% by mass or more but 80% by mass or less. When the content of the polyamide resin is within the above range, a phase structure can easily be obtained in which the polyolefin resin forms a continuous phase (A) and the polyamide resin forms a dispersed phase (B). This makes it possible to achieve excellent extensibility. The content of the polyamide resin is preferably 12% by mass or more but 78% by mass or less, more preferably 14% by mass or more but 75% by mass or less, even more preferably 25% by mass or more but 73% by mass or less, even more preferably 30% by mass or more but 71% by mass or less, particularly preferably 34% by mass or more but 68% by mass or less, more particularly preferably 40% by mass or more but 64% by mass or less. When the content of the polyamide resin is within such a preferred range, the polyamide resin and the modified elastomer can be dispersed as smaller particles of the dispersed phase (B) in the continuous phase (A), and therefore the present fiber can have more excellent extensibility.

[0048]

When the total of the polyolefin resin, the polyamide resin, and the modified elastomer is taken as 100% by mass, the content of the polyamide resin may be 0.5% by mass or more but 30% by mass or less. When the content of the polyamide resin is within the above range, the present fiber can have excellent extensibility. The content of the polyamide resin is preferably 1% by mass or more but 22% by mass or less, more preferably 2% by mass or more but 15% by mass or less.

When the total of the polyolefin resin, the polyamide resin, and the modified elastomer is taken as 100% by mass, the content of the modified elastomer may be 0.5% by mass or more but 30% by mass

or less. When the content of the polyamide resin is within the above range, the present fiber can have excellent extensibility. The content of the polyamide resin is preferably 1% by mass or more but 22% by mass or less, more preferably 2% by mass or more but 15% by mass or less.

[0049]

The specific gravity of the present fiber is not particularly limited, but may usually be 1.05 or less. When the present fiber has a polyamide resin content of 1% by mass or more but 40% by mass or less, a polypropylene resin content of 50% by mass or more but 75% by mass or less, and a modified elastomer content of 5% by mass or more but 30% by mass or less, the specific gravity may particularly be 0.89 or more but 1.05 or less, and may more particularly be 0.92 or more but 0.98 or less. That is, the present fiber can achieve excellent extensibility while having a specific gravity comparable to that of the olefin resin.

[0050]

[2] Fabric

A fabric according to the present invention uses the fiber according to the present invention. The fabric can have high stretchability resulting from the above-described fiber according to the present invention.

The fiber according to the present invention constituting the fabric may be either an undrawn fiber or a drawn fiber. The fabric may be made of only the fiber according to the present invention or may be made of the fiber according to the present invention and another fiber. When the fabric is made of the fiber according to the present invention and another fiber, the content of the fiber according to the present invention is preferably 10% by mass per 100% of its total mass. When the fabric is made of the fiber according to the present invention and another fiber, the type of another fiber to be used is not limited.

The fabric may be in the form of cloth or web. Examples of the fabric in the form of cloth include a nonwoven cloth, a woven cloth, and a knitted cloth. For example, when the fabric is a nonwoven cloth, the nonwoven cloth may be formed by any method, and examples of the nonwoven cloth include a dry-laid nonwoven cloth, a wet-laid nonwoven cloth, a spunbonded nonwoven cloth, a meltblown nonwoven cloth, an air-laid nonwoven cloth, a chemical bonded nonwoven cloth (resin bonded nonwoven cloth), a thermobonded nonwoven cloth, a needle-punched nonwoven cloth, a spunlace nonwoven cloth (hydroentangled nonwoven cloth), and a steam-jet nonwoven cloth.

[0051]

The fabric may be subjected to post treatment such as flexibility-imparting treatment, water-repellency-imparting treatment, antifouling property-imparting treatment, antimicrobial property-imparting treatment, or antistatic property-imparting treatment. The fabric may further be subjected to moisture-permeable water-resistance processing performed by coating or laminating.

[0052]

The shape, size, and the like of each of the fiber according to the present invention and the fabric according to the present invention are not particularly limited, and the applications of them are not particularly limited, either. The fiber according to the present invention can be used as a fiber for various purposes. The fabric according to the present invention can be used as a fabric for various purposes.

Particularly, the fiber and the fabric according to the present invention can be used for various articles for use in vehicles such as automobiles, railway vehicles (general railway vehicles), aircraft fuselages (general fuselages), boats and ships/hulls (general hulls), and bicycles (general bicycles) for their excellent extensibility.

The fiber and the fabric according to the present invention can be used for skin materials of interior parts for automobiles. Specific examples of the skin materials include ceiling skin materials, seat skin materials, back ground fabrics, and ornament skin materials.

Examples of engine parts for automobiles include filter media, filter papers, and oil filters (elements).

[0053]

Further, the fiber and the fabric according to the present invention are used for various articles also in non-vehicle applications other than the above vehicles. Specific examples of the various articles include: industrial materials such as ropes, nonwoven fabrics, polishing brushes, industrial brushes, filters and other general materials;

storage containers such as attache cases and suit cases and structural materials thereof;

everyday goods and housewares;

entertainment items such as toys;

sporting goods such as fibers for producing sportswear, fibers for sewing sportswear, tennis racket strings, and badminton racket strings;

clothing-related articles such as clothing, fibers for producing shoes, and shoe strings;

bullet-proof articles such as bullet-proof jackets and bullet-proof members; and

agricultural materials such as agricultural machines and various ropes and fishery materials such as fishing nets.

Further, pellets formed into various shapes may be included.

[0054]

[3] Method for producing thermoplastic resin fiber

A method for producing the thermoplastic resin fiber according to the present invention includes a spinning step in which a thermoplastic resin composition obtained by melt-kneading a melt-kneaded product of the polyamide resin and the modified elastomer and the polyolefin resin is spun into a fiber.

A spinning method used in the production method is not limited, and may be any known method. Particularly, melt spinning is preferred. More specifically, a thermoplastic resin composition in a molten state can be extruded through a spinneret and then wound up in a cooling medium bath or in the air to obtain an undrawn fiber.

A melt-spinning temperature can be appropriately set depending on the type of thermoplastic resin composition to be used, and may be, for example, 190°C or higher but 250°C or lower, but is preferably 200°C or higher but 235°C or lower, particularly preferably 205°C or higher but 220°C or lower.

When cooling is performed with a cooling medium after spinning, a cooling temperature can also be appropriately set depending on the type of thermoplastic resin composition to be used, and may be, for example 60°C or higher but 85°C or lower, but is preferably 65°C or higher but 80°C or lower, particularly preferably 70°C or higher but 80°C or lower.

[0055]

When the fiber according to the present invention is obtained as an undrawn fiber, a drawing step can be provided to draw the undrawn fiber. When drawing is performed, the temperature of the obtained undrawn fiber may be kept or further increased in the drawing step, or the obtained undrawn fiber may be again heated in another step before drawing. The drawing may be performed in one step or in two or more steps at different draw ratios. When the drawing is performed in two or more steps, the strength of the fiber can be increased as compared with when the drawing is performed in one step. Further, when the drawing is performed in two or more steps, the draw ratio is preferably set so as to decrease as the number of drawing steps increases.

[0056]

Drawing conditions are not limited, but a drawing temperature is preferably 65°C or higher but 150°C or lower. From the viewpoint of obtaining a fiber having more excellent extensibility, the drawing temperature is preferably 70°C or higher but 115°C or lower, more preferably 75°C or higher but 110°C or lower, particularly preferably 80°C or higher but 105°C or lower.

If necessary, the obtained fiber according to the present invention may further be subjected to any post-processing such as various heat treatment, interlacing, and twisting (e.g., crimping).

[0057]

The fineness (dtex) of the fiber according to the present invention is not limited, and may be appropriately selected as long as it can be achieved by spinning. Further, the fiber according to the present invention may either be a monofilament composed of one filament or a multifilament composed of two or more filaments. When the fiber according to the present invention is a monofilament, the fineness thereof is preferably 10 dtex or more but 10000 dtex or less.

When the fiber according to the present invention is a multifilament, the fineness thereof is preferably 1 dtex or more but 10000 dtex or less. When the fiber according to the present invention is a multifilament, the number of filaments is not particularly limited, and may be, for example, 2 or more but 1000 or less.

Further, the fiber according to the present invention may be used also as a microfiber having a fineness of 1 dtex or less. In this case, the fineness of the fiber according to the present invention may be 0.001 dtex or more but 1 dtex or less, and may further be 0.005 dtex or more but 0.50 dtex or less.

It is to be noted that the fineness is defined by JIS L0101.

The cross-sectional shape of the fiber according to the present invention is not particularly limited, and the fiber according to the present invention may have a circular cross-sectional shape or a modified cross-sectional shape. Examples of the modified cross-sectional shape include an X shape, a flat shape, a polygonal shape (e.g., a triangular shape, a quadrangular shape, a pentagonal shape, or a hexagonal shape), a star shape, and a multifoil shape (e.g., a trefoil shape, a quatrefoil shape, or a cinquefoil shape).

[0058]

The thermoplastic resin composition as a raw material of the fiber can be obtained by melt-kneading a melt-kneaded product of the polyamide resin and the modified elastomer and the polyolefin resin. A melt-kneading method used at this time is not particularly limited, and can be performed by, for example, using a kneading device such as an extruder (e.g., a single-screw extruder or a twin-screw extruder), a kneader, and a mixer (e.g., a high-speed flow mixer, a paddle mixer, or a ribbon mixer). These devices may be used singly or in combination of two or more of them. When two or more

devices are used, they may be operated either continuously or batch-wise. Further, all the components of the melt-kneaded product may be mixed at a time or may be mixed by adding them in several batches (multistage addition).

A kneading temperature used at this time is not particularly limited, and can be appropriately adjusted depending on the types of components to be used. Particularly, kneading is preferably performed in a state where all the resins are melted, and therefore the kneading temperature is preferably 190°C or higher but 350°C or lower, more preferably 200°C or higher but 330°C or lower, particularly preferably 205°C or higher but 310°C or lower.

The melt-kneaded product of the polyamide resin and the modified elastomer obtained above and the polyolefin resin can be melt-kneaded in the same manner as described above. That is, the melt-kneaded product of the polyamide resin and the modified elastomer and the polyolefin resin can be melt-kneaded using the same device and the same method at the same kneading temperature as those when the above-described melt-kneaded product is obtained.

EXAMPLES

[0059]

Hereinbelow, the present invention will be specifically described with reference to examples.

[1] Production of fiber

<1> Preparation of raw material composition

An impact-resistant resin was prepared by the following procedure. The obtained thermoplastic resin composition contained 55% by mass of a polyolefin, 25% by mass of a polyamide resin, and 20% by mass of a modified elastomer per 100% of its total mass.

[0060]

Pellets of the following polyamide resin and pellets of the following modified elastomer were dry-blended, then fed into a twin-screw melt-kneading extruder (manufactured by TECHNOVEL CORPORATION, screw diameter: 15 mm, L/D = 59), and melt-kneaded under conditions of a kneading temperature of 210°C, an extrusion speed of 2.0 kg/hr, and a screw rotation speed of 200 rpm, and the thus obtained melt-kneaded product was pelletized by a pelletizer to obtain pellets of the melt-kneaded product.

- Polyamide resin: nylon 11 resin, manufactured by Arkema, product name: "Rilsan BMN O", weight-average molecular weight: 18,000, melting point: 190°C

- Modified elastomer: maleic anhydride-modified ethylene-butene copolymer (modified EBR), manufactured by Mitsui Chemicals, Inc., product name: "TAFMER MH7020", MFR (230°C) = 1.5 g/10 min

[0061]

The pellets of the molten mixture obtained above and pellets of the following polyolefin resin were dry-blended, then fed into a twin-screw melt-kneading extruder (manufactured by TECHNOVEL CORPORATION, screw diameter: 15 mm, L/D = 59), and mixed under conditions of a kneading temperature of 210°C, an extrusion speed of 2.0 kg/hr, and a screw rotation speed of 200 rpm, and the thus obtained mixture was pelletized by a pelletizer to obtain pellets of a thermoplastic resin composition.

· Polyolefin resin: polypropylene resin, homopolymer, manufactured by Japan Polypropylene Corporation, product name: “NOVATEC MA1B”, weight-average molecular weight: 312,000, melting point: 165°C

[0062]

<2> Production of thermoplastic resin composition fiber

Melt-spinning (temperature: 210°C) was performed using a spinning machine and the pellets of the thermoplastic resin composition obtained in the above <1> as a raw material. At this time, a spun fiber was cooled to 70 to 80°C just after extrusion to obtain an undrawn fiber (Example 1).

Following the cooling, the drawn fiber was subjected to drawing at a temperature of 90°C or 120°C to obtain a fiber drawn at a temperature of 90°C (Example 2) and a fiber drawn at a temperature of 120°C (Example 3). It is to be noted that each of the fibers is a 182f multifilament filament.

·Example 1: undrawn fiber, fineness 3962 dtex

·Example 2: drawn fiber (drawing temperature 90°C), fineness 1500 dtex

·Example 3: drawn fiber (drawing temperature 120°C), fineness 1400 dtex

[0063]

[2] Evaluation of fibers

The strength and elongation of each of the fibers were measured in accordance with “8.5 Tensile strength and elongation percentage” described in JIS L1013 (2010) “Testing methods for man-made filament yarns” using a constant-rate-of-traverse type test machine. The measurement was performed under conditions of a temperature of 25°C, a length of specimen between grips of 50 cm, and a tension rate of 30±2 cm/min. The measurement was performed on 10 fibers of each of Examples (Examples 1 to 3) to determine the average of strength and the average of elongation. The measured maximum strength and maximum elongation were defined as breaking strength and fracture elongation, respectively.

FIG. 2 and FIG. 3 are charts each showing a correlation between the measured strength and the measured elongation.

Further, the data of the following nylon fiber (nylon 66, 72f multifilament filament, manufactured by Hyosung Japan Co., Ltd.) and the following PET fiber (polyethylene terephthalate, 182f multifilament filament, manufactured by Hyosung Japan Co., Ltd.) as general-purpose fibers is also shown in FIG. 2.

·Comparative Example 1: nylon fiber, fineness 470 dtex

·Comparative Example 2: PET fiber, fineness 555 dtex

[0064]

[3] Effects of Examples

As can be seen from FIGs. 2 and 3, the thermoplastic resin fibers of Examples 1 and 2 according to the present invention have special high extensibility. A general nylon fiber such as the nylon fiber of Comparative Example 1 has a high breaking strength but has an elongation as low as about 20%. Similarly, a general PET fiber such as the PET fiber of Comparative Example 2 has a high breaking strength, but has an elongation as low as about 20%. On the other hand, the thermoplastic resin fibers according to the present invention have a significantly high elongation of more than 80% to more than 450%.

[0065]

The breaking strength (S_0) of Example 1 (undrawn fiber) measured in the above manner was 0.57 cN/dtex. On the other hand, the breaking strength (S_1) of Example 2 (drawn fiber, drawing temperature 90°C) was 1.47 cN/dtex, and the breaking strength (S_1) of Example 3 (drawn fiber, drawing temperature 120°C) was 1.46 cN/dtex. Therefore, the breaking strength ratio between the thermoplastic resin fiber of Example 1 and the thermoplastic resin fiber of Example 2 (S_0/S_1) was as high as 0.39. Further, the breaking strength ratio between the thermoplastic resin fiber of Example 1 and the thermoplastic resin fiber of Example 3 (S_0/S_1) was also as high as 0.40.

[0066]

It is to be noted that the present invention is not limited to the specific examples described above, and various modifications may be made to the examples within the scope of the present invention depending on the purpose or intended use.

[0067]

The above-described examples are for illustrative purposes only, and shall not be construed as limiting the present invention. Although the present invention has been described with reference to exemplary embodiments, it is understood that the words used in the description and drawings of the present invention are explanatory and illustrative rather than restrictive. As described in detail herein, modifications may be made to the embodiments within the scope of the appended claims without departing from the scope and spirit of the present invention. Although the present invention has been described in detail with reference to particular structures, materials, and examples, the present invention is not intended to be limited to the particulars disclosed herein, rather the present invention extends to all the functionally-equivalent structures, methods, and uses within the scope of the appended claims.

REFERENCE SIGNS LIST

[0068]

- A; Continuous phase
- B; Dispersed phase
- B₁; Continuous phase in dispersed phase
- B₂; Fine dispersed phase
- C; Interfacial phase

CLAIMS

1. A thermoplastic resin fiber comprising a thermoplastic resin containing a polyolefin resin, a polyamide resin, and a compatibilizer, and having a fracture elongation of 50% or more, wherein the compatibilizer is a modified elastomer having a reactive group that reacts with the polyamide resin.
2. The thermoplastic resin fiber according to claim 1, which has a breaking strength of 0.5 cN/dtex or more but 3.0 cN/dtex or less.
3. The thermoplastic resin fiber according to claim 1 or 2, wherein when a breaking strength before drawing is defined as S_0 (cN/dtex) and a breaking strength after drawing is defined as S_1 (cN/dtex), the ratio between them (S_0/S_1) is 0.3 or more but 1.15 or less.
4. The thermoplastic resin fiber according to any one of claims 1 to 3, wherein when a fiber diameter before drawing is defined as D_0 (mm) and a fiber diameter after drawing is defined as D_1 (mm), D_0 is larger than D_1 .
5. The thermoplastic resin fiber according to any one of claims 1 to 4, wherein the polyolefin resin forms a continuous phase (A), and
the polyamide resin and the modified elastomer form a dispersed phase (B) dispersed in the continuous phase (A).
6. The thermoplastic resin fiber according to claim 5, wherein the dispersed phase (B) has a fine dispersed phase (B_2) dispersed in the dispersed phase (B).
7. A fabric comprising the thermoplastic resin fiber according to any one of claims 1 to 6.
8. A method for producing the thermoplastic resin fiber according to claim 1, the method comprising a spinning step in which a thermoplastic resin composition obtained by melt-kneading a melt-kneaded product of the polyamide resin and the modified elastomer and the polyolefin resin is spun into a fiber.