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(54) **SHORT POLYPROPYLENE FIBER**

(57) This short polypropylene fiber is characterized by: being a short polymer alloy fiber having a sea-island structure in which a polypropylene (A) is a sea component and a thermoplastic resin (B) having a polar functional group is an island component; having, exposed on the surface thereof, the thermoplastic resin (B) that has a

polar functional group; and having a fiber length of 20-100 mm and a single fiber fineness of 0.5-3.5 dtex. Provided is a short polypropylene fiber that has improved abrasion resistance while having characteristics of polypropylene, that has excellent texture, and that can be suitably used for a spun yarn.

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Description

TECHNICAL FIELD

5 **[0001]** The present invention relates to a short polypropylene fiber.

BACKGROUND ART

10 **[0002]** Polypropylene fibers, which are a type of polyolefin fibers, are excellent in lightweight properties and chemical resistance, and therefore are used in various fields such as interior applications such as carpet tiles, household carpets, and automobile mats, and material applications such as ropes, curing nets, narrow tapes, braids, and chair upholstery. On the other hand, since polypropylene does not have a polar functional group, intermolecular hydrogen bonds are not formed between monofilaments unlike natural fibers such as cotton and silk, and when polypropylene is used as a short fiber, fluffing easily occurs and abrasion resistance is poor. In order to improve the abrasion resistance of the fiber structure using the short polypropylene fiber, it is conceivable to add a physical action such as enhancement of entanglement between filaments or thermal bonding. However, when the entanglement between filaments is enhanced, the fiber structure is heavy and thick, and when thermally bonded, the fiber structure is fused and solidified, so that the texture is deteriorated. As a method for improving abrasion resistance while avoiding such deterioration in texture, it is conceivable to introduce a polar functional group into the polypropylene fiber to impart chemical interaction between monofilaments.

20 **[0003]** As a method for introducing a polar functional group into a polypropylene fiber, Patent Documents 1 and 2 disclose a method of using modified polypropylene in which a polar functional group is introduced into a polymer chain of polypropylene, Patent Document 3 discloses a surface treatment method such as corona discharge treatment and low-temperature plasma treatment, or Patent Document 4 discloses a method of applying a fiber treatment agent.

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

30 **[0004]**

Patent Document 1: Japanese Patent Laid-open Publication No. 2009-108427

Patent Document 2: Japanese Patent Laid-open Publication No. 2016-65357

Patent Document 3: Japanese Patent Laid-open Publication No. 2000-80559

35 Patent Document 4: Japanese Patent Laid-open Publication No. 10-53955

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

40 **[0005]** In Patent Document 1, modified polypropylene is used for the purpose of improving compatibility with different raw materials, and although improvement in compatibility between raw materials can be confirmed, chemical interaction between monofilaments is not mentioned.

45 **[0006]** In Patent Document 2, modified polypropylene is used as a fiber reinforcing agent, and it can be confirmed that adhesiveness to different materials such as carbon fiber is improved, but since the fibers are finally melted to form a resin, improvement in physical properties in fibers or chemical interaction between monofilaments cannot be confirmed.

[0007] In Patent Document 3, although hydrophilization is achieved by introducing a polar functional group by treating the surface of the fabric, the fiber strength is deteriorated, and the technique is uneconomical.

50 **[0008]** In Patent Document 4, although a polar functional group is introduced by a fiber treatment agent to achieve hydrophilization of the surface of the fabric, this is a study for nonwoven fabric applications in which washing is not performed, and when washing is repeatedly performed, the fiber treatment agent is gradually detached, and thus it is not suitable for applications requiring washing durability such as clothing applications. In addition, in Patent Documents 3 and 4, since a polar functional group is introduced for the purpose of hydrophilization, water repellency, which is a characteristic of polypropylene, is lost, and the method is not suitable for applications requiring water repellency.

55 **[0009]** As described above, short polypropylene fibers are excellent in lightweight properties, chemical resistance, and water repellency, and therefore there is a demand for the development of short polypropylene fibers in which polar functional groups are introduced while maintaining such characteristics unique to polypropylene and in which abrasion resistance of the short fibers is improved. Therefore, an object of the present invention is to solve the technical problems

related to the short polypropylene fibers described above, and to provide a short polypropylene fiber that has improved abrasion resistance while having characteristics of polypropylene, has excellent texture, and can be suitably employed particularly as a spun yarn.

SOLUTIONS TO THE PROBLEMS

[0010] The above object can be achieved by:

- (1) a short polypropylene fiber including a short polymer alloy fiber having a sea-island structure including polypropylene (A) as a sea component and a thermoplastic resin (B) having a polar functional group as an island component, in which the thermoplastic resin (B) having the polar functional group is exposed on a surface, a fiber length is 20 to 100 mm, and a single fiber fineness is 0.5 to 3.5 dtex;
- (2) the short polypropylene fiber according to (1), in which the thermoplastic resin (B) having the polar functional group is a polyester;
- (3) the short polypropylene fiber according to (1) or (2), containing a compatibilizer (C); or
- (4) a spun yarn including 20 to 80% by weight of the short polypropylene fiber according to any one of (1) to (3) .

EFFECTS OF THE INVENTION

[0011] According to the present invention, it is possible to provide a short polypropylene fiber that has improved abrasion resistance while having characteristics of polypropylene, is excellent in texture, and can be suitably employed as a fiber structure. The short polypropylene fiber obtained by the present invention can be suitably used in applications where conventional short polypropylene fibers are used, particularly in applications where excellent abrasion resistance and texture are required, by being formed into a spun yarn.

EMBODIMENTS OF THE INVENTION

[0012] The short polypropylene fiber of the present invention is a short polymer alloy fiber having a sea-island structure including polypropylene (A) as a sea component and a thermoplastic resin (B) having a polar functional group as an island component, in which the thermoplastic resin (B) having the polar functional group is exposed on a surface, the fiber length is 20 to 100 mm, and the single fiber fineness is 0.5 to 3.5 dtex.

[0013] The short polymer alloy fiber in the present invention refers to a short fiber in which an island component is dispersed discontinuously. Here, that an island component is discontinuous is that the island component exists with an appropriate length in the longitudinal direction of the fiber, the length is several tens of nanometers to several hundreds of thousands of nanometers, and a monofilament differs in shape of its sea-island structure in two cross sections perpendicular to its fiber axis, that is, lateral fiber cross sections, observed at arbitrary intervals in the same monofilament. The discontinuity of the island component in the present invention can be confirmed by the method described in Examples.

[0014] When the island component is discontinuously dispersed, the specific interface area of the sea-island interface can be sufficiently increased, so that interfacial peeling can be suppressed, and a short polymer alloy fiber excellent in dynamic characteristics and abrasion resistance can be obtained. In addition, a part of the island component can be exposed to the fiber surface, and the fiber surface layer is not covered only with the sea component, so that the characteristics of both the sea component and the island component appear more remarkably as the characteristics of the fiber surface. As described above, the short polymer alloy fiber in the present invention is essentially different from a core-sheath composite fiber in which one island is formed continuously and in the same shape along the fiber axis direction and a sea-island composite fiber in which a plurality of islands are formed continuously and in the same shape along the fiber axis direction. Such a short polymer alloy fiber can be obtained, for example, from a polymer alloy composition formed by kneading the polypropylene (A) and the thermoplastic resin (B) having a polar functional group at an arbitrary stage before melt spinning is completed.

[0015] In the short polypropylene fiber in the present invention, the thermoplastic resin (B) having a polar functional group is exposed on the surface. When the component present on the surface is only the polypropylene (A), since polypropylene does not have a polar functional group, uneven distribution of electrons does not occur, and chemical interaction does not occur between monofilaments that are in close contact with each other when the fiber structure is formed, so that fluffing is likely to occur when external stress such as friction is applied. Therefore, in order to prevent fluffing from occurring, the monofilaments must be physically and firmly entangled with each other, and the method is limited to a method of increasing the fiber length and strengthening the twists, a method of thermally melting the monofilaments to fuse the monofilaments, and the like, and the texture is also limited, so that it becomes difficult to obtain a wide variety of texture when used alone or in combination with other materials. On the other hand, when the thermoplastic resin (B) having a polar functional group is exposed on the surface, chemical interaction occurs due to uneven distribution

of electrons derived from the polar functional group of the thermoplastic resin (B) having a polar functional group between monofilaments that are in close contact with each other when the fiber is formed into a fiber structure, fluffing due to external stress can be suppressed without strengthening physical entanglement, and a wide variety of texture can be produced when the fiber is used alone or combined with other materials. In addition, the convergency is increased by chemical interaction between monofilaments, fluffing and single yarn falling off during processing are suppressed, and the process passability is excellent.

[0016] The sea component that constitutes the sea-island structure of the short polypropylene fiber of the present invention is the polypropylene (A).

[0017] The polypropylene (A) of the present invention may be either a propylene homopolymer or a copolymer with another α -olefin. The other α -olefin may be copolymerized singly or in combination of two or more kinds thereof.

[0018] The island component constituting the sea-island structure of the short polypropylene fiber of the present invention is the thermoplastic resin (B) having a polar functional group.

[0019] The short polypropylene fiber of the present invention preferably contains 5.0 to 20.0 parts by weight of the thermoplastic resin (B) having a polar functional group based on a total of 100 parts by weight of the fiber composition. When the content of the thermoplastic resin (B) having a polar functional group is 5.0 parts by weight or more, chemical interaction between monofilaments due to introduction of the polar functional group sufficiently appears, and abrasion resistance is improved, which is preferable. On the other hand, when the content of the thermoplastic resin (B) having a polar functional group is 20.0 parts by weight or less, hydrophilization due to introduction of a large amount of polar functional groups is not remarkable, and therefore water repellency, which is a characteristic as a polypropylene fiber, is not impaired, which is preferable. The effect obtained by introducing the thermoplastic resin (B) having a polar functional group can be simply confirmed by measuring the contact angle. The method for measuring the contact angle is as described in Examples, and when the thermoplastic resin (B) having a polar functional group is contained, the thermoplastic resin (B) having a polar functional group is exposed on the fiber surface to increase the hydrophilicity, so that the value decreases. The contact angle is preferably 146° or less, more preferably 143° or less in order to make chemical interaction between monofilaments sufficiently appear and improve abrasion resistance. On the other hand, the contact angle is preferably 135° or more, more preferably 138° or more in order not to impair water repellency, which is a characteristic as a polypropylene fiber.

[0020] Specific examples of the thermoplastic resin (B) having a polar functional group of the present invention include, but are not limited to, polyesters, polyamides, acrylic, modified polypropylene, and modified polyethylene. Among them, polyesters and polyamides are preferable because they stably have many polar functional groups, and polyesters having a shorter Hansen solubility parameter (HSP) distance, which is calculated from an HSP, which is an index of affinity, to polypropylene and good dispersibility are further preferable.

[0021] Preferable polyesters in the present invention are mainly composed of terephthalic acid and ethylene glycol, and may contain a polymerization component. Examples of the copolymerization dicarboxylic acid component include phthalic acid, isophthalic acid, 1,2-cyclohexanedicarboxylic acid, 1,3-cyclohexanedicarboxylic acid, and 1,4-cyclohexanedicarboxylic acid; aromatic dicarboxylic acids such as 5-sodium sulfoisophthalic acid, 1,5-naphthalenedicarboxylic acid, 2,6-naphthalenedicarboxylic acid, 2,2'-biphenyldicarboxylic acid, 3,3'-biphenyldicarboxylic acid, 4,4'-biphenyldicarboxylic acid, and anthracenedicarboxylic acid; and aliphatic dicarboxylic acids such as malonic acid, fumaric acid, maleic acid, succinic acid, itaconic acid, adipic acid, azelaic acid, sebacic acid, 1,11-undecanedicarboxylic acid, 1,12-dodecanedicarboxylic acid, 1,14-tetradecanedicarboxylic acid, 1,18-octadecanedicarboxylic acid, 1,2-cyclohexanedicarboxylic acid, 1,3-cyclohexanedicarboxylic acid, and dimer acid; and examples of the copolymerization diol component include aromatic diols such as catechol, naphthalenediol, and bisphenol; and aliphatic diols such as trimethylene glycol, tetramethylene glycol, hexamethylene glycol, diethylene glycol, polyethylene glycol, polypropylene glycol, neopentyl glycol, and cyclohexanedimethanol. Only one kind of these copolymerization components may be used, or two or more kinds thereof may be used in combination.

[0022] In the short polymer alloy fiber in the present invention, a compatibilizer (C) may be added as necessary for the purpose of improving the dispersibility of the island component (thermoplastic resin (B)) in the polypropylene (A) as the sea component, controlling the dispersion state, improving the interfacial adhesion between the polypropylene (A) as the sea component and the island component, and increasing the surface area of the island component on the surface of the monofilament. In addition, when a sea-island structure is produced by melt spinning, bulges caused by what is called the Barus tend to be formed immediately below a spinneret to make the thinning deformation of the fiber unstable and accordingly, a compatibilizer is preferably used with the aim of improving the spinning operability through, for example, prevention of thread breakage caused by the Barus or obtaining a high quality fiber that is small in variation of fineness and superior in uniformity in the longitudinal direction of a fiber.

[0023] The compatibilizer (C) in the present invention can be appropriately selected according to the compositions of the polypropylene (A) as the sea component and the island component, the composite ratio of the polypropylene (A) as the sea component and the island component, and the like. Only one species of the compatibilizer may be used, or two or more species thereof may be used in combination.

[0024] When the compatibilizer is added, the short polypropylene fiber of the present invention preferably contains 0.1 to 10.0 parts by weight of the compatibilizer (C) based on a total of 100 parts by weight of the composition. A content of the compatibilizer of 0.1 parts by weight or more is preferable because it leads to an effect to compatibilize the polypropylene (A) as the sea component with the island component, so that the dispersion diameter of the island component is reduced and a dye compound is inhibited from aggregating and can reach close to monodispersity, and as a result, the color developing efficiency is improved and vivid and deep color development is obtained. In addition, as the dispersion diameter of the island component decreases, the surface area of the island component increases, and the ratio of the island component on the fiber surface also increases, so that the chemical interaction between monofilaments is also enhanced, which is preferable. Furthermore, it is preferable because the spinning operability such as prevention of thread breakage can be improved and a high-quality fiber being small in variation of fineness and superior in uniformity in the longitudinal direction of a fiber can be obtained. On the other hand, a content of the compatibilizer (C) of 10.0 parts by weight or less is preferable because the resulting fiber can maintain good fiber characteristics, appearance, and texture that originate from the polypropylene (A) as the sea component and the island component constituting the short polypropylene fiber. In addition, it is preferable because this serves to prevent the spinning operability from being destabilized by an excessive compatibilizer.

[0025] The short polypropylene fiber of the present invention preferably contains an antioxidant. Inclusion of an antioxidant is preferable because the oxidative decomposition of polypropylene by long-term storage or tumbler drying is thereby suppressed and durability of fiber characteristics including mechanical characteristics is improved.

[0026] The antioxidant to be used in the present invention is preferably a phenol-based compound, a phosphorus-based compound, a sulfur-based compound, or a hindered amine-based compound. Such antioxidants may be used singly, or two or more species thereof may be used in combination.

[0027] Next, the form of the short polypropylene fiber of the present invention will be described.

[0028] The short polypropylene fiber of the present invention has a fiber length of 20 to 100 mm. When the fiber length of the short polypropylene fiber is 20 mm or more, entanglement and chemical interaction between monofilaments are sufficient, process passability after cutting into a short fiber is excellent, and fluffing is suppressed during formation of the fiber structure. The fiber length of the short polypropylene fiber is preferably 35 mm or more. On the other hand, when the fiber length of the short polypropylene fiber is 100 mm or less, entanglement of monofilaments is sufficient, and texture specific to a short fiber is provided. In addition, a problem hardly occurs in process passability. The short polypropylene fiber preferably has a fiber length of 80 mm or less.

[0029] The single fiber fineness of the short polypropylene fiber of the present invention may be appropriately selected depending on the application and required properties and falls within the range of 0.5 to 3.5 dtex. The single fiber fineness in the present invention is measured by the method described in the Examples section. When the single fiber fineness of the short polypropylene fiber is 0.5 dtex or more, in addition to low yarn breakage frequency and good process passability due to chemical interaction because of the sufficiently large surface area of the monofilament, such a fiber will have less fluff during use and superior durability. Meanwhile, when the short polypropylene fiber has a single fiber fineness of 3.5 dtex or less, the flexibility of the fiber and fiber structure is not impaired. The short polypropylene fiber preferably has a single fiber fineness of 3.0 dtex or less.

[0030] The cross-sectional shape of the short polypropylene fiber of the present invention is not particularly limited, may be appropriately selected depending on the application and required properties, and may be a circular cross-section of a perfect circle or non-circular cross-section. Specific examples of the non-circular cross-section include, but are not limited to, multilobar, polygonal, flattened, elliptic, C-shaped, H-shaped, S-shaped, T-shaped, W-shaped, X-shaped, Y-shaped, grid-like, double-crossed, hollow, and the like. Among them, a multilobar shape is preferable in which the intermolecular force between monofilaments increases, so that the surface area increases and the adhesion area between monofilaments that are in close contact with each other also increases. In addition to the increase in the surface area of the monofilament, the hollow shape is also preferable because the lightweight property, which is a characteristic of polypropylene, is improved.

[0031] Next, a method for manufacturing the short polypropylene fiber of the present invention will be described below.

[0032] As a method for manufacturing the short polypropylene fiber of the present invention, a known melt spinning method and a known crimping method can be used.

[0033] In the present invention, since it is preferable to set the water content of the raw material to 0.3% by weight or less before performing melt spinning, it is preferable to dry the raw material as necessary. A water content of 0.3% by weight or less is preferable because it does not foam due to water during the melt spinning, allowing the spinning to be performed stably. In addition, depending on the type of the thermoplastic resin, it is preferable because reduction of mechanical characteristics and deterioration of color tone due to hydrolytic degradation are suppressed. The water content is more preferably 0.2% by weight or less, further preferably 0.1% by weight or less.

[0034] When performing melt spinning of the polymer alloy fiber, examples of a method of discharging from a spinneret to form a fiber yarn include the following, but the method is not limited thereto. In a first example, composite chips formed by melt-kneading the sea component and the island component in an extruder or the like in advance to make the sea-

island structure uniform are dried as required, followed by supplying the chips to a melt spinning machine, where they are melted, and weighing the melt with a measuring pump. Subsequently, it is introduced into a spinning pack heated in a spinning block, and the molten polymer is filtered in the spinning pack, followed by discharging it through the spinneret to provide a fiber yarn. In a second example, chips are dried as required, and chips of the sea component and those of the island component are mixed together, followed by supplying the mixed chips to a melt spinning machine, where they are melted, and weighing with a measuring pump. Subsequently, it is introduced into the spinning pack heated in the spinning block, and the sea and island components of the molten polymer are kneaded and filtered in the spinning pack, followed by discharging it through the spinneret to provide a fiber yarn. In a third example, composite chips in which the weight percentage of the island component is larger than in the composition of the final fiber are dried as necessary, and then the composite chips and chips of the sea component are separately supplied and melted, and measured with a measuring pump. Subsequently, it is introduced into the spinning pack heated in the spinning block, and the sea and island components of the molten polymer are kneaded and filtered in the spinning pack, followed by discharging it through the spinneret to provide a fiber yarn. In a fourth example, composite chips in which the weight percentage of the island component is larger than in the composition of the final fiber are dried as necessary, then the composite chips and chips of the sea component are mixed in the form of chips, and then the mixed chips are supplied to a melt spinning machine, melted, and measured with a measuring pump. Subsequently, it is introduced into the spinning pack heated in the spinning block, and the sea and island components of the molten polymer are kneaded and filtered in the spinning pack, followed by discharging it through the spinneret to provide a fiber yarn.

[0035] The yarn spun in the melt spinning can be supplied to the crimping step after being wound once, converged into a tow shape without being wound once, collected, and then supplied to the crimping step, or continuously supplied to the crimping step without being wound or collected in a can.

[0036] When the yarn spun by melt spinning is once wound, there are a method of cooling and solidifying the fiber yarn discharged from a spinneret with a cooling device, taking up the fiber yarn with a first godet roller, and winding the fiber yarn with a winder through a second godet roller to form a wound yarn, and a method of taking up the fiber yarn with a heated first roller, stretching the fiber yarn between the first roller and a heated second roller, and winding the fiber yarn with a winder through a third godet roller and a fourth godet roller to form a wound yarn, but the present invention is not limited thereto. In addition, an oil feeder may be used to supply oil to the fiber yarn, or an entangling device may be used to entangle the fiber yarn.

[0037] In the crimping step, crimps can be imparted, and examples of a method for imparting the crimps include a stuffer box method, a heated gear stuffing method, and a high-speed air jetting stuffing method, but are not limited thereto. In addition, if necessary, it is also possible to suitably apply oil as a finishing agent before or after crimping. The fiber bundle with or without crimps is cut with a known cutter so as to have a fiber length of 20 to 100 mm. In the short polypropylene fiber of the present invention cut to have a fiber length of 20 to 100 mm, since the polar functional group is exposed on the surface, chemical interaction between monofilaments appears, the process passability is excellent, and fluffing is suppressed during formation of the fiber structure.

[0038] The short polypropylene fiber of the present invention can be used as a spun yarn or a fiber structure such as a nonwoven fabric and can be particularly preferably used as a spun yarn.

[0039] The method for manufacturing a spun yarn at least partially including the short polypropylene fiber of the present invention is not particularly limited, and for mixing with other fibers, known methods such as raw stock mixed spinning, wrap spinning, and sliver spinning can be appropriately selected according to the application and required characteristics. Regarding the spun yarn at least partially including the short polypropylene fiber, fibers other than the short polypropylene fiber also preferably have polar functional groups. When fibers other than the short polypropylene fiber also have polar functional groups, chemical interaction is also exhibited with the polar functional group exposed on the surface of the short polypropylene fiber of the present invention, thus the process passability is good, in addition, generation of fluff during use is small, and durability is excellent, which is preferable. Examples of such fibers include animal hair such as wool, natural fibers such as cotton, hemp, and silk, synthetic fibers such as polyester fibers, nylon fibers, and acrylic fibers, and semisynthetic fibers and regenerated fibers, but are not limited thereto. In the case of mixed spinning of the short polypropylene fiber of the present invention and the fiber having a polar functional group, in order to further strengthen the chemical interaction between the short polypropylene fiber and the short fiber in other fiber, it is preferable to mix them at an early stage of manufacture. The proportion of the short polypropylene fiber contained in the spun yarn is preferably 20 to 80% by weight. When the short polypropylene fiber is contained in an amount of 20% by weight or more, water repellency and lightweight properties that are characteristics of polypropylene can be imparted to the spun yarn, which is preferable. When the proportion of the short polypropylene fiber is 80% by weight or less, the water repellency and lightweight properties of polypropylene are remarkable, and at the same time, the characteristics of other materials being mixed are imparted to the spun yarn, which is preferable.

EXAMPLES

[0040] Hereinafter, the present invention will be described in more detail with reference to Examples. Each characteristic value in Examples was obtained by the following method.

A. Composite ratio

[0041] The composite ratio of sea component (A)/island component (B)/compatibilizer (C) [parts by weight] was calculated on the basis of 100 parts by weight in total of the sea component (A), the island component (B), and the compatibilizer (C) used as raw materials of a short polypropylene fiber.

B. Fiber length, single fiber fineness

[0042] Measurement was performed according to JIS L 1015: 2010 (Test methods for man-made staple fibres).

C. Contact angle

[0043] Using a regular winding evaluation device (model: SAW-S05-60) manufactured by Eiko Industrial Co., Ltd., the obtained fiber was wound into a plate-wound product with a winding pitch of 0.3 mm and 8 times of traverse, and then immersed in ethanol for 24 hours to remove the oil. Using the plate-wound product as a sample, evaluation was performed using a contact angle meter DropMaster (DMo-501SA) manufactured by Kyowa Interface Chemical Co., Ltd.

[0044] The contact angle was measured by fixing the plate-wound product so that the fiber was wound in the horizontal direction with respect to the line of sight of a camera and dropping 2 μ L of water droplets. The measurement was performed five times for each sample, and the average value thereof was taken as the contact angle.

D. Discontinuity of island component

[0045] After embedding a fiber obtained in Example with an epoxy resin, the fiber was cut together with the epoxy resin with an Ultramicrotome LKB-2088 manufactured by LKB in the direction perpendicular to the fiber axis, and thus an ultrathin section having a thickness of about 100 nm was obtained. The obtained ultrathin section was stained by holding it in a vapor phase of ruthenium tetroxide for about four hours at ambient temperature, then the stained face was cut with the Ultramicrotome, and thus an ultrathin section stained with ruthenium tetroxide was prepared. For the stained ultrathin section, its cross section perpendicular to the fiber axis, that is, its lateral fiber cross section was observed at arbitrary intervals of 10,000 times or more the monofilament diameter in the same monofilament under the condition with an acceleration voltage of 100 kV, and 5 microscopic photographs of the lateral fiber cross section were taken using a transmission electron microscope (TEM) H-7100FA manufactured by Hitachi Ltd. In the photographs taken, when the respective lateral fiber cross sections were different in the number of island components and the shape of the sea-island structure, it was assumed that the island component was discontinuous, and when the island component was discontinuous, this was denoted by "Y" and when the island component was not discontinuous, this was denoted by "N".

E. Abrasion resistance

[0046] Using the fiber obtained in Example as a raw material, about 2 g of cylindrical knit was prepared, and then the cylindrical knit was scoured at 80°C for 20 minutes in an aqueous solution containing 1.5 g/L of sodium carbonate and 0.5 g/L of a surfactant GRAN UP US-20 manufactured by Meisei Chemical Works, Ltd., rinsed with running water for 30 minutes, and dried in a hot air dryer at 60°C for 60 minutes. The cylindrical knit after drying was subjected to dry heat setting at 135°C for 1 minute and set on the upper and lower sides of an appearance retention tester described in JIS L 1076: 2012, and after abrasion at a pressing pressure of 7.4 N for 10 minutes, a change in fluffing (fibrillation) before and after the abrasion was observed at 50 times with a microscope VHX-2000 manufactured by Keyence Corporation, and evaluation was performed according to three level criteria S, A, and B. The evaluation shows that S is the best, A is the second, and B is the worst. "No change (no fibrillation)" was defined as S, "slight fibrillation" was defined as A, and "clear fibrillation" was defined as B.

F. Quality

[0047] The cylindrical knit subjected to dry heat setting prepared in the above E was evaluated according to four level criteria S, A, B and C based on a consultation by five examiners having 5-year or more experience in quality evaluation. The evaluation shows that S is the best, the level lowers with A and B in order, and C is the worst. "Extremely excellent

in quality" was defined as S, "excellent in quality" was defined as A, "poor in quality" was defined as B, and "extremely poor in quality" was defined as C.

(Example 1)

[0048] A mixing ratio was set to 90.0% by weight of polypropylene (PP) (PP3155E5 manufactured by Exxon Mobil Corporation, melting peak temperature: 163°C, MFR: 36 g/10 min) as a sea component and 10.0% by weight of polyethylene terephthalate copolymerized with 35 mol% of 1,4-cyclohexanedicarboxylic acid as an island component, and kneading was performed at a kneading temperature of 230°C using a twin screw extruder. The strand discharged from the twin screw extruder was cooled in water and then cut with a pelletizer at intervals of about 5 mm to obtain composite chips. The composite chips obtained were vacuum-dried at 90°C for 12 hours and then supplied to an extruder type melt spinning machine in which they were melted and discharged through a spinneret (discharge hole size 0.20 mm, discharge hole length 0.50 mm, number of holes 96, round holes) at a spinning temperature of 240°C and a discharging rate of 33.0 g/min to obtain a spun yarn. The spun yarn was cooled with cooling air at a wind temperature of 20°C and a wind speed of 25 m/min. An oil was applied to the yarn with an oiling device to converge the yarn.

[0049] The yarn was taken up by a first godet roller rotating at 1,000 m/min, and wound by a winder through a second godet roller rotating at 3,000 m/min and heated to 140°C, a third godet roller rotating at 2,950 m/min, and a fourth godet roller at a tension at the time of winding of 0.08 cN/dtex to obtain a long polymer alloy fiber. The long fiber was subjected to mechanical crimping by a stuffing method, then subjected to a relaxation heat treatment at 150°C, and then cut to obtain a short polymer alloy fiber having a single fiber fineness of 1.2 dtex and a fiber length of 51 mm, and the short fiber was formed into a spun yarn.

[0050] Evaluation results of the fiber characteristics and the fabric characteristics of the spun yarn obtained are shown in Table 1.

(Examples 2 to 4, Comparative Example 1)

[0051] A spun yarn was produced in the same manner as in Example 1 except that 1.0% by weight of a styrenebutadiene-butylene-styrene copolymer (Tuftec MP10 manufactured by Asahi Kasei Corporation) having an amino group as a functional group was contained as a compatibilizer, and the composite ratio of the sea component and the island component was changed as shown in Table 1.

[0052] Evaluation results of the fiber characteristics and the fabric characteristics of the spun yarn obtained are shown in Table 1. In Comparative Example 1, a thermoplastic resin having a polar functional group was not contained, and therefore poor abrasion resistance and poor quality were exhibited.

(Examples 5 to 7)

[0053] A spun yarn was produced in the same manner as in Example 2 except that the island component was changed to polyethylene terephthalate in Example 5, polyethylene terephthalate copolymerized with 25 mol% of isophthalic acid and 10 mol% of adipic acid in Example 6, and nylon 6 in Example 7.

[0054] Evaluation results of the fiber characteristics and the fabric characteristics of the spun yarn obtained are shown in Table 1.

(Examples 8 and 9, Comparative Examples 2 and 3)

[0055] A spun yarn was prepared in the same manner as in Example 2 except that the fiber length was changed as shown in Table 2.

[0056] Evaluation results of the fiber characteristics and the fabric characteristics of the spun yarn obtained are shown in Table 2. In Comparative Example 2, since the fiber length was short, abrasion resistance was poor, and quality was also poor. In Comparative Example 3, since the fiber length was long, the process passability was poor, and the abrasion resistance was excellent, but the quality was poor.

(Example 10, Comparative Examples 4 and 5)

[0057] A spun yarn was prepared in the same manner as in Example 2 except that the single fiber fineness was changed as shown in Table 2.

[0058] Evaluation results of the fiber characteristics and the fabric characteristics of the spun yarn obtained are shown in Table 2. In Comparative Example 4, since the single fiber fineness was small, abrasion resistance and quality were poor. In Comparative Example 5, since the single fiber fineness was thick, the process passability was poor, and the

abrasion resistance was excellent, but the quality was poor.

(Example 11)

5 **[0059]** Using the spun yarn obtained in Example 2 as a yarn type (1) and wool according to the standard of Table 3 as a yarn type (2), the respective slivers were subjected to mixed spinning at the weight ratio in Table 3 to obtain a spun yarn.

[0060] Evaluation results of the fabric characteristics of the spun yarn obtained are shown in Table 3. The fabric was excellent in quality with the heat retaining property and the lightweight property.

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(Examples 12 and 13)

[0061] A spun yarn was prepared in the same manner as in Example 11 except that the mixing ratio was changed as shown in Table 3.

15 **[0062]** Evaluation results of the fabric characteristics of the spun yarn obtained are shown in Table 3. In Example 12 in which the mixing ratio of the short polypropylene fiber of the present invention was large, a fabric excellent in the lightweight property was obtained, and in Example 13 in which the mixing ratio of wool was large, a fabric excellent in the heat retaining property was obtained.

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(Example 14)

[0063] A spun yarn was prepared in the same manner as in Example 11 except that the yarn type (2) was changed as shown in Table 3.

25 **[0064]** Evaluation results of the fabric characteristics of the spun yarn obtained are shown in Table 3. Even in the mixed spinning of the short polypropylene fiber of the present invention and cotton, the fabric had good quality.

(Comparative Example 6)

30 **[0065]** A spun yarn was prepared in the same manner as in Example 11 except that the yarn type (1) was changed as shown in Table 3.

[0066] Evaluation results of the fabric characteristics of the spun yarn obtained are shown in Table 3. Since the yarn type (1) did not contain a thermoplastic resin having a polar functional group, a fabric with poor abrasion resistance was obtained.

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[Table 1-1]

			Example 1	Example 2	Example 3	Example 4
Sea-island composite condition	Sea component (A)	Polymer type	PP	PP	PP	PP
	Island component (B)	Polymer type	Copolymerized PET (1)	Copolymerized PET (1)	Copolymerized PET (1)	Copolymerized PET (1)
	Composite ratio	A/B/C [parts by weight]	90/10/0	89/10/1	97/2/1	69/30/1
	Fiber length [mm]		51	51	51	51
Fiber characteristics	Single fiber fineness [dtex]		1.2	1.2	1.2	1.2
	Contact angle [°]		143	141	146	135
	Discontinuity of island component		Y	Y	Y	Y
	Abrasion resistance	Fluffing	A	A	A	S
Fabric characteristics	Quality		A	S	B	B
	PP: polypropylene, PET: polyethylene terephthalate, copolymerized PET (1): PET copolymerized with 35 mol% of 1,4-cyclohexanedicarboxylic acid Copolymerized PET (2): PET copolymerized with 25 mol% of isophthalic acid and 10 mol% of adipic acid					

[Table 1-2]

			Comparative Example 1	Example 5	Example 6	Example 7
Sea-island composite condition	Sea component (A)	Polymer type	PP	PP	PP	PP
	Island component (B)	Polymer type	-	PET	Copolymerized PET (2)	N6
	Composite ratio	A/B/C [parts by weight]	100/0/0	89/10/1	89/10/1	89/10/1
Fiber characteristics	Fiber length [mm]		51	51	51	51
	Single fiber fineness [dtex]		1.2	1.2	1.2	1.2
	Contact angle [°]		149	141	141	138
	Discontinuity of island component		N	Y	Y	Y
Fabric characteristics	Abrasion resistance	Fluffing	B	A	A	A
	Quality		B	A	S	A
PP: polypropylene, PET: polyethylene terephthalate, copolymerized PET (1): PET copolymerized with 35 mol% of 1,4-cyclohexanedicarboxylic acid Copolymerized PET (2): PET copolymerized with 25 mol% of isophthalic acid and 10 mol% of adipic acid						

[Table 2]

			Example 8	Example 9	Comparative Ex-ample 2	Comparative Ex-ample 3	Example 10	Comparative Ex-ample 4	Comparative Ex-ample 5
Sea-island composite condition	Sea component (A)	Polymer type	PP	PP	PP	PP	PP	PP	PP
	Island component (B)	Polymer type	Copolymerized PET (1)	Copolymerized PET (1)	Copolymerized PET (1)	Copolymerized PET (1)	Copolymerized PET (1)	Copolymerized PET (1)	Copolymerized PET (1)
	Composite ratio	A/B/C [parts by weight]	89/10/1	89/10/1	89/10/1	89/10/1	89/10/1	89/10/1	89/10/1
	Fiber length [mm]		30	90	10	120	51	51	51
Fiber characteristics	Single fiber fineness [dtex]		1.2	1.2	1.2	1.2	3.0	0.3	4.5
	Contact angle [°]		141	141	141	141	141	141	141
	Discontinuity of island component		Y	Y	Y	Y	Y	Y	Y
Fabric characteristics	Abrasion resistance	Fluffing	A	S	B	S	A	B	A
	Quality		A	A	c	B	A	B	B
	PP: polypropylene, PET: polyethylene terephthalate, copolymerized PET (1): PET copolymerized with 35 mol% of 1,4-cyclohexanedicarboxylic acid								

[Table 3]

			Example 11	Example 12	Example 13	Example 14	Comparative Example 6
	Fabric composition	Yarn type (1)	Example 2	Example 2	Example 2	Example 2	Comparative Example 1
		Raw material	Wool	Wool	Wool	Cotton	Wool
		Average fiber length [mm]	35	35	35	25	35
		Average diameter [μm]	22	22	22	20	22
		Mixing ratio	(1)/(2)[parts by weight]	50/50	70/30	30/70	50/50
	Fabric characteristics	Abrasion resistance	Fluffing	A	A	A	A
		Quality		s	s	s	A

INDUSTRIAL APPLICABILITY

[0067] As for the short polypropylene fiber of the present invention, provided is a short polypropylene fiber that has improved abrasion resistance while having characteristics of polypropylene, is excellent in texture, and can be suitably employed as a fiber structure.

Claims

1. A short polypropylene fiber comprising a short polymer alloy fiber having a sea-island structure including polypropylene (A) as a sea component and a thermoplastic resin (B) having a polar functional group as an island component, wherein
the thermoplastic resin (B) having the polar functional group is exposed on a surface,
a fiber length is 20 to 100 mm, and
a single fiber fineness is 0.5 to 3.5 dtex.
2. The short polypropylene fiber according to claim 1, wherein the thermoplastic resin (B) having the polar functional group is a polyester.
3. The short polypropylene fiber according to claim 1 or 2, further comprising a compatibilizer (C).
4. A spun yarn comprising 20 to 80% by weight of the short polypropylene fiber according to any one of claims 1 to 3.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2022/045425

A. CLASSIFICATION OF SUBJECT MATTER <i>D01F 6/46</i> (2006.01)i; <i>D01F 8/06</i> (2006.01)i; <i>D01F 8/14</i> (2006.01)i; <i>D02G 3/04</i> (2006.01)i FI: D01F6/46 D; D01F8/06; D01F8/14 Z; D02G3/04 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) D01F6/46; D01F8/06; D01F8/14; D02G3/04 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Published examined utility model applications of Japan 1922-1996 Published unexamined utility model applications of Japan 1971-2023 Registered utility model specifications of Japan 1996-2023 Published registered utility model applications of Japan 1994-2023 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2008-538391 A (AQUADYE FIBERS, INC.) 23 October 2008 (2008-10-23) claims 1, 2, 5, 9, 15, paragraphs [0031], [0036], [0037], [0043]-[0047], examples 9, 10	1-4
X	JP 6-248514 A (DAIWABO CO., LTD.) 06 September 1994 (1994-09-06) claims 1, 4, paragraphs [0010], [0019], examples 1-3	1-3
A	WO 2017/154665 A1 (TORAY INDUSTRIES, INC.) 14 September 2017 (2017-09-14)	1-4
A	WO 2018/079152 A1 (TORAY INDUSTRIES, INC.) 03 May 2018 (2018-05-03)	1-4
A	JP 2007-308830 A (UNITICA FIBERS LTD.) 29 November 2007 (2007-11-29)	1-4
A	US 5534335 A (KIMBERLY-CLARK CORP.) 09 July 1996 (1996-07-09)	1-4
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 02 February 2023		Date of mailing of the international search report 21 February 2023
Name and mailing address of the ISA/JP Japan Patent Office (ISA/JP) 3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915 Japan		Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/JP2022/045425

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REFERENCES CITED IN THE DESCRIPTION

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