

DESCRIPTION

Title of Invention:

FIBER FOR ARTIFICIAL HAIR AND HAIR ACCESSORY PRODUCT

Technical Field

[0001]

The present invention relates to a fiber for artificial hair and a hair accessory product.

Background Art

[0002]

In hair accessory products such as wigs, hair wigs, false hair, hairbands, and doll hair, the importance of artificial hair as a substitute for human hair has been increasing. Materials constituting a fiber for artificial hair include acrylic-based resins, vinyl chloride-based resins, and polyester-based resins, and fibers for artificial hair made of these resins are commercially available.

[0003]

Patent Literature 1 discloses an artificial hair characterized by containing a hollow fiber having a hollow portion with a hollow ratio of from 10% to 50%. Furthermore, Patent Literature 2 discloses a fiber for artificial hair characterized by having a void in a central part of a fiber cross-section, wherein a ratio of an area of the void to a total area of the fiber cross-section is from 5% to 50%, a cross-sectional shape of the fiber cross-section is a flat multilobal shape, and the void has a first side and a second side with an inclination of from 70 degrees to 110 degrees with respect to a major axis of the fiber cross-section.

Citation List

Patent Literature

[0004]

Patent Literature 1: JP 2008-285772 A

Patent Literature 2: WO 2014/196642 A1

Summary of Invention

Technical Problem

[0005]

From the viewpoint of preventing discomfort of a user, a fiber for artificial hair preferably has an excellent feeling of use. In particular, conventional fibers for artificial hair sometimes had poor combability during use. Here, the combability of a fiber bundle refers to the degree of smoothness of finger passage felt when finger-combing the fiber bundle.

[0006]

The present invention has been made in view of such circumstances, and an object thereof is to provide a fiber for artificial hair having excellent combability.

Solution to Problem

[0007]

The present inventors have conducted intensive studies and found that the above problem can be solved by providing a fiber for artificial hair having a specific hollow retention rate relative to stress, and have completed the present invention.

[0008]

According to the present invention, the following is provided.

[1] A fiber for artificial hair, comprising a hollow portion extending in a longitudinal direction of the fiber for artificial hair, wherein when a stress of 150 N/cm² is applied in a transverse direction to a fiber bundle for artificial hair comprising a plurality of the fibers for artificial hair, a hollow retention rate relative to that before application of the stress is 90% or more.

[2] The fiber for artificial hair of [1], wherein when a stress of 200 N/cm² is applied in a transverse direction to the fiber bundle for artificial hair, a hollow retention rate relative to that before application of the stress is 80% or more.

[3] The fiber for artificial hair of [1] or [2], wherein a hollow ratio in a fiber cross-section perpendicular to the longitudinal direction of the fiber for artificial hair is from 5% to 50%.

[4] The fiber for artificial hair of any one of [1] to [3], wherein the fiber for artificial hair comprises a vinyl chloride-based resin.

[5] A hair accessory product comprising the fiber for artificial hair of any one of [1] to [4].

[6] The hair accessory product of [5], comprising a braid.

Advantageous Effects of Invention

[0009]

According to the present invention, a fiber for artificial hair having excellent combability and a hair accessory product comprising the fiber for artificial hair can be provided.

Brief Description of Drawings

[0010]

FIG. 1 is a schematic cross-sectional view of a fiber for artificial hair according to one embodiment of the present invention. FIG. 1A shows a circular cross-section, FIG. 1B shows a circular cross-section having an inner projecting portion and an outer projecting portion, FIG. 1C shows a two-lobed cross-section in which two C-shapes are joined, FIG. 1D shows a three-lobed cross-section in which three C-shapes are joined, FIG. 1E shows a substantially triangular cross-section, and FIG. 1F shows a substantially quadrangular cross-section.

Description of Embodiments

[0011]

The present invention will be described in detail below. The present invention is not limited to these descriptions. The features of the embodiments shown below can be combined with each other. In addition, each feature can independently constitute an invention.

[0012]

<Explanation of Terms>

In the present specification, for example, the description "X to Y" means being equal to or greater than X and being equal to or less than Y.

[0013]

1 Fiber for Artificial Hair

1.1 Shape of Fiber for Artificial Hair

The fiber for artificial hair according to the present embodiment comprises a hollow portion extending in a longitudinal direction of the fiber for artificial hair. Note that, in the present specification, a "hollow portion" may be one that is continuously present for 3 cm or more in the longitudinal direction of the fiber for artificial hair and has a major diameter of 1 μ m or more in the fiber cross-section. In the fiber for artificial hair, hollow portions of 3 cm or more (preferably 4 cm or more, 5 cm or more, or 10 cm or more) may be provided intermittently in the longitudinal direction via a non-hollow portion of 1 cm or less (preferably 0.5 cm or less). In this case, it is preferable that the fiber for artificial hair comprises the hollow portion along 80% or more (preferably 90% or more) of the total length in the longitudinal direction. Further, a plurality of hollow portions may be present in a cross-section perpendicular to the longitudinal direction of the fiber for artificial hair. Since the fiber for artificial hair according to the embodiment comprises the hollow portion, it is lightweight and brings about many advantages such as being able to form a desired voluminous hairstyle with a small amount of the fiber attached, realizing a wide range of

hairstyles including long hairstyles with a full, weighty appearance, reducing damage to natural hair and the scalp, and reducing waste and environmental load.

[0014]

An example of a cross-section perpendicular to the longitudinal direction of the fiber for artificial hair according to the present embodiment is shown in FIG. 1. The shape of the cross-section perpendicular to the longitudinal direction of the fiber for artificial hair according to the present embodiment may be any one selected from a circular shape (FIG. 1A and FIG. 1B), an elliptical shape, a two-lobed shape in which two C-shapes are joined (FIG. 1C), a three-lobed shape in which three C-shapes are joined (FIG. 1D), a four-lobed shape in which four or more C-shapes are joined, and the like, as well as a substantially triangular shape (FIG. 1E), a substantially quadrangular shape (FIG. 1F), and a substantially polygonal shape.

[0015]

Note that a manufacturing method for the fiber for artificial hair according to the present embodiment is not particularly limited, but the fiber for artificial hair is generally obtained by melt-spinning a resin composition. The fiber for artificial hair having a hollow portion is formed, for example, by being melt-extruded from a nozzle having one C-shaped nozzle hole or a nozzle having a plurality of holes, as shown in FIG. 1 of Patent Literature 1. Here, at least a part of the resin composition is separated while passing through the nozzle, but after being discharged from the nozzle holes, portions of the resin composition come into contact with each other and are fused to form the hollow portion. The fiber for artificial hair according to the present embodiment may have a joining surface 14 (shown by a broken line in FIG. 1) where portions of the resin composition are fused together in the melt extrusion process. Further, a joining portion 13, which is a region including the joining surface 14, may comprise at least one selected from an inner projecting portion 16 projecting toward the hollow portion and an outer projecting portion 17 projecting toward the outside of the fiber for artificial hair (FIG. 1B). Although FIG. 1B shows a case where the fiber cross-section is circular, even when the hollow portion has another shape, at least one selected from an inner projecting portion projecting toward the hollow portion and an outer projecting portion projecting toward the outside of the fiber for artificial hair may be similarly provided at the joining portion. In this way, by providing the projecting portion to make the joining portion 13 thick-walled and increasing the area of the joining surface 14 where portions of the resin composition are fused together, the joining strength may be improved. The manufacturing method will be described later.

[0016]

A major diameter (fineness) in a cross-section perpendicular to the longitudinal direction of the fiber for artificial hair according to the present embodiment is preferably from 10 to 100 μm , more preferably from 20 to 80 μm , and still more preferably from 30 to 60 μm . The major diameter is, for example, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, or 100 μm , and may be within a range between any two of the numerical values exemplified here. When the major diameter in the fiber for artificial hair according to the present embodiment is in such a range, the hollow retention rate is improved, and consequently, the fiber bundle for artificial hair has better combability.

[0017]

When an area ratio occupied by the hollow portion in a cross-section perpendicular to the longitudinal direction of the fiber for artificial hair is defined as a hollow ratio, the hollow ratio of the fiber for artificial hair according to the present embodiment is preferably from 5% to 50%, more preferably from 10% to 45%, and still more preferably from 20% to 40%. The hollow ratio is, for example, 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, or 50%, and may be within a range between any two of the numerical values exemplified here. The hollow ratio may be determined by the following formula.

(Hollow ratio) = {(area enclosed by inner surface 12) / (area enclosed by outer surface 11)}
× 100

The area enclosed by the outer surface 11 means a cross-sectional area assuming that the fiber for artificial hair does not have a hollow portion. Further, in a case where a plurality of hollow portions are present in a cross-section perpendicular to the longitudinal direction of the fiber for artificial hair, the area enclosed by the inner surface 12 may be the sum of areas enclosed by inner surfaces of the respective hollow portions. The hollow ratio may be determined by cutting the fiber for artificial hair perpendicularly to the longitudinal direction, observing the cut surface with a laser microscope, a scanning electron microscope, or the like, and performing image analysis, and specifically may be determined by the method described in Examples. When the hollow ratio according to the present embodiment is in such a range, the advantages of having the hollow portion may be more reliably obtained. Specifically, when the hollow ratio is in such a range, structural defects (cases where joining portions are separated or a hollow portion is collapsed) are suppressed, an increase in rigidity due to an increase in fineness can be prevented, and tactile feel is improved. Further, when the upper limit value of the hollow ratio is such a value, the fiber bundle for artificial hair has better combability.

[0018]

1.2 Composition of Fiber for Artificial Hair

1.2.1 Resin

The resin composition constituting the fiber for artificial hair according to the present embodiment is not particularly limited, and may comprise at least one selected from the group consisting of a vinyl chloride-based resin, an AS-based resin (acrylonitrile-styrene-based resin), a polyester-based resin, a polyamide-based resin, and a polyolefin-based resin. From the viewpoint of easily obtaining a die swell effect to be described later, the fiber for artificial hair according to the present embodiment preferably comprises a vinyl chloride-based resin. Further, the fiber for artificial hair according to the present embodiment preferably comprises a vinyl chloride-based resin and an AS-based resin. The resin composition constituting the fiber for artificial hair according to the present embodiment preferably contains 70% by mass or more of the resin, more preferably 80% by mass or more, and still more preferably 90% by mass or more of the resin in 100% by mass of the resin composition. Specifically, the content of the resin is, for example, 70, 75, 80, 85, 90, 94, 95, 96, 97, 98, 99, or 100% by mass, and may be within a range between any two of the numerical values exemplified here.

[0019]

1.2.1.1 Vinyl Chloride-Based Resin

The vinyl chloride-based resin according to the present embodiment may comprise a vinyl chloride-based polymer comprising monomer units derived from a vinyl chloride monomer (vinyl chloride monomer units). The vinyl chloride-based resin according to the present embodiment may comprise a homopolymer obtained by homopolymerizing a vinyl chloride monomer, and/or a copolymer comprising monomer units derived from a vinyl chloride monomer and another monomer copolymerizable with the vinyl chloride monomer. Examples of the copolymer include copolymers of vinyl chloride and vinyl esters such as a vinyl chloride-vinyl acetate copolymer and a vinyl chloride-vinyl propionate copolymer; copolymers of vinyl chloride and olefins such as a vinyl chloride-ethylene copolymer and a vinyl chloride-propylene copolymer; and a vinyl chloride-acrylonitrile copolymer. Further, the vinyl chloride-based resin according to the present embodiment may consist of one type of vinyl chloride-based polymer, or may comprise two or more types of vinyl chloride-based polymers.

[0020]

The resin composition constituting the fiber for artificial hair according to the present embodiment preferably contains 50% by mass or more of the vinyl chloride-based resin,

more preferably 60% by mass or more, and still more preferably 65% by mass or more of the vinyl chloride-based resin in 100% by mass of the resin composition. Specifically, the content of the vinyl chloride-based resin is, for example, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, or 100% by mass, and may be within a range between any two of the numerical values exemplified here.

[0021]

1.2.1.2 AS-Based Resin

An AS-based resin (acrylonitrile-styrene-based resin) is a copolymer having styrene-based monomer units and acrylonitrile-based monomer units, and may comprise other monomer units copolymerizable with these monomer units as necessary. The resin composition constituting the fiber for artificial hair according to the present embodiment preferably contains from 5 to 50% by mass of the AS-based resin, more preferably from 10 to 40% by mass, and still more preferably from 20 to 30% by mass of the AS-based resin in 100% by mass of the resin composition. The AS-based resin comprises, for example, 60, 65, 70, 75, 80, 85, or 90% by mass of styrene-based monomer units with respect to 100% by mass of the AS-based resin, and may be within a range between any two of the numerical values exemplified here. The AS-based resin comprises, for example, 10, 15, 20, 25, 30, 35, or 40% by mass of acrylonitrile-based monomer units with respect to 100% by mass of the AS-based resin, and may be within a range between any two of the numerical values exemplified here.

[0022]

1.2.1.3 Polyester-Based Resin

Examples of the polyester-based resin according to the present embodiment include aromatic polyester-based resins such as polyethylene terephthalate, polytrimethylene terephthalate, polybutylene terephthalate, and polyethylene naphthalate; and aliphatic polyester-based resins such as polylactic acid, polyhydroxybutyric acid, polycaprolactone, polybutylene succinate, polybutylene adipate, polyethylene succinate, polyglycolic acid, poly-3-hydroxypropionate, and poly-3-hydroxybutyrate. These polyester-based resins may be used alone or in combination of two or more kinds thereof.

[0023]

1.2.1.4 Polyamide-Based Resin

Examples of the polyamide-based resin according to the present embodiment include nylon 6, nylon 66, nylon 11, nylon 12, nylon 6/10, nylon 6/12, and copolymers thereof. These polyamide-based resins may be used alone or in combination of two or more kinds thereof.

[0024]

1.2.1.5 Polyolefin-Based Resin

Examples of the polyolefin-based resin according to the present embodiment include polyethylene, polypropylene, an ethylene-vinyl acetate copolymer, an ethylene-ethyl acrylate copolymer, and an ethylene-propylene copolymer. These polyolefin-based resins may be used alone or in combination of two or more kinds thereof.

[0025]

1.2.2 Other Components

The fiber for artificial hair according to the present embodiment may also contain other components as necessary. Examples of the other components include a stabilizer, an antistatic agent, a heat stabilizer, a lubricant, a colorant, a processing aid, a plasticizer, a reinforcing agent, an ultraviolet absorber, an antioxidant, a filler, a flame retardant, a pigment, an initial coloration improver, a conductivity-imparting agent, and a fragrance. Examples of the other components according to the present embodiment include a hydrotalcite compound, an organic acid zinc salt (for example, zinc stearate), silica, a β -diketone compound (for example, dibenzoylmethane), polyols (for example, dipentaerythritol), an epoxy compound (for example, epoxidized soybean oil), an organic phosphite compound (for example, a phosphorus-based chelating agent), and a

polyethylene wax. The resin composition according to the present embodiment may contain, for example, preferably 10 parts by mass or less, and more preferably 5.5 parts by mass or less of the other components with respect to 100 parts by mass of the resin.

[0026]

1.3 Manufacturing Method for Fiber for Artificial Hair

The manufacturing method for the fiber for artificial hair according to the present embodiment comprises a resin composition preparation step and a spinning step, and may further comprise a drawing step, a heat treatment step, and a gear processing step.

[0027]

1.3.1 Resin Composition Preparation Step

In the resin composition preparation step, raw materials including a resin are mixed, whereby a resin composition may be obtained. Here, the raw materials include a base resin and may include other components as necessary.

[0028]

The mixing method is not particularly limited, and a conventionally known method may be adopted. For example, a powdery resin composition (powder compound) may be obtained using a known mixing device such as a Henschel mixer, a super mixer, or a ribbon blender, and the powder compound may be melt-mixed to obtain a pellet-shaped resin composition (pellet compound). A method for producing the powder compound may be hot blending or cold blending, and as an example, in order to reduce volatile components from the resin composition, hot blending may be performed with a cut temperature during mixing set to from 105 to 155°C. A method for producing the pellet compound may be the same as a general method for producing a pellet compound of a vinyl chloride-based resin. For example, the pellet compound may be produced using a kneading machine such as a single-screw extruder, a counter-rotating twin-screw extruder, a conical twin-screw extruder, a co-rotating twin-screw extruder, a co-kneader, a planetary gear extruder, or a roll kneader. Conditions for producing the pellet compound are not particularly limited, but a resin temperature is preferably set to be 185°C or lower in order to prevent thermal degradation of the resin composition. In addition, a mesh may be installed near a tip of the screw in order to remove metal fragments of the screw or fibers attached to protective gloves that may be mixed in small amounts into the pellet compound. A cold cut method may be employed for the production of pellets. A means for removing cutting chips (fine powder generated during pellet production) or the like that may be mixed in during the cold cut may be employed. Further, since the cutter blade may become chipped after long-term use and cutting chips tend to be generated, it is preferable to replace the cutter as appropriate.

[0029]

1.3.2 Spinning Step

In the spinning step, the resin composition is melt-spun to obtain the fiber for artificial hair. As an example, the resin composition (for example, the pellet compound) may be extruded from a heated cylinder through a nozzle and melt-spun. As the extruder, a conventionally known extruder may be used, and examples thereof include a single-screw extruder, a counter-rotating twin-screw extruder, and a conical twin-screw extruder.

[0030]

Conditions for the melt spinning may be appropriately set according to the type of the resin composition so that the resin melts and the hollow portion can be formed. A cylinder temperature may be from 150 to 300°C. The cylinder temperature may be set according to the type of the resin. When the resin is a vinyl chloride-based resin or an AS-based resin, the cylinder temperature is preferably from 160 to 180°C. When the resin is a polyester-based resin or a polyamide-based resin, the cylinder temperature is preferably from 250 to 290°C. When the resin is a polyolefin-based resin, the cylinder temperature is preferably from 180 to 220°C.

[0031]

A nozzle temperature may be set according to the type of the resin. When the resin is a vinyl chloride-based resin or an AS-based resin, the nozzle temperature is preferably from 160 to 200°C, more preferably from 170 to 200°C, still more preferably from 175 to 195°C, and particularly preferably from 175 to 185°C. When the resin is a polyester-based resin or a polyamide-based resin, the nozzle temperature is preferably from 270 to 310°C, and more preferably from 280 to 300°C. When the resin is a polyolefin-based resin, the nozzle temperature is preferably from 200 to 240°C, and more preferably from 210 to 230°C. With such a nozzle temperature, portions of the resin composition discharged from the nozzle holes sufficiently adhere to each other at the joining portion, and the hollow retention rate of the fiber bundle for artificial hair is improved.

[0032]

An undrawn yarn melt-spun from the nozzle may be introduced into a heating cylinder (for example, a heating cylinder temperature of 250°C) to be instantaneously heat-treated, and may be wound up by a take-up machine installed at a position directly below the nozzle (for example, about 4.5 m).

[0033]

The shape of the nozzle for melt extrusion of the fiber for artificial hair according to the present embodiment may be appropriately selected according to the shape and hollow ratio of the fiber for artificial hair to be obtained. As an example, when producing the fiber for artificial hair having a circular cross-section shown in FIG. 1A, a nozzle having a C-shaped nozzle hole may be used; when producing the fiber for artificial hair having a two-lobed cross-section in which two C-shapes are joined as shown in FIG. 1C, a nozzle having two C-shaped nozzle holes may be used; and when producing the fiber for artificial hair having a three-lobed cross-section in which three C-shapes are joined as shown in FIG. 1D, a nozzle having three C-shaped nozzle holes may be used. Further, when producing the fiber for artificial hair having a substantially triangular cross-section shown in FIG. 1E, a nozzle having three rod-shaped nozzle holes may be used, and when producing the fiber for artificial hair having a substantially quadrangular cross-section shown in FIG. 1F, a nozzle having four rod-shaped nozzle holes may be used. Due to the presence of spaces between the nozzle holes, at least a part of the resin composition is separated during melt extrusion, but after being discharged from the nozzle holes, portions of the resin composition come into contact with each other and are fused to form the hollow portion. Further, in the present embodiment, the resin composition discharged from the nozzle holes may swell due to a die swell effect, whereby the inner projecting portion and/or the outer projecting portion may be formed.

[0034]

Further, a land length of the nozzle is preferably from 0.2 to 3.5 mm, and more preferably from 0.3 to 3.0 mm. When the lower limit value of the land length of the nozzle is such a value, the die swell effect is more easily obtained, and the area of the joining surface at the joining portion increases, so that the hollow retention rate of the fiber bundle for artificial hair is improved. When the upper limit value of the land length of the nozzle is such a value, a sufficient area of the joining surface may be obtained even when the hollow ratio is high, and further, pressure loss may be minimized to improve productivity.

[0035]

1.3.3 Drawing Step

The manufacturing method for the fiber for artificial hair according to the present embodiment may also comprise a drawing step. In the drawing step according to the present embodiment, the undrawn fiber for artificial hair obtained in the above melt spinning step may be drawn with a drawing machine to obtain a fiber for artificial hair after the drawing step. As an example, in the drawing step, the undrawn fiber for artificial hair may be drawn, for example, by 2 to 5 times at from 90 to 110°C in an air atmosphere.

[0036]

1.3.4 Heat Treatment Step

The manufacturing method for the fiber for artificial hair according to the present embodiment may also comprise a heat treatment step. In the heat treatment step according to the present embodiment, the fiber for artificial hair after the drawing step may be heat-treated using a heat treatment machine. As an example, in the heat treatment step, the fiber for artificial hair after the drawing step may be heat-treated at from 90 to 120°C in an air atmosphere at a relaxation rate of 0.5 to 0.99, and the total fiber length may be heat-shrunk to obtain a fiber for artificial hair after the heat treatment step having a desired fineness. Note that a "relaxation rate during heat treatment" is a value calculated by (rotational speed of a take-up roller during annealing) / (rotational speed of a feed roller during annealing).

[0037]

1.3.5 Gear Processing Step

The manufacturing method for the fiber for artificial hair according to the present embodiment may also comprise a gear processing step. In the gear processing step, crimping may be performed by passing a fiber bundle between two meshing high-temperature gears. The material of the gears, the wave shape of the gears, the number of gear teeth, and the like used in the gear processing step are not particularly limited. In the gear processing step, the shape of the obtained fiber for artificial hair may be controlled by appropriately adjusting a depth of gear waveform grooves, a gear surface temperature, a processing speed, pressure conditions between gears, and the like in consideration of the fiber material and fineness. These processing conditions are not particularly limited, but as an example, the depth of the gear waveform grooves may be from 0.2 to 6 mm, preferably from 0.5 to 5 mm, the gear surface temperature may be from 30 to 100°C, preferably from 40 to 80°C, and the processing speed may be from 0.5 to 10 m/min, preferably from 1.0 to 8.0 m/min.

[0038]

The manufacturing method for the fiber for artificial hair according to the present embodiment may also comprise other steps, and for example, may comprise a step of applying a surface treatment agent.

[0039]

Note that, in the present invention, the term "fiber for artificial hair" includes the fiber for artificial hair after spinning, and encompasses the fiber for artificial hair before the drawing step, after the drawing step, before the heat treatment step, after the heat treatment step, before the gear processing step, and after the gear processing step.

[0040]

2 Fiber Bundle for Artificial Hair

The fiber bundle for artificial hair according to the present embodiment comprises the above-described fiber for artificial hair. The fiber bundle for artificial hair according to the present embodiment preferably consists of the above-described fibers for artificial hair.

[0041]

2.1 Properties of Fiber Bundle for Artificial Hair

2.1.1 Hollow Retention Rate

In the present embodiment, when a stress of 150 N/cm² is applied in a transverse direction to a fiber bundle for artificial hair comprising a plurality of the above-described fibers for artificial hair, a hollow retention rate relative to that before application of the stress is preferably 90% or more, more preferably 95% or more, and particularly preferably 100%.

When a stress of 150 N/cm² is applied in the transverse direction, the hollow retention rate relative to that before application of the stress is, for example, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, or 100%, and may be within a range between any two of the numerical values exemplified here. Note that, in the present specification, the "hollow retention rate" may be

a retention rate of the hollow portion before and after applying a stress to the fiber bundle for artificial hair.

Whether or not the hollow portion is retained may be determined by placing a weight applying 150 N/cm² per unit area on a region where a plurality of the fibers for artificial hair (for example, sample size $n = 20$ to 30) are spread, and then observing a fiber cross-section perpendicular to the longitudinal direction of the fiber for artificial hair to see whether the hollow portion is maintained, or whether the hollow portion is not maintained due to cracking of the joining portion or the like. Note that, in a case where a plurality of hollow portions are present in a cross-section perpendicular to the longitudinal direction of the fiber for artificial hair, it may be determined that the hollow portion is not maintained when the hollow portions are connected to each other. The hollow retention rate may be determined by the following formula.

(Hollow retention rate) = {(number of fibers in which a hollow portion is maintained after application of stress) / (number of fibers in which a hollow portion is maintained before application of stress)} $\times 100$

When the hollow retention rate is such a value, the fiber bundle for artificial hair is excellent in combability. Note that the fiber for artificial hair used for measurement of the hollow retention rate may be any of the fiber for artificial hair after the heat treatment step, before the gear processing step, or after the gear processing step.

[0042]

In the present embodiment, when a stress of 200 N/cm² is applied in the transverse direction to the fiber bundle for artificial hair comprising a plurality of the above-described fibers for artificial hair, the hollow retention rate relative to that before application of the stress is preferably 80% or more, more preferably 85% or more, and particularly preferably 90% or more.

When a stress of 200 N/cm² is applied in the transverse direction, the hollow retention rate relative to that before application of the stress is, for example, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, or 100%, and may be within a range between any two of the numerical values exemplified here. Whether or not the hollow portion is retained may be determined in the same manner as in the above-described measurement method, except that the weight is changed to one applying 200 N/cm² per unit area. When the hollow retention rate is such a value, the fiber bundle for artificial hair has better combability.

[0043]

The hollow retention rate may be improved by sufficient adhesion at the joining portion.

Therefore, the hollow retention rate may be improved particularly by setting a nozzle temperature and a land length of a nozzle to appropriate values among melt spinning conditions in the spinning step. Further, the hollow retention rate may also be adjusted by a major diameter and a hollow ratio of the fiber for artificial hair.

[0044]

2.1.2 Combability

The fiber bundle for artificial hair according to the present embodiment preferably has excellent combability. The combability of the fiber bundle for artificial hair may be evaluated, for example, based on the degree of smoothness of finger passage felt when an artificial hair fiber processing technician (with 5 years or more of practical experience) passes fingers through the fiber bundle for artificial hair having a length of 600 mm and a mass of 120 g.

[0045]

3 Hair Accessory Product

The hair accessory product according to the present embodiment comprises the above-described fiber for artificial hair.

[0046]

The fiber bundle for artificial hair according to the present embodiment may be used for a hair accessory product. Examples of the hair accessory product include wigs, hairpieces, braids, hair extensions, doll hair, hair wigs, false hair, hairbands, and the like. The hair accessory product obtained from the fiber bundle for artificial hair according to the present embodiment is excellent in combability.

[0047]

Further, since the hollow structure of each fiber is maintained with high certainty, the hair accessory product obtained from the fiber bundle for artificial hair according to the present embodiment is lightweight and brings about many advantages such as being able to form a desired voluminous hairstyle with a small amount of the fiber attached, realizing a wide range of hairstyles including long hairstyles with a full, weighty appearance, reducing damage to natural hair and the scalp, and reducing waste and environmental load. The hair accessory product according to the present embodiment is applicable to various styles, and is particularly suitable for a braid including braiding such as plaiting and twisting.

Examples

[0048]

Hereinafter, the present invention will be described in more detail based on examples.

Note that the examples described below show an example of representative examples of the present invention, and the scope of the present invention should not be construed narrowly thereby.

[0049]

(Example 1)

<Resin Composition Preparation Step>

100 parts by mass of a vinyl chloride-based resin (manufactured by Taiyo Vinyl Corporation, product name: TH1000), a total of 5 parts by mass of additives such as a plasticizer, a stabilizer, and a lubricant (specifically, 3 parts by mass of a stabilizer composition, 1 part by mass of epoxidized soybean oil, 0.4 parts by mass of a phosphorus-based chelating agent, and 0.6 parts by mass of polyethylene wax), and 0.5 parts by mass of carbon black were mixed using a blender. The blended materials were kneaded using a single-screw extruder of $\phi 40$ mm to obtain a pellet-shaped resin composition for spinning.

[0050]

The stabilizer composition used to obtain the resin composition had the following components and composition.

- Hydrotalcite compound ($\text{Mg}_4\text{Al}_2(\text{OH})_{12}\text{CO}_3 \cdot 3\text{H}_2\text{O}$): 72.6 parts by mass
- Zinc stearate: 13.1 parts by mass
- Silica ("Carplex (registered trademark) #80" manufactured by DSL. Japan Co., Ltd.): 2.2 parts by mass
- Dibenzoylmethane: 2.3 parts by mass
- Dipentaerythritol: 0.9 parts by mass
- Vinyl chloride resin (manufactured by Taiyo Vinyl Corporation, product name: TH1000): 8.9 parts by mass

[0051]

Other additives used to obtain the resin composition are as follows.

- Epoxidized soybean oil: "ADK CIZER (registered trademark) O-130P" manufactured by ADEKA CORPORATION
- Phosphorus-based chelating agent: "ADK STAB (registered trademark) 1030" manufactured by ADEKA CORPORATION
- Polyethylene wax: manufactured by Mitsui Chemicals, Inc.

[0052]

<Spinning Step>

The obtained pellet-shaped resin composition was spun with a $\phi 40$ mm single-screw melt spinning machine. The discharge amount and the take-up speed were adjusted, and an undrawn yarn was produced from the molten resin discharged from the nozzle. As the nozzle, a nozzle having three shallow C-shaped nozzle holes in cross-section was used. Note that the land length of the nozzle, the nozzle temperature, and the cylinder temperature of the spinning machine are shown in Table 1 and Table 2.

[0053]

<Drawing Step and Heat Treatment Step>

The obtained undrawn yarn (fiber for artificial hair before the drawing step) was drawn by 3 times at 100°C, then put into a heat treatment apparatus and subjected to a heat treatment step at 115°C, to obtain a fiber for artificial hair after the heat treatment step.

The relaxation rate during heat treatment was set to 0.50 to 0.99.

[0054]

<Gear Processing Step>

Using a gear machine ("NEW YAKI BRAID CRIMPING M/C-2.5 mm" manufactured by SUNG JIN INDUSTRIAL CO., LTD.), gear processing was performed on the fiber for artificial hair after the heat treatment step under conditions of a gear pitch of 2.5 mm, preheating at 90°C, a gear roll temperature of 90°C, and a gear roll rotation speed of 1 m/min, to obtain a fiber for artificial hair after gear processing.

[0055]

(Examples 2 to 13, Comparative Examples 1 to 6)

Fibers for artificial hair were obtained in the same manner as in Example 1, except that the type of the resin, the presence or absence of additives, the shape of the nozzle, the land length, the nozzle temperature, the cylinder temperature, the fineness, and the hollow ratio were changed.

[0056]

In Examples 9 and 11 to 13, the following resins were used. In Examples 11 to 13, no additives were used, and only 0.5 parts by mass of carbon black was used in each of Examples 11 to 13.

- AS-based resin: acrylonitrile-styrene copolymer ("GR-AT-6S" manufactured by Denka Company Limited)
- Polyester-based resin: polyethylene terephthalate ("J125S" manufactured by Mitsui Chemicals, Inc.)
- Polyamide-based resin: nylon 66 ("Leona (registered trademark) 1500" manufactured by Asahi Kasei Chemicals Corporation)
- Polyolefin-based resin: polypropylene ("Sumitomo Noblen (registered trademark) S131" manufactured by Sumitomo Chemical Co., Ltd.)

[0057]

The results of the tests and evaluations described later performed on each of the fibers for artificial hair thus produced are shown in Table 1 and Table 2.

[0058]

[Table 1]

Table 1		Unit	Example									
			1	2	3	4	5	6	7	8	9	10
Resin	Vinyl Chloride-Based Resin	parts by mass	100	100	100	100	100	100	100	100	75	100
	AS-Based Resin	parts by mass									25	
	Polyester-Based Resin	parts by mass										
	Polyamide-Based Resin	parts by mass										
	Polyolefin-Based Resin	parts by mass										
Manufacturing Conditions	Land Length of Nozzle	mm	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Nozzle Temperature	°C	180	180	180	190	200	180	180	180	180	180
	Cylinder Temperature	°C	160-180	160-180	160-180	160-180	160-180	160-180	160-180	160-180	160-180	160-180
	Major Diameter (Fineness)	μm	40	40	40	40	40	30	40	40	40	60
Hollow Portion	Cross-Sectional Shape		Circular	Elliptical	Two-Lobed	Circular	Circular	Circular	Circular	Circular	Circular	Circular
	Cross-Sectional Shape of Hollow Portion		Circular	Elliptical	Two-Lobed	Circular	Circular	Circular	Circular	Circular	Circular	Circular
	Hollow Ratio	%	25	25	25	25	25	25	45	4	25	25
Hollow Retention Rate	150 N/cm ²	%	100	100	100	100	100	100	100	100	100	100
	200 N/cm ²	%	100	100	100	90	80	80	90	100	100	100
Evaluation	Combability		A	A	A	B	C	C	B	A	A	A

Table 2		Unit	Example			Comparative Example					
Resin	Vinyl Chloride-Based Resin		11	12	13	1	2	3	4	5	6
	AS-Based Resin	parts by mass				100	100	100	100	100	100
	Polyester-Based Resin	parts by mass									
	Polyamide-Based Resin	parts by mass	100								
	Polyolefin-Based Resin	parts by mass		100							
	Land Length of Nozzle	mm			100						
Manufacturing Conditions	Nozzle Temperature	°C	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.1	4.0
	Cylinder Temperature	°C	290	290	220	205	155	170	170	180	180
	Major Diameter (Fineness)	μm	250-290	250-290	180-220	160-180	160-180	160-180	160-180	160-180	160-180
Hollow Portion	Cross-Sectional Shape		40	40	40	40	40	25	40	40	40
	Cross-Sectional Shape of Hollow Portion		Circular	Circular	Circular	Circular	Circular	Circular	Circular	Circular	Circular
	Hollow Ratio	%	Circular	Circular	Circular	Circular	Circular	Circular	Circular	Circular	Circular
Hollow Retention Rate	150 N/cm ²	%	25	25	25	25	25	25	55	25	25
	200 N/cm ²	%	100	100	100	80	80	80	80	80	50
	Combability	%	90	90	90	50	50	50	50	50	30
Evaluation			B	B	B	D	D	D	D	D	D

(Hollow Ratio)

A yarn bundle obtained by cutting the fiber for artificial hair into an appropriate length was wrapped with vinyl tape, the yarn bundle was cut with a utility knife so as to be perpendicular to the longitudinal direction to prepare a cross-section, and the cross-section was observed. A cross-sectional photograph of the fiber was taken at a magnification of 400 times using a laser microscope, and an area ratio of the hollow portion in the cross-section (hollow ratio) was measured.

(Hollow ratio) = {(area enclosed by inner surface) / (area enclosed by outer surface)} × 100

Note that a controller VK-X150 manufactured by KEYENCE CORPORATION was used for calculating the hollow ratio. The hollow ratio was an average value with a sample size $n = 50$. Note that, in all of the Examples and Comparative Examples, hollow portions were present in all of the fibers for artificial hair.

[0061]

(Hollow Retention Rate (Stress of 150 N/cm²))

A weight applying 150 N/cm² per unit area was placed on a region where a plurality of the fibers for artificial hair (sample size $n = 20$) were spread. Next, a yarn bundle obtained by cutting the fiber for artificial hair into an appropriate length was wrapped with vinyl tape, the yarn bundle was cut with a utility knife so as to be perpendicular to the longitudinal direction to prepare a cross-section, and the cross-section was observed. A cross-sectional photograph of the fiber was taken at a magnification of 400 times using a laser microscope, and it was confirmed whether the hollow portion was maintained, or whether the hollow portion was not maintained due to cracking of the joining portion or the like. A retention rate of the hollow portion before and after applying the stress to the fiber bundle for artificial hair was calculated as the hollow retention rate.

(Hollow retention rate) = {(number of fibers in which a hollow portion is maintained after application of stress) / (number of fibers in which a hollow portion is maintained before application of stress)} × 100

[0062]

(Hollow Retention Rate (Stress of 200 N/cm²))

A test was performed in the same manner as for the hollow retention rate (stress of 150 N/cm²), except that the weight was changed to one applying 200 N/cm² per unit area, and the hollow retention rate was calculated.

[0063]

(Combability)

For a fiber bundle for artificial hair for evaluation having a length of 600 mm and a mass of 120 g, the degree of smoothness of finger passage felt when ten artificial hair fiber processing technicians (with 5 years or more of practical experience) passed their fingers through the bundle was evaluated on a two-rank scale of "good combability" or "poor combability", and evaluated based on the following criteria.

A: 0 technicians evaluated the bundle as having poor combability.

B: 1 to 4 technicians evaluated the bundle as having poor combability.

C: 5 to 8 technicians evaluated the bundle as having poor combability.

D: 9 or more technicians evaluated the bundle as having poor combability.

Reference Signs List

[0064]

100: cross-section of fiber for artificial hair, 11: outer surface, 12: inner surface, 13: joining portion, 14: joining surface, 15: hollow portion, 16: inner projecting portion, 17: outer projecting portion

CLAIMS

[Claim 1]

A fiber for artificial hair, comprising a hollow portion extending in a longitudinal direction of the fiber for artificial hair, wherein when a stress of 150 N/cm^2 is applied in a transverse direction to a fiber bundle for artificial hair comprising a plurality of the fibers for artificial hair, a hollow retention rate relative to that before application of the stress is 90% or more.

[Claim 2]

The fiber for artificial hair of claim 1, wherein when a stress of 200 N/cm^2 is applied in a transverse direction to the fiber bundle for artificial hair, a hollow retention rate relative to that before application of the stress is 80% or more.

[Claim 3]

The fiber for artificial hair of claim 1, wherein a hollow ratio in a fiber cross-section perpendicular to the longitudinal direction of the fiber for artificial hair is from 5% to 50%.

[Claim 4]

The fiber for artificial hair of claim 1, wherein the fiber for artificial hair comprises a vinyl chloride-based resin.

[Claim 5]

A hair accessory product comprising the fiber for artificial hair of any one of claims 1 to 4.

[Claim 6]

The hair accessory product of claim 5, comprising a braid.