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(54) CORE-SHEATH COMPOSITE FIBER FOR ARTIFICIAL HAIR, HAIR ORNAMENT INCLUDING SAME, AND METHOD FOR MANUFACTURING SAME

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(57) ABSTRACT

A core-sheath conjugate fiber for artificial hair including a core part and a sheath part is provided. The core part includes of a polyester-based resin composition that contains a polyester-based resin as a main component and the sheath part includes a polyamide-based resin composition that contains a polyamide-based resin as a main component. The core-sheath conjugate fiber for artificial hair has a core-to-sheath area ratio of core:sheath=2:8 to 8:2 and a flat two-lobed cross sectional shape, and the polyamide-based resin composition has a melt viscosity of 140 Pa·s or less and contains a pigment. With this configuration, a core-sheath conjugate fiber for artificial hair in which exposure of the core part is suppressed and that has a touch close to that of human hair and an improved combing property, a hair ornament product including the same, and a method for producing the same are provided.

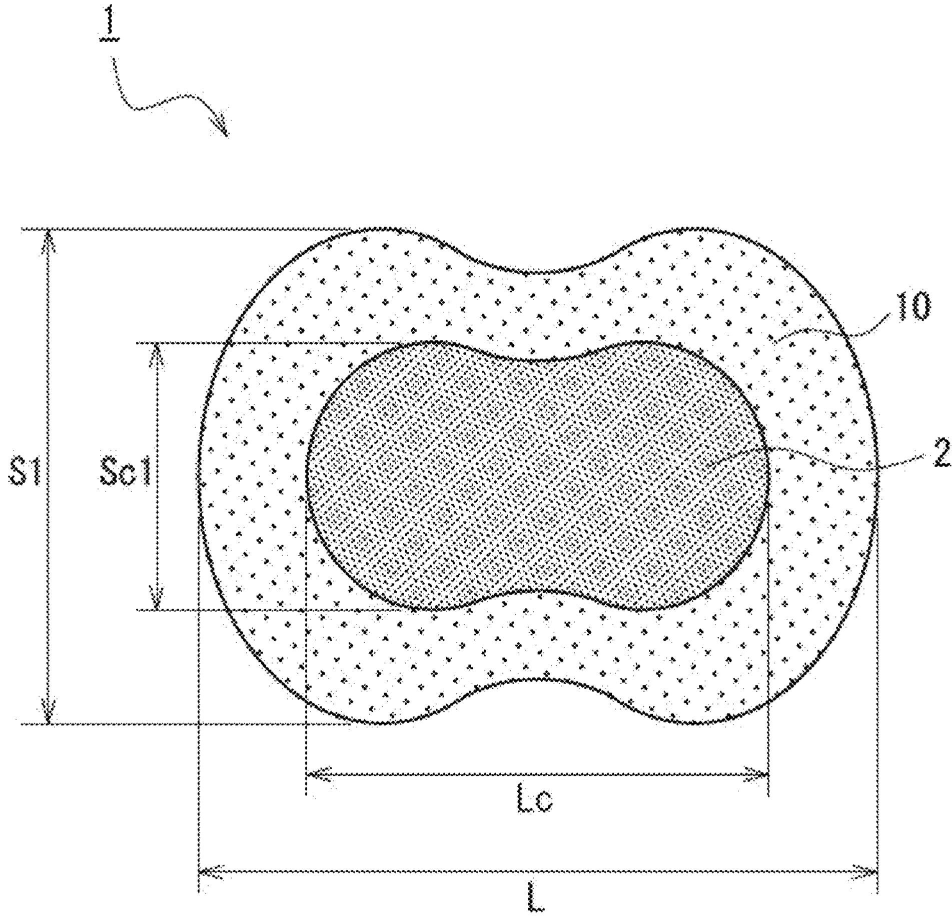


FIG. 1

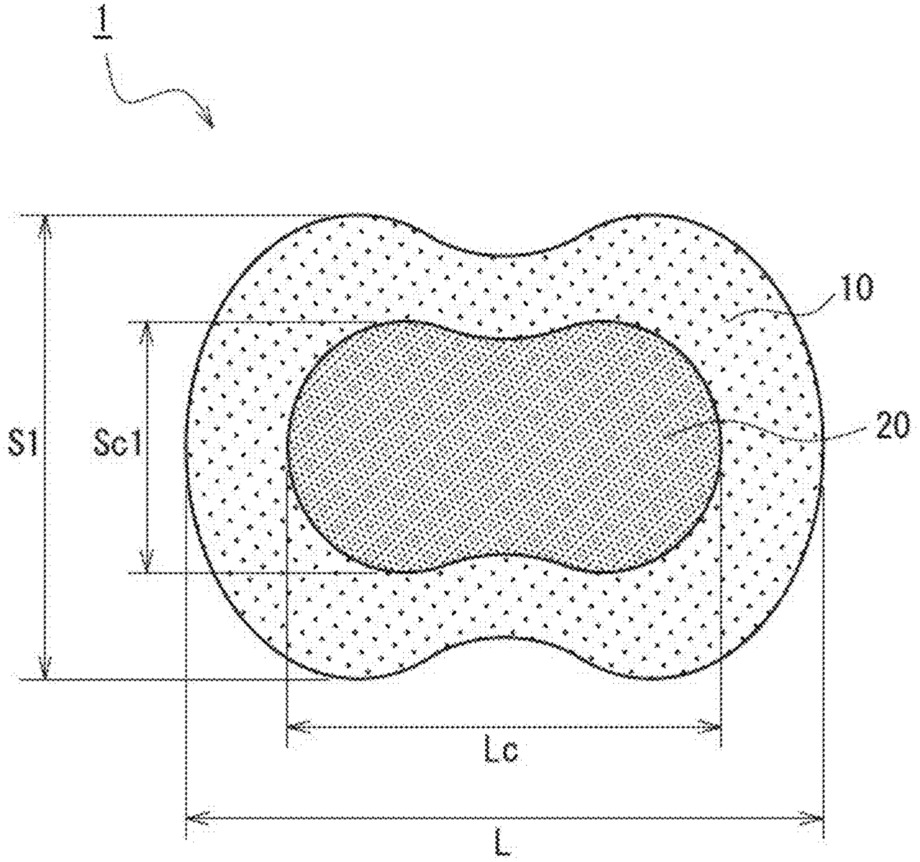


FIG. 2

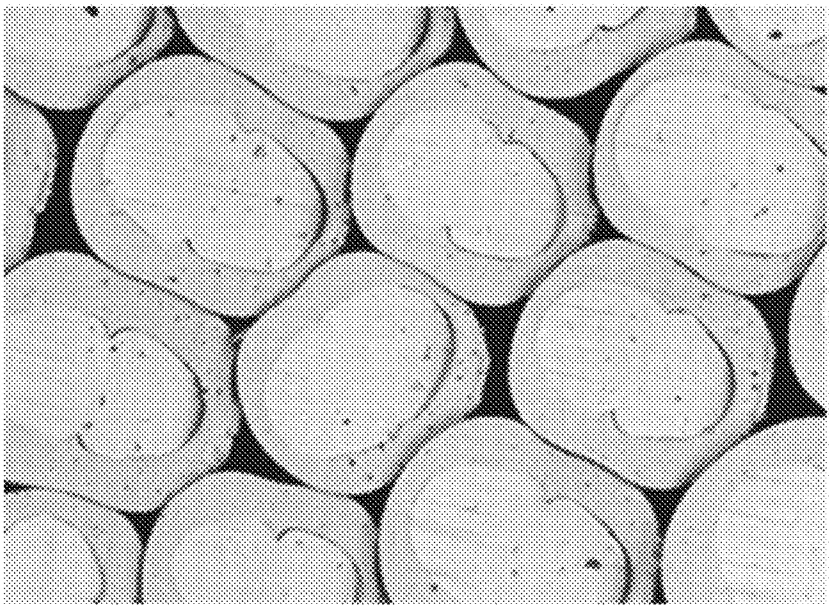
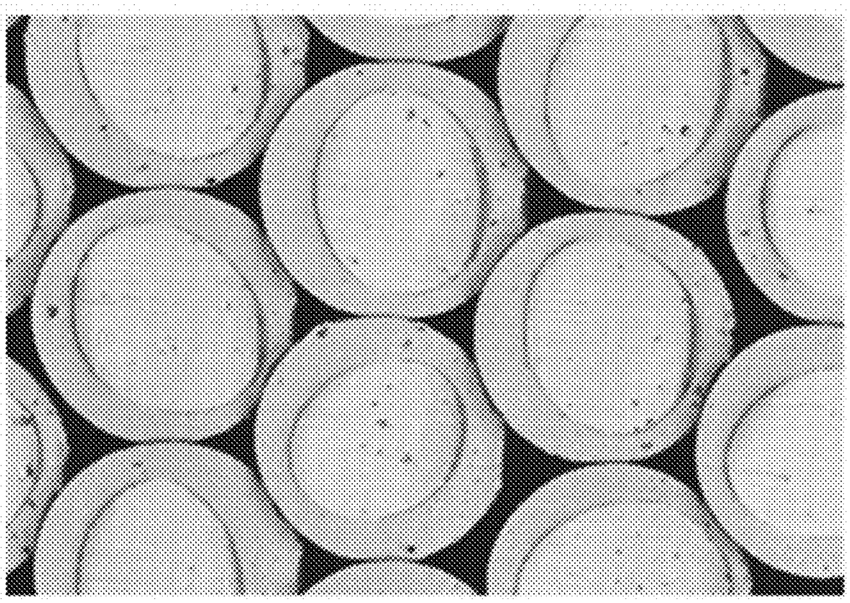


FIG. 3



CORE-SHEATH COMPOSITE FIBER FOR ARTIFICIAL HAIR, HAIR ORNAMENT INCLUDING SAME, AND METHOD FOR MANUFACTURING SAME

TECHNICAL FIELD

[0001] One or more embodiments of the present invention relate to a core-sheath conjugate fiber for artificial hair capable of being used as an alternative to human hair, a hair ornament product including the same, and a production method therefor.

BACKGROUND

[0002] Conventionally, human hair is used for hair ornament products such as hairpieces, hair wigs, hair extensions, hair bands, and doll hair. However, in recent years, it is becoming difficult to obtain human hair, and thus there is an increasing demand for artificial hair capable of being used as an alternative to human hair. Artificial hair is required to have a touch and appearance close to those of human hair, and examples of synthetic fibers that can be used for artificial hair include acrylic-based fibers, vinyl chloride-based fibers, vinylidene chloride-based fibers, polyester-based fibers, polyamide-based fibers, and polyolefin-based fibers. In particular, a core-sheath conjugate fiber containing polyester as a core component and polyamide as a sheath component has been developed as a fiber for artificial hair having a texture close to that of human hair and excellent durability and heat resistance (Patent Document 1). In the core-sheath conjugate fiber, polyethylene terephthalate having a high degree of polymerization and polyamide having a high degree of polymerization are used, and in a melt spinning method, the fiber is rapidly cooled and solidified through liquid cooling, and thereafter passed through a fiber surface layer crystallization promoting machine to form a specific streak-like asperity structure on the fiber surface, and thus, the desired fiber for artificial hair described above is obtained by suppressing the gloss of the polyamide constituting the sheath while securing the strength of the fiber.

PATENT DOCUMENT

[0003] Patent Document 1: JP H03-185103A

[0004] However, when a cross section of a core-sheath conjugate fiber has a non-circular shape, e.g., a flat two-lobed shape, die swell (also called “Barus effect”) that occurs when the fiber is discharged from a nozzle becomes ununiform. Accordingly, if the degree of polymerization of the resin used is high, the fiber cross section is significantly deformed from the shape of the nozzle, and consequently, the cross sectional shape of the core part also significantly changes from the shape of the nozzle. In particular, when both of the core and the sheath are formed using resins having high degrees of polymerization as in Patent Document 1, it is difficult to form cross sections of the core and the sheath into the same shape as the nozzle due to Barus effect, and the core component may be exposed, for example. Therefore, there is room for improvement from the viewpoint of the production yield of the fiber. Furthermore, the fiber has unintended waviness due to displacement of the center of the fiber cross section, and there is room for improvement. Moreover, depending on spinning conditions, streak-like asperities are formed on the fiber surface due to spherulites formed in the polyamide used for the sheath, and the touch and the combing property are impaired.

[0005] In order to address the above, one or more embodiments of the present invention provide a core-sheath conjugate fiber for artificial hair in which exposure of the core part is suppressed and that has a touch close to that of human hair and an improved combing property, a hair ornament product including the same, and a method for producing the same.

SUMMARY

[0006] One or more embodiments of the present invention relate to a core-sheath conjugate fiber for artificial hair including a core part and a sheath part, the core part being comprised of a polyester-based resin composition that contains a polyester-based resin as a main component, the sheath part being comprised of a polyamide-based resin composition that contains a polyamide-based resin as a main component, wherein the core-sheath conjugate fiber for artificial hair has a core-to-sheath area ratio of core: sheath=2:8 to 8:2 and a flat two-lobed cross sectional shape, and the polyamide-based resin composition has a melt viscosity of 140 Pa·s or less and contains a pigment.

[0007] Furthermore, one or more embodiments of the present invention relate to a hair ornament product including the core-sheath conjugate fiber for artificial hair.

[0008] Furthermore, one or more embodiments of the present invention relate to a method for producing the core-sheath conjugate fiber for artificial hair, including a step of melt spinning the polyester-based resin composition and the polyamide-based resin composition using a core-sheath conjugate nozzle, wherein the polyamide-based resin composition has a melt viscosity of 140 Pa·s or less at a set temperature of the core-sheath conjugate nozzle.

[0009] According to one or more embodiments of the present invention, it is possible to provide a core-sheath conjugate fiber for artificial hair in which exposure of the core part is suppressed and that has a touch close to that of human hair and an improved combing property, a hair ornament product including the same, and a method for producing the same.

[0010] According to the production method of one or more embodiments of the present invention, it is possible to obtain a core-sheath conjugate fiber for artificial hair in which exposure of the core part is suppressed and that has a touch close to that of human hair and a good combing property.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. **1** is a schematic view showing a fiber cross section of a core-sheath conjugate fiber for artificial hair according to one or more embodiments of the present invention.

[0012] FIG. **2** is a laser microscopic photograph of a fiber cross section of a fiber of Example 4.

[0013] FIG. **3** is a laser microscopic photograph of a fiber cross section of a fiber of Comparative Example 5.

DETAILED DESCRIPTION

[0014] The inventor of one or more embodiments of the present invention conducted an in-depth research in order to address the above, and found that, in a core-sheath conjugate fiber for artificial hair that has a flat two-lobed cross sectional shape and in which a polyester-based resin composition is used for a core part and a polyamide-based resin composition is used for a sheath part, if the core-to-sheath area ratio is set to a predetermined value and the polyamide-based resin composition used for the sheath part has a melt viscosity of 140 Pa·s or less, deformation of the fiber cross section due to Barus effect is suppressed and exposure of the core part is suppressed, and if a pigment is contained in the polyamide-based resin composition, streak-like asperities are unlikely to be formed on the fiber surface, the gloss peculiar to polyamide can be suppressed, and it is possible to obtain a core-sheath conjugate fiber for artificial hair (hereinafter also simply referred to as a "core-sheath conjugate fiber") having a touch close to that of human hair and a good combing property, and thus one or more embodiments of the present invention were achieved.

[0015] A core-sheath conjugate fiber for artificial hair according to one or more embodiments of the present invention is comprised of a core part and a sheath part and has a flat two-lobed cross sectional shape. In the core-sheath conjugate fiber for artificial hair according to one or more embodiments of the present invention, it is preferable that the core part also has a flat two-lobed cross sectional shape. In the flat two-lobed shape, two lobal portions having a shape selected from the group consisting of a circular shape and an elliptical shape are connected via recessed portions. The circular or elliptical shape does not absolutely have to be a continuous arc, and may also be a substantially circular shape or a substantially elliptical shape that is partially deformed, as long as no acute angle is formed. Furthermore, no consideration needs to be given to asperities with a size of 2 μm or less generated at the outer circumference of the fiber cross section and the outer circumference of the core part due to an additive or the like contained.

[0016] FIG. **1** is a schematic view showing a fiber cross section of a core-sheath conjugate fiber for artificial hair according to one or more embodiments of the present invention. A core-sheath conjugate fiber **1** for artificial hair of this embodiment is comprised of a sheath part **10** and a core part **20**, and the fiber **1** and the core part **20** both have flat two-lobed cross sections in which two elliptical portions are connected via recessed portions.

[0017] In the fiber cross section of the core-sheath conjugate fiber for artificial hair according to one or more embodiments of the present invention, it is preferable that a length (represented by "L") of a major axis of the fiber cross section, which is a straight line with the largest length among an axisymmetric axis and straight lines connecting any two points on the outer circumference of the fiber cross section so as to be in parallel to the axisymmetric axis, and a length (represented by "**S1**") of a first minor axis of the fiber cross section, which is a straight line connecting two points so as to have the largest length when connecting any two points on the outer circumference of the fiber cross section so as to be perpendicular to the major axis of the fiber cross section, satisfy the equation (1) below.

$$L/S1=1.1 \text{ or more and } 2.0 \text{ or less} \qquad (1)$$

[0018] Furthermore, in the fiber cross section, it is preferable that a length (represented by "Lc") of a major axis of the core part cross section, which is a straight line with the largest length among an axisymmetric axis and straight lines connecting any two points on the outer circumference of the core part cross section so as to be in parallel to the axisymmetric axis, and a length (represented by "Sc**1**") of a first minor axis of the core part cross section, which is a straight line connecting two points so as to have the largest length when connecting any two points on the outer circumference of the core part cross section so as to be perpendicular to the major axis of the core part cross section, satisfy the equation (2) below.

$$Lc/Sc1=1.3 \text{ or more and } 2.0 \text{ or less} \qquad (2)$$

[0019] In the fiber cross section of the core-sheath conjugate fiber for artificial hair according to one or more embodiments of the present invention, it is preferable that the center point of the major axis of the core part coincides with the center point of the major axis of the fiber cross section, in which case, the fiber can be kept from having unintended waviness.

[0020] The above-described cross sectional shapes of the fiber and the core part can be controlled by using a nozzle (pores) with a shape close to the target cross sectional shape.

[0021] The core-sheath conjugate fiber for artificial hair having the flat two-lobed fiber cross section has a shape in which two lobal portions having a shape selected from the group consisting of a circular shape and an elliptical shape are connected via recessed portions. Accordingly, there are smooth recessed portions and protrusions on the fiber surface, the area of flat portions in the surface decreases, and thus reflection of light is suppressed and the gloss of the fiber is likely to be close to that of human hair.

[0022] Furthermore, since the fiber surface includes smooth asperities, the area of contact between fibers or between fibers and a comb passed therethrough decreases, and thus it is easy to realize a touch close to that of human hair and a good combing property.

[0023] The core-sheath conjugate fiber for artificial hair has a core-to-sheath area ratio in the range of core: sheath=2:8 to 8:2. If the core-to-sheath area ratio is in this range, the value of bending rigidity, which is a physical property relating to the touch, texture, and the like, is close to that of human hair, and thus a core-sheath conjugate fiber for artificial hair with a quality similar to that of human hair can be obtained. If the ratio of the core part is lower than this range, the bending rigidity value becomes smaller than that of human hair, and thus a core-sheath conjugate fiber for artificial hair with a quality similar to that of human hair cannot be obtained. On the other hand, if the ratio of the core part is higher than this range, the bending rigidity value becomes too large and the quality is not close to that of human hair, and, moreover, the sheath part is so thin that the core part is likely to be exposed. From the viewpoint of obtaining a touch, texture, and the like similar to those of human hair, the core-to-sheath area ratio of the core-sheath conjugate fiber for artificial hair may be in the range of core:sheat=3:7 to 7:3, or 4:6 to 6:4.

[0024] From the viewpoint of suitability for artificial hair, the core-sheath conjugate fiber for artificial hair may have a single fiber fineness of 10 dtex or more and 150 dtex or less, 30 dtex or more and 120 dtex or less, 40 dtex or more and 100 dtex or less, or 50 dtex or more and 90 dtex or less.

[0025] In a mass of the core-sheath conjugate fibers for artificial hair according to one or more embodiments of the present invention, e.g., a fiber bundle of the core-sheath conjugate fibers for artificial hair, all fibers do not necessarily have to have the same fineness and the same cross sectional shape, and fibers having different values of fineness and different cross sectional shapes may be mixed.

[0026] The melt viscosity of a resin composition used for the core part or the sheath part is a value that is measured using the resin composition in the form of pellets dehumidified and dried to have a moisture content of 1000 ppm or less, under conditions of a resin composition sample amount of 20 cc, a piston speed of 200 mm/min, a capillary length of 20 mm, and a capillary diameter of 1 mm, while setting the temperature to the temperature during formation of fibers, that is, the nozzle temperature during spinning.

[0027] In the case where additives such as a pigment and a flame retardant are added, resin and the additives are melt kneaded in advance using an ordinary kneader, and the mixture is pelletized and then used for the measurement of the melt viscosity. For example, a capillary rheometer LCR7000 manufactured by Dynisco is used as the measurement apparatus.

[0028] In the core-sheath conjugate fiber for artificial hair, the melt viscosity of the polyamide-based resin composition at the time of spinning in the production of the artificial fiber is 140 Pa·s or less, and preferably 60 Pa·s or more and 120 Pa·s or less. The cross sectional shape of the core part of the core-sheath conjugate fiber changes depending on viscosities of the resin compositions used for the core part and the sheath part. In particular, when a nozzle having a flat two-lobed shape is used, a polymer is not discharged uniformly with respect to the fiber cross section due to Barus effect, and therefore, the shape of the fiber cross section changes from the shape of the nozzle. It is highly likely that consequently, the cross sectional shape of the core part also changes from the shape of the nozzle. If the polyamide-based resin composition that constitutes the sheath part has a viscosity of 140 Pa·s or less, Barus effect can be suppressed and a core-sheath conjugate fiber that has a cross sectional shape similar to the shape of the nozzle can be stably obtained. If the viscosity of the polyamide-based resin composition that constitutes the sheath part is higher than 140 Pa·s, Barus effect becomes very significant, and the fiber cross section is very significantly deformed from the shape of the nozzle. Therefore, a core-sheath conjugate fiber having the flat two-lobed shape is unlikely to be obtained, and the core component and the sheath component may separate from each other or the core part may be exposed, for example.

[0029] In the core-sheath conjugate fiber for artificial hair, the core part and the sheath part do not have to have the same fineness and the same cross sectional shape, and fibers having different values of fineness and different cross sectional shapes may be mixed. In the fiber cross section of the core-sheath conjugate fiber for artificial hair, it is preferable that the core part is completely covered by the sheath part without being exposed to the fiber surface, in order to prevent the core part and the sheath part from separating from each other.

[0030] In the core-sheath conjugate fiber for artificial hair, the core part is comprised of a polyester-based resin composition that contains a polyester-based resin as a main component, and the sheath part is comprised of a polyamide-based resin composition that contains a polyamide-based resin as a main component and also contains a pigment.

[0031] In one or more embodiments of the present invention, when the total weight of the polyester-based resin composition containing a polyester-based resin as a main component is taken as 100% by weight, the polyester-based resin composition may contain the polyester-based resin in an amount of more than 50% by weight, 70% by weight or more, 80% by weight or more, 90% by weight or more, or 95% by weight or more.

[0032] One or more of polyester-based resins selected from the group consisting of polyalkylene terephthalate and a copolymerized polyester mainly containing polyalkylene terephthalate may be used as the polyester-based resin. In the present disclosure, the "copolymerized polyester mainly containing polyalkylene terephthalate" refers to a copolymerized polyester containing polyalkylene terephthalate in an amount of 80 mol % or more.

[0033] The polyalkylene terephthalate is not particularly limited, and may be, for example, polyethylene terephthalate, polypropylene terephthalate, polybutylene terephthalate, or polycyclohexane dimethylene terephthalate.

[0034] The copolymerized polyester mainly containing polyalkylene terephthalate is not particularly limited, and may be, for example, a copolymerized polyester mainly containing polyalkylene terephthalate such as polyethylene terephthalate, polypropylene terephthalate, polybutylene terephthalate, or polycyclohexane dimethylene terephthalate, and further containing other copolymerizable components.

[0035] Examples of the other copolymerizable components include: polycarboxylic acids such as isophthalic acid, orthophthalic acid, naphthalenedicarboxylic acid, paraphenylenedicarboxylic acid, trimellitic acid, pyromellitic acid, succinic acid, glutaric acid, adipic acid, suberic acid, azelaic acid, sebacic acid, and dodecanedioic acid, and their derivatives; dicarboxylic acids and their derivatives containing sulfonates such as 5-sodiumsulfoisophthalic acid and dihydroxyethyl 5-sodiumsulfoisophthalate; 1,2-propanediol; 1,3-propanediol; 1,4-butanediol; 1,6-hexanediol; neopentyl glycol; 1,4-cyclohexanedimethanol; diethylene glycol; polyethylene glycol; trimethylolpropane; pentaerythritol; 4-hydroxybenzoic acid; ϵ-caprolactone; and an ethylene glycol ether of bisphenol A.

[0036] The copolymerized polyester may be produced by adding a small amount of other copolymerizable components to polyalkylene terephthalate serving as a main component, and allowing them to react with each other, from the viewpoint of stability and ease of operation. Examples of the polyalkylene terephthalate include a polymer of terephthalic acid and/or its derivatives (e.g., methyl terephthalate) and alkylene glycol. The copolymerized polyester may be produced by adding a small amount of monomer or oligomer component serving as other copolymerizable components, to a mixture of terephthalic acid and/or its derivatives (e.g., methyl terephthalate) and alkylene glycol, used for polymerization of polyalkylene terephthalate serving as a main component, and subjecting them to polymerization.

[0037] It is sufficient that the copolymerized polyester has a structure in which the other copolymerizable components are polycondensed on the main chain and/or side chain of polyalkylene terephthalate serving as a main component, and the copolymerization method and the like are not particularly limited.

[0038] Specific examples of the copolymerized polyester mainly containing polyalkylene terephthalate include a polyester obtained through copolymerization of polyethylene terephthalate serving as a main component with one compound selected from the group consisting of an ethylene glycol ether of bisphenol A, 1,4-cyclohexanedimethanol, isophthalic acid, and dihydroxyethyl 5-sodiumsulfoisophthalate.

[0039] The polyalkylene terephthalate and the copolymerized polyester mainly containing polyalkylene terephthalate may be used alone or in a combination of two or more. In particular, polyethylene terephthalate; polypropylene terephthalate; polybutylene terephthalate; a polyester obtained through copolymerization of polyethylene terephthalate serving as a main component with an ethylene glycol ether of bisphenol A; a polyester obtained through copolymerization of polyethylene terephthalate serving as a main component with 1,4-cyclohexanedimethanol; a polyester obtained through copolymerization of polyethylene terephthalate serving as a main component with isophthalic acid; a polyester obtained through copolymerization of polyethylene terephthalate serving as a main component with dihydroxyethyl 5-sodiumsulfoisophthalate, and the like may be used alone or in a combination of two or more.

[0040] The intrinsic viscosity (alternatively referred to as "IV value") of the polyester-based resin is not particularly limited, but may be 0.3 or more and 1.2 or less, or 0.4 or more and 1.0 or less. If the intrinsic viscosity is 0.3 or more, the mechanical strength of the obtained fiber does not decrease, and there is no risk of dripping during a combustion test. On the other hand, if the intrinsic viscosity is 1.2 or less, the molecular weight is not too large, and the melt viscosity is not too high, and thus it is easy to perform melt spinning, and the fineness is likely to be uniform.

[0041] The polyester-based resin composition may further contain other resins in addition to the polyester-based resin. Examples of the other resins include a polyamide-based resin, a vinyl chloride-based resin, a modacrylic-based resin, a polycarbonate-based resin, a polyolefin-based resin, and a polyphenylenesulfide-based resin. These resins may be used alone or in a combination of two or more.

[0042] In one or more embodiments of the present invention, when the total weight of the polyamide-based resin composition containing a polyamide-based resin as a main component is taken as 100% by weight, the polyamide-based resin composition may contain the polyamide-based resin in an amount of more than 50% by weight, 70% by weight or more, 80% by weight or more, 90% by weight or more, or 95% by weight or more.

[0043] The polyamide-based resin used in the present disclosure means a nylon resin obtained through polymerization of one or more selected from the group consisting of lactam, aminocarboxylic acid, a mixture of dicarboxylic acid and diamine, a mixture of a dicarboxylic acid derivative and diamine, and a salt of dicarboxylic acid and diamine.

[0044] Specific examples of the lactam include, but are not particularly limited to, for example, 2-azetidinone, 2-pyrrolidinone, δ-valerolactam, ϵ-caprolactam, enantholactam, capryllactam, undecalactam, and laurolactam. Of these lactams, it is preferable to use ϵ-caprolactam, undecalactam, and laurolactam, and more preferable to use ϵ-caprolactam. These lactams may be used alone or in a combination of two or more.

[0045] Specific examples of the aminocarboxylic acid include, but are not particularly limited to, for example, 6-aminocaproic acid, 7-aminoheptanoic acid, 8-aminooctanoic acid, 9-aminononanoic acid, 10-aminodecanoic acid, 11-aminoundecanoic acid, and 12-aminododecanoic acid. Of these aminocarboxylic acids, it is preferable to use 6-aminocaproic acid, 11-aminoundecanoic acid, and 12-aminododecanoic acid, and more preferable to use 6-aminocaproic acid. These aminocarboxylic acids may be used alone or in a combination of two or more.

[0046] Specific examples of the dicarboxylic acid that can be used for the mixture of dicarboxylic acid and diamine, the mixture of a dicarboxylic acid derivative and diamine, or the salt of dicarboxylic acid and diamine include, but are not particularly limited to, for example: 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 cyclohexane dicarboxylic acid; and aromatic dicarboxylic acids such as phthalic acid, isophthalic acid, terephthalic acid, and naphthalenedicarboxylic acid. Of these dicarboxylic acids, it is preferable to use adipic acid, sebacic acid, dodecanedioic acid, terephthalic acid, and isophthalic acid, and more preferable to use adipic acid, terephthalic acid, and isophthalic acid. These dicarboxylic acids may be used alone or in a combination of two or more.

[0047] Specific examples of the diamine that can be used for the mixture of dicarboxylic acid and diamine, the mixture of a dicarboxylic acid derivative and diamine, or the salt of dicarboxylic acid and diamine include, but are not particularly limited to, for example: aliphatic diamines such as 1,4-diaminobutane, 1,5-diaminopentane, 1,6-diaminohexane, 2-methyl-1,5-diaminopentane (MDP), 1, 7-diaminoheptane, 1,8-diaminooctane, 1,9-diaminononan, 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, and 1,20-diaminoeicosane; alicyclic diamines such as cyclohexanediamine and bis-(4-aminohexyl)methane; and aromatic diamines such as m-xylylenediamine and p-xylylenediamine. Of these diamines, it is preferable to use an aliphatic diamine, and more preferable to use hexamethylenediamine. These diamines may be used alone or in a combination of two or more.

[0048] The polyamide-based resin (alternatively referred to as a "nylon resin") is not particularly limited, but it is preferable to use, for example, Nylon 6, Nylon 66, Nylon 11, Nylon 12, Nylon 6/10, Nylon 6/12, semi-aromatic nylon containing the Nylon 6T and/or 61 unit, copolymers of these nylon resins, or the like. It is more preferable to use Nylon 6, Nylon 66, or a copolymer of Nylon 6 and Nylon 66.

[0049] The polyamide-based resin can be produced for example, using a polyamide-based resin polymerization method in which a raw material for the polyamide-based resin is heated in the presence or absence of a catalyst. During the polymerization, stirring may or may not be performed, but it is preferable to perform stirring in order to obtain a uniform product. The polymerization temperature can be set as appropriate according to the degree of polymerization, the reaction yield, and the reaction time of a target polymer, but it is preferable to set the temperature to a low temperature in consideration of the quality of a finally obtained polyamide-based resin. The reaction ratio can also be set as appropriate. The pressure is not limited, but it is preferable to reduce the pressure in the system in order to efficiently let volatile components move to the outside of the system.

[0050] The polyamide-based resin used in one or more embodiments of the present invention may have a terminal end that is capped by an end-capping agent such as a carboxylic acid compound or an amine compound as necessary. The concentration of terminal amino groups or terminal carboxyl groups in a nylon resin obtained when a terminal end is capped by adding monocarboxylic acid and/or monoamine is lower than that when such an end-capping agent is not used. On the other hand, the total concentration of terminal amino groups and terminal carboxyl groups does not change when a terminal end is capped by dicarboxylic acid or diamine, but the concentration ratio between terminal amino groups and terminal carboxyl groups changes.

[0051] Specific examples of the carboxylic acid compound include, but are not particularly limited to, for example: aliphatic monocarboxylic acids such as acetic acid, propionic acid, butyric acid, valeric acid, caproic acid, enanthic acid, caprylic acid, pelargonic acid, undecanoic acid, lauric acid, tridecanoic acid, myristic acid, myristoleic acid, palmitic acid, stearic acid, oleic acid, linoleic acid, and arachic acid; alicyclic monocarboxylic acids such as cyclohexanecarboxylic acid and methylcyclohexanecarboxylic acid; aromatic monocarboxylic acids such as benzoic acid, toluic acid, ethylbenzoic acid, and phenylacetic acid; 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, isophthalic acid, terephthalic acid, and naphthalenedicarboxylic acid.

[0052] Specific examples of the amine compound include, but are not particularly limited to, for example: aliphatic monoamines such as butylamine, pentylamine, hexylamine, heptylamine, octylamine, 2 -ethylhexylamine, nonylamine, decylamine, undecylamine, dodecylamine, tridecylamine, tetradecylamine, pentadecylamine, hexadecylamine, octadecylamine, nonadecylamine, and icosylamine; alicyclic monoamines such as cyclohexylamine and methylcyclohexylamine; aromatic monoamines such as benzylamine and β-phenylethylamine; aliphatic diamines such as 1,4-diaminobutane, 1,5-diaminopentane, 1,6-diaminohexane, 1,7-diaminoheptane, 1,8-diaminooctane, 1,9-diaminononan, 1,10-diaminodecane, 1,11-diaminoundecane, 1,12-diaminododecane, 1,13-diaminotridecane, 1,14-diaminotetradecane, 1,15-diamino pentadecane, 1,16-diaminohexadecane, 1,17-diaminoheptadecane, 1,18-diaminooctadecane, 1,19-diaminononadecane, and 1,20-diaminoeicosane; alicyclic diamines such as cyclohexanediamine and bis-(4-aminohexyl)methane; and aromatic diamines such as xylylenediamine.

[0053] The terminal group concentration of the polyamide-based resin is not particularly limited, but the terminal amino group concentration may be high, for example, when it is necessary to increase the dyeability for fiber uses or when designing a material suitable for alloying for resin uses. On the other hand, the terminal amino group concentration may be low, for example, when it is required to suppress coloring or gelation under extended aging conditions. Furthermore, the terminal carboxyl group concentration and the terminal amino group concentration may be both low when it is required to suppress reproduction of lactam during re-melting, yarn breakage during melt spinning due to production of oligomer, mold deposit during continuous injection molding, and generation of die marks during continuous extrusion of a film. It is preferable to adjust the terminal group concentration according to the applications, but the terminal amino group concentration and the terminal carboxyl group concentration both may be 1.0×10^{-5} to 15.0×10^{-5} eq/g, 2.0×10^{-5} to 12.0×10^{-5} eq/g, or 3.0×10^{-5} to 11.0×10^{-5} eq/g.

[0054] Furthermore, the end-capping agent may be added using a method in which the end-capping agent is added simultaneously with raw materials such as caprolactam at the initial stage of polymerization, a method in which the end-capping agent is added during polymerization, a method in which the end-capping agent is added when a nylon resin in a molten state is caused to pass through a vertical stirring thin-film evaporator, or the like. The end-capping agent may be added without any treatment, or in the form of being dissolved in a small amount of solvent.

[0055] The polyamide-based resin composition may contain other resins in addition to the polyamide-based resin. Examples of the other resins include a vinyl chloride-based resin, a modacrylic-based resin, a polycarbonate-based resin, a polyolefin-based resin, and a polyphenylenesulfide-based resin. These resins may be used alone or in a combination of two or more.

[0056] From the viewpoint of obtaining a touch and appearance closer to those of human hair and further improving curling properties and curl retention properties, it is preferable that the core part of the core-sheath conjugate fiber for artificial hair is comprised of a polyester-based resin composition containing, as a main component, one or more of polyester-based resins selected from the group consisting of polyalkylene terephthalate and a copolymerized polyester mainly containing polyalkylene terephthalate, and it is more preferable that the sheath part of the core-sheath conjugate fiber for artificial hair is comprised of a polyamide-based resin composition containing, as a main component, a polyamide-based resin mainly containing at least one selected from the group consisting of Nylon 6 and Nylon 66. In the present disclosure, the “polyamide-based resin mainly containing at least one selected from the group consisting of Nylon 6 and Nylon 66” means a polyamide-based resin that contains Nylon 6 and/or Nylon 66 in an amount of 80 mol % or more.

[0057] In one or more embodiments of the present invention, the sheath part is comprised of a polyamide-based resin composition that contains a pigment, in which case, streak-like asperities are unlikely to be formed on the fiber surface, and it is possible to suppress the gloss peculiar to polyamide and obtain a good touch and a good combing property. Moreover, it is possible to obtain a core-sheath fiber for artificial hair having a desired color.

[0058] Depending on solidification conditions of the polyamide-based resin during spinning, streak-like asperities are formed on the fiber surface due to spherulites, and the touch and the combing property are impaired. However, when a pigment is contained in the polyamide-based resin composition and the polyamide-based resin composition has a melt viscosity of 140 Pa·s or less, the growth of spherulites, which occurs on the surface of the polyamide-based resin when the resin is solidified during spinning, is hindered and streak-like asperities are not formed on the fiber surface, and thus it is possible to obtain a core-sheath conjugate fiber for artificial hair that has a smooth surface, a good touch, and a good combing property.

[0059] The pigment is not particularly limited, and an ordinary pigment such as carbon black or an anthraquinone-based pigment can be used, for example. It is also possible to use a pigment masterbatch. The pigment masterbatch is obtained by kneading and pelletizing (which may be referred to as "compounding") a pigment and a resin composition using a kneader such as an extruder, wherein the pigment, which is typically difficult to handle due to its fine powder form, is dispersed in advance in the resin composition, and thus it is possible to easily handle the pigment and to suppress color spots of the obtained fiber.

[0060] Furthermore, in the core-sheath conjugate fiber for artificial hair, which is required to have a large number of colors, it is preferable to use several specific types of pigment masterbatches and adjust the addition ratio of the masterbatches to obtain a fiber that is spun-dyed to have a desired color, from the viewpoint of simplifying the production and reducing the pigment inventory cost. In particular, it is preferable to use at least one of three types of pigment masterbatches of black, red, and yellow. Furthermore, it is preferable to use a plurality of pigment masterbatches at a prescribed ratio to obtain a fiber with a desired color. For example, if a pigment having a concentration of 20% by weight obtained by blending pigment masterbatches at the ratio of black:red:yellow=10:60:30 (parts by weight) is added in an amount of 2.0 parts by weight with respect to 100 parts by weight of the polyamide-based resin, it is possible to obtain a brown conjugate fiber for artificial hair.

[0061] From the viewpoint of further improving the touch and the combing property, it is preferable that the polyamide-based resin composition may contain a pigment in an amount of 0.005 parts by weight or more and 2 parts by weight or less, or 0.01 parts by weight or more and 1 part by weight or less, with respect to 100 parts by weight of the polyamide-based resin, although there is no particular limitation thererto.

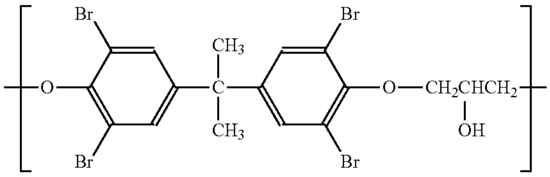
[0062] Note that the polyester-based resin composition constituting the core part may also contain a pigment, and a pigment similar to that used for the sheath part may be used for the core part. The pigment may be used in an amount of 0.005 parts by weight or more and 2 parts by weight or less with respect to 100 parts by weight of the polyester-based resin.

[0063] In one or more embodiments of the present invention, a flame retardant may also be used from the viewpoint of flame retardance. Examples of the flame retardant include a bromine-containing flame retardant and a phosphorus-containing flame retardant.

[0064] Examples of the phosphorus-containing flame retardant include a phosphoric acid ester amide compound and an organic cyclic phosphorus-based compound. Examples of the bromine-based flame retardant include, but are not particularly limited to, for example: a brominated epoxy-based flame retardant; bromine-containing phosphoric acid esters such as pentabromotoluene, hexabromobenzene, decabromodiphenyl, decabromodiphenyl ether, bis(tribromophenoxy)ethane, tetrabromophthalic anhydride, ethylene bis(tetrabromophthalimide), ethylene bis(pentabromophenyl), octabromotrimethylphenylindan, and tris(tribromoneopentyl)phosphate; brominated polystyrenes; brominated polybenzyl acrylates; a brominated phenoxy resin; brominated polycarbonate oligomers; tetrabromobisphenol A and tetrabromobisphenol A derivatives such as tetrabromobisphenol A-bis(2,3-dibromopropyl ether), tetrabromobisphenol A-bis(allylether), and tetrabromobisphenol A-bis (hydroxyethyl ether); bromine-containing triazine compounds such as tris(tribromophenoxy)triazine; and bromine-containing isocyanuric acid compounds such as tris(2, 3-dibromopropyl)isocyanurate. In particular, it is preferable to use a brominated epoxy-based flame retardant from the viewpoint of heat resistance and flame retardance.

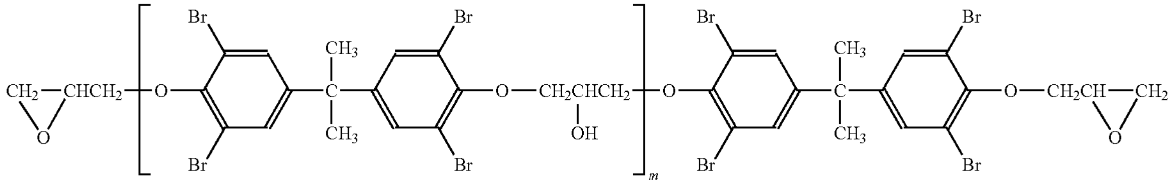
[0065] A brominated epoxy-based flame retardant having an epoxy group or tribromophenol at a molecular end thereof may be used as a raw material. The structure of the brominated epoxy-based flame retardant after melt kneading is not particularly limited, but it is preferable that 80 mol % or more of the structure is comprised of a constituent unit represented by the chemical formula (1) below when the total number of constituent units each represented by the chemical formula (1) below and constituent units obtained by at least partially modifying the chemical formula (1) below is taken as 100 mol %. The structure of the brominated epoxy-based flame retardant may change at a molecular end thereof after melt kneading. For example, a molecular end of the brominated epoxy-based flame retardant may be substituted by a hydroxyl group, a phosphate group, a phosphoric acid group, or the like other than an epoxy group or tribromophenol, or may be bound to a polyester component through an ester group.

(1)



[0066] Furthermore, part of the structure of the brominated epoxy-based flame retardant, other than the molecular end, may be changed. For example, the brominated epoxy-based flame retardant may have a branched structure in which the secondary hydroxyl group and the epoxy group are bound. Also, part of the bromine of the chemical formula (1) may be eliminated or added, as long as the bromine content in the molecules of the brominated epoxy-based flame retardant does not change significantly.

[0067] For example, a polymeric brominated epoxy-based flame retardant as represented by the general formula (2) below may be used as the brominated epoxy-based flame retardant. In the general formula (2) below, m is 1 to 1000. Examples of the polymeric brominated epoxy-based flame retardant represented by the general formula (2) below include a commercially available product such as a brominated epoxy-based flame retardant (product name "SR-T2MP") manufactured by Sakamoto Yakuhin Kogyo Co., Ltd.



(2)

[0068] For example, the bromine-based epoxy flame retardant may be contained in an amount of 5 parts by weight or more and 40 parts by weight or less with respect to 100 parts by weight of the main component resin, although there is no particular limitation thereto. From the viewpoint of heat resistance and flame retardance, it is preferable that the core part is comprised of a polyester-based resin composition containing 100 parts by weight of one or more of polyester resins selected from the group consisting of polyalkylene terephthalate and a copolymerized polyester mainly containing polyalkylene terephthalate and 5 parts by weight or more and 40 parts by weight or less of the bromine-based epoxy flame retardant, and the sheath part is comprised of a polyaniide-based resin composition containing 100 parts by weight of a polyaniide-based resin mainly containing at least one selected from the group consisting of Nylon 6 and Nylon 66 and 5 parts by weight or more and 40 parts by weight or less of the bromine-based epoxy flame retardant.

[0069] In one or more embodiments of the present invention, a flame retardant auxiliary may also be used. The flame retardant auxiliary is not particularly limited, but from the viewpoint of flame retardance, it is preferable to use an antimony-based compound or a composite metal including antimony, for example. Examples of the antimony-based compound include antimony trioxide, antimony tetraoxide, antimony pentoxide, sodium antimonate, potassium antimonate, and calcium antimonate. It is more preferable to use one or more selected from the group consisting of antimony trioxide, antimony pentoxide, and sodium antimonate, from the viewpoint of improving the flame retardance and the influence on a touch.

[0070] For example, it is preferable that the flame retardant auxiliary is contained in an amount of 0.1 parts by weight or more and 10 parts by weight or less with respect to 100 parts by weight of the main component resin, although there is no particular limitation thereto.

[0071] In particular, when the polyamide-based resin composition constituting the sheath part contains the flame retardant auxiliary, appropriate asperities are formed on the surface of the fiber, and a core-sheath conjugate fiber for artificial hair having an appearance with a low gloss close to that of human hair as well as flame retardance is likely to be obtained.

[0072] As necessary, the core-sheath conjugate fiber for artificial hair may contain various types of additives such as a heat-resistant agent, a stabilizer, a fluoresces, an antioxidant, and an antistatic agent within a range that does not inhibit the effects of one or more embodiments of the present invention.

[0073] It is possible to produce the core-sheath conjugate fiber for artificial hair by melt-kneading each of the resin compositions that respectively constitute the core and the sheath using various types of ordinary kneaders, and then performing melt spinning using a core-sheath conjugate nozzle. For example, a core component is prepared by dry blending components such as the above-described polyester-based resin and the brominated epoxy-based flame retardant, and melt-kneading the obtained polyester-based resin composition using any of various ordinary kneaders. On the other hand, a sheath component is prepared by dry blending components such as the above-described polyamide-based resin, the pigment, and the brominated epoxy-based flame retardant, and melt-kneading the obtained polyamide-based resin composition using any of various ordinary kneaders. The core-sheath conjugate fiber can be produced by melt spinning the core component and the sheath component using a core-sheath conjugate spinning nozzle. Examples of the kneaders include a single-screw extruder, a twin-screw extruder, a roll, a Banbury mixer, and a kneader. Of these kneaders, it is preferable to use a twin-screw extruder from the viewpoint of adjusting the kneading degree and easily performing the operation.

[0074] A melt spinning method may be used as the method for producing the fiber of one or more embodiments of the present invention, and, for example, in the case of a polyester-based resin composition, melt spinning is performed while the temperatures of an extruder, a gear pump, a nozzle, and the like are set to 250° C. or more and 300° C. or less, and in the case of a polyamide-based resin composition, melt spinning is performed while the temperatures of an extruder, a gear pump, a nozzle, and the like are set to 260° C. or more and 320° C. or less, after which the extruded yarns are cooled to a temperature not higher than the glass transition points of the resins, and wound up at a speed of 50 m/min or more and 5000 m/min or less, and thus extruded yarns (undrawn yarns) are obtained.

[0075] Specifically, during the melt spinning, the polyester-based resin composition that constitutes the core part is supplied from a core-part extruder of a melt spinning machine, the polyamide-based resin composition that constitutes the sheath part is supplied from a sheath-part extruder of the melt spinning machine, and a molten polymer is discharged from a core-sheath conjugate spinning nozzle (pores) having a predetermined shape, and thus extruded yarns (undrawn yarns) are obtained. Here, the melt viscosity of the polyamide-based resin composition at the set temperature of the core-sheath conjugate nozzle needs to be 140 Pa·s or less. In this case, it is possible to suppress deformation of the fiber cross section due to Barus effect, and to stably obtain a core-sheath conjugate fiber having a cross sectional shape similar to the shape of the nozzle.

[0076] It is preferable that the extruded yarns (undrawn yarns) are hot drawn. The drawing may be performed by either a two-step method or a direct drawing method. In the two-step method, the extruded yarns are wound once, and then drawn. In the direct drawing method, the extruded yarns are drawn continuously without winding. The hot drawing may be performed by a single-stage drawing method or a multi-stage drawing method that includes two or more stages.

[0077] The heating means for the hot drawing may be a heating roller, a heat plate, a steam jet apparatus, a hot water bath, or the like, which can be used in combination as desired.

[0078] It is also possible to make the touch and texture closer to those of human hair, by adding an oil solution such as a fiber treating agent and a softener to the core-sheath conjugate fiber for artificial hair. Examples of the fiber treating agent include a silicone-based fiber treating agent and a non-silicone-based fiber treating agent for improving the touch and the combing property.

[0079] The core-sheath conjugate fiber for artificial hair may be subjected to gear crimping. In this case, it is possible to make the fiber gently curved and have a natural appearance, and to reduce the contact between fibers, thereby improving the combing property. In the gear crimping, typically, a fiber heated to the softening temperature or more is caused to pass through a portion between two meshing gears, so that the shape of the gears is transferred to the fiber, and the fiber is thus curved. Furthermore, as necessary, it is also possible to make a fiber curled in different shapes by heat-treating the core-sheath conjugate fiber for artificial hair at different temperatures during the fiber treatment processes.

[0080] The core-sheath conjugate fiber for artificial hair can be used for hair ornament products without particular limitation. For example, it is possible to use the core-sheath conjugate fiber for hair wigs, hairpieces, weaving hair, hair extensions, braided hair, hair accessories, doll hair, and the like.

[0081] The hair ornament product may be constituted only by the core-sheath conjugate fiber for artificial hair of one or more embodiments of the present invention. Alternatively, the hair ornament product may be comprised of the core-sheath conjugate fiber for artificial hair of one or more embodiments of the present invention combined with other fibers for artificial hair and natural fibers such as human hair and animal hair.

EXAMPLES

[0082] Hereinafter, one or more embodiments of the present invention will be more specifically described by way of examples. Note that one or more embodiments of the present invention are not limited to these examples.

[0083] The measuring methods and the evaluation methods used in the examples and comparative examples are as follows.

Melt Viscosity

[0084] The melt viscosity of a resin composition in the form of pellets that were used for the core part or the sheath part and dried to have a moisture content of 1000 ppm or less was measured under conditions of a sample amount of 20 cc, a piston speed of 200 mm/min, a capillary length of 20 mm, and a capillary diameter of 1 mm, while setting the temperature to the temperature during formation of fibers, i.e., the nozzle temperature during spinning.

Single Fiber Fineness

[0085] The measurement was performed using an autovibro type fineness measuring apparatus “Denier Computer type DC-11” (manufactured by Search), and an average of measured values of 30 samples was calculated and taken as the single fiber fineness.

Evaluation of Core Part Exposure

[0086] Fibers were bundled at room temperature (23° C.) and fixed with a shrinkage tube such that the fiber bundle was not displaced, after which the bundle was cut using a cutter, and whether or not the core part was exposed was evaluated through visual observation or evaluated by observing cross sections of the cut fibers using a laser microscope (“VK-9500” manufactured by Keyence Corporation).

Shape of Fiber Cross Section

[0087] Fibers were bundled at room temperature (23° C.) and fixed with a shrinkage tube such that the fiber bundle was not displaced, after which the fiber bundle was cut in round slices using a cutter, and thus a fiber bundle for cross section observation was prepared. An image of this fiber bundle was captured using a laser microscope (“VK-9500” manufactured by Keyence Corporation) at a magnification of 500 times, and thus a photograph of a fiber cross section was obtained. L/S**1** and Lc/Sc**1** were obtained based on the photograph of the fiber cross section.

Touch

[0088] Sensory evaluation by professional hairstylists was performed in four stages below.

[0089] A: Very good touch similar to that of human hair

[0090] B: Good touch although it is slightly poor compared with that of human hair

[0091] C: Bad touch that is poor compared with that of human hair

[0092] D: Bad touch that is significantly poor compared with that of human hair

Combing Property

[0093] Fibers whose curls were completely stretched were cut to have a length of 63.5 cm, and 5.0 g of thus obtained fibers with a fiber length of 63.5 cm was bundled. Subsequently, the fiber bundle was bound with a string at the middle thereof, folded in half, and fixed at the string portion, and thus a fiber bundle for hair iron treatment was prepared. Next, the fiber bundle was heated and crimped five times from the root at which the fiber bundle was fixed to the ends, using a hair iron (“Izunami ITC450 flat iron” manufactured by Izunami. Inc, U.S.) heated to 180° C., and thus a fiber bundle for combing property evaluation was prepared. Subsequently, a comb for combing hair (“Matador Professional 386.8 1/2F” made in Germany) was passed through the fiber bundle for combing property evaluation 100 times from the root at which the fiber bundle was fixed to the ends, the combing property was evaluated according to the following criteria based on the number of fibers deformed or split, and if the evaluation result was level B or higher, the combing property was taken as acceptable.

[0094] A: Number of fibers deformed or split after a comb is passed through the fibers 100 times is less than 10, and the comb can be passed through the fibers to the ends without resistance.

[0095] B: Number of fibers deformed or split after a comb is passed through the fibers 100 times is 10 or more and less than 30, and the comb can be passed through the fibers although the resistance somewhat significantly increases during the passing process.

[0096] C: Number of fibers deformed or split after a comb is passed through the fibers 100 times is 30 or more and less than 100, and the comb cannot be passed through the fibers once or more and less than 20 times due to the resistance having increased during the passing process.

[0097] D: Number of fibers deformed or split after a comb is passed through the fibers 100 times is 100 or more, and the comb cannot be passed through the fibers 20 times or more due to the resistance having increased during the passing process.

Example 1

[0098] 20 parts by weight of a brominated epoxy-based flame retardant (product name "SR-T2MP" manufactured by Sakamoto Yakuhin Kogyo Co., Ltd.), 2 parts by weight of sodium antimonate (product name "SA-A' manufactured by NIHON SEIKO CO., LTD.), 2.1 parts by weight of a black pigment masterbatch (product name TESM22367BLACK (20)" manufactured by Dainichiseika Color & Chemicals Mfg. Co., Ltd., pigment: 20% by weight, base resin: polyester-based resin), 0.8 parts by weight of a yellow pigment masterbatch (product name "PESM1001YELLOW (20)" manufactured by Dainichiseika Color & Chemicals Mfg. Co., Ltd., pigment: 20% by weight, base resin: polyester-based resin), and 0.6 parts by weight of a red pigment masterbatch (product name

[0099] "PESM3005RED (20)" manufactured by Dainichiseika Color & Chemicals Mfg. Co., Ltd., pigment: 20% by weight, base resin: polyester-based resin) were added with respect to 100 parts by weight of polyethylene terephthalate pellets (product name "DFG1" manufactured by Bell Polyester Products, Inc., hereinafter also referred to as "PET"), the mixture was dry blended, then supplied to a twin-screw extruder, melt-kneaded at a barrel setting temperature of 280° C., and pelletized, and thus a polyester-based resin composition was obtained.

[0100] Next, 2.1 parts by weight of a black pigment masterbatch (product name "PESM22367BLACK (20)" manufactured by Dainichiseika Color & Chemicals Mfg. Co., Ltd.), 0.8 parts by weight of a yellow pigment masterbatch (product name

[0101] "PESM1001YELLOW (20)" manufactured by Dainichiseika Color & Chemicals Mfg. Co., Ltd.), and 0.6 parts by weight of a red pigment masterbatch (product name "PESM3005RED (20)" manufactured by Dainichiseika Color & Chemicals Mfg. Co., Ltd.) were added with respect to 100 parts by weight of Nylon 66 (product name "AMILAN CM3001" manufactured by Toray Industries, Inc., hereinafter also referred to as "PA66"), the mixture was dry blended, then supplied to a twin-screw extruder, melt-kneaded at a barrel setting temperature of 280° C., and pelletized, and thus a polyamide-based resin composition was obtained.

[0102] Next, the polyester-based resin composition and the polyamide-based resin composition in the form of pellets were supplied to extruders, extruded from a core-sheath conjugate spinning nozzle (pores) at a set temperature of 280° C. having a nozzle shape shown in Table 1 below, and wound up at a speed of 40 to 200 m/min, and thus undrawn yarns of core-sheath conjugate fibers each including a core part comprised of the polyester-based resin composition and a sheath part comprised of the polyamide-based resin composition and having a core-to-sheath area ratio of 5:5 were obtained.

[0103] The obtained undrawn yarns were drawn to 3 times while being wound up at a speed of 45 m/min using a heat roll at 85° C., and subsequently heat-treated by being wound up at a speed of 45 m/min using a heat roll heated to 200° C. After application of a polyether-based oil solution (product name "KWC-Q" manufactured by Marubishi Oil Chemical Corporation) in an amount of 0.20% omf (by oil pure weight percentage with respect to the dry fiber weight), the yarns were dried, and thus a core-sheath conjugate fiber having a single fiber fineness shown in Table 1 below was obtained.

Example 2

[0104] A core-sheath conjugate fiber was obtained in a similar way to that of Example 1, except that the resin used for the core part was changed to polyethylene terephthalate pellets (EastPET product name "A-12" manufactured by East West Chemical Private

[0105] Limited), the resin used for the sheath part was changed to Nylon 6 (product name "A1030BRL" manufactured by UNITIKA LTD., hereinafter also referred to as "PM"), the barrel setting temperature during pelletization was changed to 260° C., the nozzle setting temperature was changed to 270° C., and the core-to-sheath area ratio was changed to 8:2.

Example 3

[0106] A core-sheath conjugate fiber was obtained in a similar way to that of Example 1, except that the resin used for the core part was changed to polybutylene terephthalate pellets (product name "NOVADURAN 5020" manufactured by Mitsubishi Chemical Corporation, hereinafter also referred to as "PBT"), the barrel setting temperature during pelletization was changed to 260° C., the resin used for the sheath part was changed to Nylon 6 (product name "A1030BRL" manufactured by UNITIKA LTD.), the barrel setting temperature during pelletization was changed to 260° C., and the nozzle setting temperature was changed to 260° C.

Example 4

[0107] A core-sheath conjugate fiber was obtained in a similar way to that of Example 2, except that the core-to-sheath area ratio was changed to 5:5 and the sheath part was comprised of a polyamide-based resin composition obtained by adding 20 parts by weight of a brominated epoxy-based flame retardant (product name "SR-T2MP" manufactured by Sakamoto Yakuhin Kogyo Co., Ltd.), 2 parts by weight of sodium antimonate (product name "SA-A" manufactured by NIHON SEIKO CO., LTD.), 2.1 parts by weight of a black pigment masterbatch (product name "PESM22367BLACK (20)" manufactured by Dainichiseika

Color & Chemicals Mfg. Co., Ltd.), 0.8 parts by weight of a yellow pigment masterbatch (product name “PESM1001YELLOW (20)” manufactured by Dainichiseika Color & Chemicals Mfg. Co., Ltd.), and 0.6 parts by weight of a red pigment masterbatch (product name “PESM3005RED (20)” manufactured by Dainichiseika Color & Chemicals Mfg. Co., Ltd.) with respect to 100 parts by weight of Nylon 6 (product name “A1030BRL” manufactured by UNITIKA LTD.), dry blending the mixture, then supplying the mixture to a twin-screw extruder, melt-kneading the mixture at a barrel setting temperature of 260° C., and pelletizing the mixture.

Example 5

[0108] A core-sheath conjugate fiber was obtained in a similar way to that of Example 4, except that the resin used for the core part was changed to polyethylene terephthalate pellets (product name “DFG1” manufactured by Bell Polyester Products, Inc.), and the extruded yarn was cooled for 1 second using a water bath at 20° C. right after the resins were extruded from the spinning nozzle.

Example 6

[0109] A core-sheath conjugate fiber was obtained in a similar way to that of Example 4, except that the resin used for the sheath part was changed to Nylon 66 (product name **[0110]** “AMILAN CM3001” manufactured by Toray Industries, Inc.), the barrel setting temperature during pelletization was changed to 280° C., the nozzle setting temperature was changed to 280° C., and the core-to-sheath area ratio was changed to 2:8.

Comparative Example 1

[0111] A core-sheath conjugate fiber was obtained in a similar way to that of Example 2, except that the resin used for the sheath part was changed to Nylon 6 (product name “A1030BRT” manufactured by UNITIKA LTD.).

Comparative Example 2

[0112] A core-sheath conjugate fiber was obtained in a similar way to that of Example 2, except that the core-to-sheath area ratio was changed to 9:1.

Comparative Example 3

[0113] A core-sheath conjugate fiber was obtained in a similar way to that of Example 2, except that the sheath part was comprised of a polyamide-based resin composition obtained by supplying Nylon 6 (product name “A1030BRL” manufactured by UNITIKA **[0114]** LTD.) to a twin-screw extruder, melt-kneading the resin at a barrel setting temperature of 260° C., and pelletizing the resin, and the extruded yarn was cooled for 1 second using a water bath at 20° C. right after the resins were extruded from the spinning nozzle.

Comparative Example 4

[0115] A core-sheath conjugate fiber was obtained in a similar way to that of Example 6, except that the resin used for the core part was changed to polyethylene terephthalate pellets (product name “DFG1” manufactured by Bell Polyester Products, Inc.), the resin used for the sheath part was changed to Nylon 66 (product name “Zyte142A” manufactured by DuPont), and the core-to-sheath area ratio was changed to 8:2.

Comparative Example 5

[0116] A core-sheath conjugate fiber was obtained in a similar way to that of Example 4, except that the cross sectional shape was changed as shown in Table 1.

Comparative Example 6

[0117] A core-sheath conjugate fiber was obtained in a similar way to that of Example 6, except that the core-to-sheath area ratio was changed to 5:5 and the sheath part was comprised of a polyamide-based resin composition obtained by adding 20 parts by weight of a brominated epoxy-based flame retardant (product name “SR-T2MP” manufactured by Sakamoto Yakuhin Kogyo Co., Ltd.) and 2 parts by weight of sodium antimonate (product name “SA-A” manufactured by NIHON SEIKO CO., LTD.) with respect to 100 parts by weight of Nylon 66 (product name “AMILAN CM3001” manufactured by Toray Industries, Inc.), dry blending the mixture, then supplying the mixture to a twin-screw extruder, melt-kneading the mixture at a barrel setting temperature of 280° C., and pelletizing the mixture.

Comparative Example 7

[0118] A core-sheath conjugate fiber was obtained in a similar way to that of Example 4, except that the core-to-sheath area ratio was changed to 1:9.

[0119] With respect to the fibers of the examples and the comparative examples, whether or not the core part was exposed and the cross sectional shape were observed and evaluated as described above. Also, the touch and the combing property of the fibers of the examples and the comparative examples were evaluated as described above. The results are shown in Table 1.

TABLE 1

	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Com. Ex. 1	Com. Ex. 2	Com. Ex. 3	Com. Ex. 4	Com. Ex. 5	Com. Ex. 6	Com. Ex. 7
Nozzle shape (fiber)	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Circular	Flat two-lobed	Flat two-lobed
Nozzle shape (core part)	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Circular	Flat two-lobed	Flat two-lobed
Main component resin (core)	PET	PET	PBT	PET	PET	PET	PET	PET	PET	PET	PET	PET	PET
Main component resin (sheath)	PA66	PA6	PA6	PA6	PA6	PA66	PA6	PA6	PA6	PA66	PA6	PA66	PA6

TABLE 1-continued

	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Com. Ex. 1	Com. Ex. 2	Com. Ex. 3	Com. Ex. 4	Com. Ex. 5	Com. Ex. 6	Com. Ex. 7
Flame retardant addition (sheath)	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes
Pigment addition (sheath)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Pigment addition amount (sheath) (parts by weight)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.7	0.7	0.0	0.7
Core-to-sheath ratio (area ratio)	5:5	8:2	5:5	5:5	5:5	2:8	8:2	9:1	8:2	8:2	5:5	5:5	1:9
Nozzle temperature (° C.)	280	270	260	270	270	280	270	270	270	280	270	280	270
Melt viscosity of core part resin composition (Pa · s)	406	162	173	162	464	142	162	162	162	406	162	142	162
Melt viscosity of sheath part resin composition (Pa · s)	72	81	89	113	113	98	158	81	81	214	113	98	113
Single fiber fineness (dtex)	58	63	58	58	58	54	63	65	63	63	58	58	52
Cross sectional shape (fiber)	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Circular	Flat two-lobed	Flat two-lobed
Cross sectional shape (core part)	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Flat two-lobed	Elliptical	Flat two-lobed	Flat two-lobed	Elliptical	Circular	Flat two-lobed	Flat two-lobed
L/S1	1.2	1.3	1.2	1.2	1.3	1.1	1.3	1.3	1.3	1.4	1.0	1.2	1.1
Lc/Sc1	1.6	1.5	1.6	1.6	1.6	1.7	1.6	1.4	1.5	1.6	1.2	1.6	1.7
Cross section photograph	—	—	—	FIG. 2	—	—	—	—	—	—	FIG. 3	—	—
Exposure of core part	No	No	No	No	No	No	Yes	Yes	No	Yes	No	No	No
Touch	A	B	B	A	A	B	C	D	C	D	C	C	C
Combing property	B	B	A	B	B	A	C	D	C	C	D	C	A

[0120] FIG. **2** is a laser microscopic photograph of a fiber cross section of the fiber of Example 4. As can be seen from FIG. **2**, in the core-sheath conjugate fiber for artificial hair, the fiber and the core part both have flat two-lobed cross sectional shapes. FIG. **3** is a laser microscopic photograph of a fiber cross section of the fiber of Comparative Example 5. As shown in FIG. **3**, in the core-sheath conjugate fiber for artificial hair, the fiber and the core part both have substantially circular cross sectional shapes.

[0121] As can be seen from Table 1, in the fibers of Examples 1 to 6, the core part was not exposed, and the fibers had a touch close to that of human hair and a good combing property.

[0122] On the other hand, in the cases of the fibers of Comparative Examples 1 and 4 in which the polyamide-based resin composition used for the sheath part had a viscosity higher than 140 Pa·s, the core part was exposed, and the touch and the combing property were impaired. In the case of the fiber of Comparative Example 2, the core part was exposed to the fiber surface because the ratio of the sheath part was too low, the touch and the combing property were both very bad, and the fiber could not be formed favorably. In the cases of the fibers of Comparative Examples 3 and 6 in which no pigment was added to the sheath part, streak-like asperities were formed on the fiber surface due to spherulites during spinning, and accordingly, the touch and the combing property were both impaired. In the case of the fiber of Comparative Example 5 having a circular cross section, the fiber surface did not include asperities, and therefore, the appearance of the fiber was unnatural, and the touch and the combing property were both bad. The fiber of Comparative Example 7 lacked firmness because the ratio of the core component was too low, and the fiber could not have a touch close to that of human hair.

LIST OF REFERENCE NUMERALS

[0123] **1** Core-sheath conjugate fiber for artificial hair (cross section)

[0124] **10** Sheath part

[0125] **20** Core part

[0126] Although the disclosure has been described with respect to only a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that various other embodiments may be devised without departing from the scope of the present disclosure. Accordingly, the scope of the invention should be limited only by the attached claims.

What is claimed is:

1. A core-sheath conjugate fiber for artificial hair comprising:

a core part; and

a sheath part,

wherein:

the core part is comprised of a polyester-based resin composition that comprises a polyester-based resin as a main component and the sheath part is comprised of a polyamide-based resin composition that comprises a polyamide-based resin as a main component, the core-sheath conjugate fiber for artificial hair has a core-to-sheath area ratio of core:sheath=2:8 to 8:2 and a flat two-lobed cross sectional shape, and the polyamide-based resin composition has a melt viscosity of 140 Pa·s or less and comprises a pigment.

2. The core-sheath conjugate fiber for artificial hair according to claim **1**, wherein the polyester-based resin composition comprises, as the main component, one or more of polyester-based resins selected from the group consisting of polyalkylene terephthalate and a copolymerized polyester mainly containing polyalkylene terephthalate.

3. The core-sheath conjugate fiber for artificial hair according to claim **1**, wherein the polyamide-based resin composition comprises, as the main component, a polyamide-based resin mainly containing at least one selected from the group consisting of Nylon 6 and Nylon 66.

4. The core-sheath conjugate fiber for artificial hair according to claim **1**, wherein the melt viscosity of the polyamide-based resin composition is 60 Pa·s or more and 120 Pa·s or less.

5. The core-sheath conjugate fiber for artificial hair according to claim **1**, wherein the pigment is at least one selected from the group consisting of a black pigment masterbatch, a red pigment masterbatch, and a yellow pigment masterbatch.

6. A hair ornament product comprising the core-sheath conjugate fiber for artificial hair according to claim **1**.

7. The hair ornament product according to claim **6**, wherein the hair ornament product is one selected from the group consisting of a hair wig, a hairpiece, weaving hair, a hair extension, braided hair, a hair accessory, and doll hair.

8. The hair ornament product according to claim **6**, wherein the polyester-based resin composition comprises, as the main component, one or more of polyester-based resins selected from the group consisting of polyalkylene terephthalate and a copolymerized polyester mainly containing polyalkylene terephthalate.

9. The hair ornament product according to claim **6**, wherein the polyamide-based resin composition comprises, as the main component, a polyamide-based resin mainly containing at least one selected from the group consisting of Nylon 6 and Nylon 66.

10. The hair ornament product according to claim **6**, wherein the melt viscosity of the polyamide-based resin composition is 60 Pa·s or more and 120 Pa·s or less.

11. The hair ornament product according to claim **6**, wherein the pigment is at least one selected from the group consisting of a black pigment masterbatch, a red pigment masterbatch, and a yellow pigment masterbatch.

12. The hair ornament product according to claim **6**, wherein the polyamide-based resin composition comprises the pigment in an amount of 0.005 parts by weight or more and 2 parts by weight or less with respect to 100 parts by weight of the polyamide-based resin.

13. A method for producing the core-sheath conjugate fiber for artificial hair according to claim **1**, comprising a step of melt spinning the polyester-based resin composition and the polyamide-based resin composition with a core-sheath conjugate nozzle, wherein the polyamide-based resin composition has a melt viscosity of 140 Pa·s or less at a set temperature of the core-sheath conjugate nozzle.

14. The method for producing the core-sheath conjugate fiber for artificial hair according to claim **13**, wherein the polyester-based resin composition comprises, as the main component, one or more of polyester-based resins selected from the group consisting of polyalkylene terephthalate and a copolymerized polyester mainly containing polyalkylene terephthalate.

15. The method for producing the core-sheath conjugate fiber for artificial hair according to claim **13**, wherein the polyamide-based resin composition comprises, as the main component, a polyamide-based resin mainly containing at least one selected from the group consisting of Nylon 6 and Nylon 66.

16. The method for producing the core-sheath conjugate fiber for artificial hair according to claim **13**, wherein the melt viscosity of the polyamide-based resin composition is 60 Pa·s or more and 120 Pa·s or less.

17. The method for producing the core-sheath conjugate fiber for artificial hair according to claim **13**, wherein the pigment is at least one selected from the group consisting of a black pigment masterbatch, a red pigment masterbatch, and a yellow pigment masterbatch.

18. The method for producing the core-sheath conjugate fiber for artificial hair according to claim **13**, wherein the polyamide-based resin composition comprises the pigment in an amount of 0.005 parts by weight or more and 2 parts by weight or less with respect to 100 parts by weight of the polyamide-based resin.

19. The core-sheath conjugate fiber for artificial hair according to claim **1**, wherein the polyamide-based resin composition comprises the pigment in an amount of 0.005 parts by weight or more and 2 parts by weight or less with respect to 100 parts by weight of the polyamide-based resin.

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