A method for manufacturing bristles on a toothbrush and a toothbrush using the same are provided, in which the bristles on a toothbrush have a core-sheath double structure and various cross-sectional shapes, have uneven portions formed on a surface thereof by a tapering process while containing inorganic particles, and include inorganic or organic antimicrobial materials.
METHOD FOR MANUFACTURING BRISTLES ON TOOTHBRUSH AND TOOTHBRUSH USING SAME

TECHNICAL FIELD

[0001] The present invention relates to a method for manufacturing bristles on a toothbrush and a toothbrush using the same.

BACKGROUND ART

[0002] A toothbrush is a representative tool used in order to clean the mouth including teeth and gums. In general, the toothbrush is composed of a handle and bristles on the toothbrush, wherein the bristles on the toothbrush are manufactured using a synthetic resin having elasticity. In general bristles on a toothbrush as described above are mainly manufactured using nylon or polyester as a raw material, whereas the nylon bristles on a toothbrush have advantages such as suitable elasticity and flexibility but have disadvantages in that a life time thereof is short due to a high absorption property, the nylon bristles on a toothbrush should have a predetermined thickness or more due to low strength, and since it is impossible to perform a processing process such as a tapering process, or the like, penetration between the teeth or between the gums and teeth is low, such that it is difficult to completely remove tartar, food residue, or the like. Further, in the case in which polyester-based bristles on a toothbrush are not tapered, while elasticity is large, flexibility is deteriorated, such that the gum of a user may be easily hurt, and in the case in which the polyester-based bristles on a toothbrush are tapered, penetration and flexibility are excellent but removal of tartar, or the like, may be deteriorated.

[0003] As another disadvantage of general bristles on a toothbrush, there is proliferation of bacteria in the bristles. In most of the cases, after a user brushes his or her teeth, a toothbrush is stored in a state in which the toothbrush is exposed to air, and bristles on a toothbrush are not dried due to characteristics of the toothbrush, such that an environment suitable for microbes to live therein is generated. These microbes are transferred to the mouth at the time of brushing, thereby causing periodontal diseases.

[0004] In order to solve the above-mentioned problems, toothbrushes having antimicrobial and antioxic activities and having various shapes have emerged. In these functional toothbrushes, components of pine needle, charcoal, barley sprout, a bamboo salt, a pine salt, or the like, are mainly contained, or an inorganic antimicrobial agent such as nanosilver, silver ions, platinum, gold, copper, manganese, or the like, is mostly contained in the bristles on a toothbrush. These materials are generally contained in a polymer resin configuring a bristle basic material to thereby be spun. In this case, the inorganic antimicrobial agents are hardly affected by a spinning resin, but in the case of vegetable antimicrobial agents, components having antimicrobial activity or beneficial effects on human bodies may be damaged by a temperature of a spinning solution.

[0005] The invention relating to a method for manufacturing bristles on a toothbrush by mixing components of barley sprout and inorganic antimicrobial agent powder so as to be contained with predetermined contents in a polymer resin during a molding process of the bristles on a toothbrush has been disclosed in Korean Patent No. 10-0944799. According to the above-mentioned invention, there is an effect of imparting freshness to the gums and promoting blood circulation due to functions of the components of barley sprout. However, among the components contained in barley sprout, since vitamin C is vulnerable to heat, vitamin C is easily destroyed by a temperature of a spinning solution, such that it is doubtful that the desired function may be obtained in the above-mentioned invention.

[0006] In addition, the invention relating to bristles on a toothbrush having various effects of pine needle such as antimicrobial activity, humidity controlling performance, deodorization performance, purification performance, or the like, by mixing pine needle powder and a bamboo salt component with a synthetic resin has been disclosed in Korean Patent No. 10-0953868. However, in the invention, there is a risk that the component contained in pine needles will be partially destroyed or deformed by heat of a spinning solution, and the bristles have failed to have a function such as penetration performance, or the like, required in order to effectively remove tartar and food residue.

RELATED ART DOCUMENT


DISCLOSURE

Technical Problem

[0009] An object of the present invention is to provide a novel method for manufacturing bristles on a toothbrush capable of having semi-permanent antimicrobial activity, which is a disadvantage of an existing toothbrush and bristles on a toothbrush, and implementing excellent detergency and penetration, and a toothbrush using the same.

Technical Solution

[0010] The present invention relates to a method for manufacturing bristles on a toothbrush and a toothbrush using the same, wherein the bristles on a toothbrush have a core-sheath double structure and various cross-sectional shapes, have uneven portions formed on a surface thereof by a tapering process while containing inorganic particles, and include inorganic or organic antimicrobial materials.

[0011] In one general aspect, a method for manufacturing bristles on a toothbrush, the method including:

[0012] a) manufacturing a core-sheath type filament composed of a core part and a sheath part;
[0013] b) cutting the filament;
[0014] c) immersing one end of the filament in step b) in a processing tank filled with a tapering solution; and
[0015] d) immersing the other end of the filament in step c) in a processing tank filled with an alkaline solution.

[0016] In another general aspect, there is provided a toothbrush using bristles on a toothbrush manufactured by the method as described above.

[0017] Hereinafter, the method for manufacturing bristles on a toothbrush and the toothbrush using the same according to the present invention will be described in detail.

[0018] It is preferable that the bristles on a toothbrush according to the present invention have a core-sheath structure composed of a core part and a sheath part. It is preferable that a polymer resin capable of being tapered is used in the
corresponding to the core part and the sheath part, and the polymer resins forming the core part and the sheath part may be the same as or different from each other, but in order to dissolve a sea component to form fine bristles on a toothbrush, it is preferable that different polymer resins are used in the sea component and an island component. More preferably, polymer resins satisfying the following Equation are used in the sea component and the island component.

\[ V_{c} > V_{s} \]  \[ \text{[Equation 1]} \]

(0019) In Equation 1, \( V_{c} \) is a dissolution rate of the sea component in the alkaline solution, and \( V_{s} \) is a dissolution rate of the island component in the alkaline solution.

(0020) As the polymer resin forming the island component, it is preferable to use at least one or at least two polymer resins of polyester such as polyethylene naphthalate, polybutylene terephthalate, polycyclohexylene dimethyleneterephthalate, polyester ether, polyester ether ketone, or the like, a thermoplastic rubber, an elastomer, silicone, BPA(bisphenol-A)-free bio plastic, polyoxymethylene, nylon 4, nylon 6, nylon 7, nylon 9, nylon 11, nylon 12, nylon 4,6, nylon 6,6, nylon 6,10, and nylon 6,12.

(0021) As the polymer resin forming the sea component, it is preferable to use a polyester copolymer polymer resin obtained by copolymerizing at least one monomer selected from polyethylene glycol, polypropylene glycol, 1,4-cyclohexane dicanoxide, 1,4-cyclohexane dimethanol, 1,4-cyclohexane dicarboxylate, 2,2-dimethyl-1,3-propanediol, 2,2-dimethyl-1,4-butenediol, 2,2,4-trimethyl-1,3-propanediol, adipic acid, isophthalic acid, 5-sodium sulfosuccinic acid, polylactic acid, polyethylene oxide, and ultra-high molecular polyethylene oxide at a content of 10 to 50 wt% or to use polyester alone. These copolymers have at least 10 times the solubility of general polyester, such that these copolymers are suitable for forming fine split-type bristles on a toothbrush to be described in the present invention.

(0022) It is preferable that the bristles on a toothbrush are composed of 10 to 90 vol% of the core part and 10 to 90 vol% of the sheath part based on 100 vol% of the entire filament.

(0023) When the bristles on a toothbrush are cut in a direction vertical to an axial direction, the bristles on a toothbrush may have a different cross-sectional shape as well as a circular shape. It is preferable that the bristles on a toothbrush are formed to have any one of a cross-sectional shape of a circular shape, a dumbbell shape, a cross shape, a disk shape, a chevron shape, a triangular shape, a tetragonal shape, a trapezoidal shape, and a cone shape. The cross section may be determined by a shape of a spinneret at the time of spinning the polymer resin forming the bristles on a toothbrush.

(0024) An additive may be further contained in the polymer resin forming the bristles on a toothbrush, that is, any one of the core part and the sheath part, or both of the core part and the sheath part. The additive includes organic particles, inorganic particles, or a mixture of organic particles and inorganic particles, and the additive serves to improve strength of the bristles on a toothbrush and adjust elasticity thereof and acts as an insoluble portion at the time of performing a tapering process on the bristles on a toothbrush to thereby form uneven portions on a surface of the bristles on a toothbrush.

(0025) The kind of organic particles is not limited as long as the organic particles are generally used in the art, and a powdery form of the organic particles may be also used. As the organic particles, for example, any one or at least two selected from various vegetable extracts such as green tea extracts, barley sprout extracts, ginkgo biloba extracts, pine needle extracts, bamboo extracts, or the like; powder such as activated carbon, xylitol, or the like; polyacrylic polymers such as polyacrylic acid, poly(methyl)acrylate, polyvinylacetate, or the like, cellulose-based polymer such as cellulose, hydroxypropylmethylcellulose, hydroxyethylcellulose, methylcellulose, ethylcellulose, hydroxypropylmethylcellulose, hydroxyethylcellulose, hydroxyethylmethylcellulose, carboxymethylcellulose, or the like; a polyalcohol-based polymer such as polyvinyl alcohol, polyethylene glycol, polypropylene glycol, a polypropylene glycol copolymer, or the like; and polyethylene oxide may be used. These materials may impart freshness to the gums, promote blood circulation, activate cell functions, and release functional components useful for oral health.

(0026) In addition, based on an idea that among the organic particles according to the present invention, the activated carbon has a porous structure, antimicrobial activity and deodorization performance of charcoal may be significantly improved by adsorbing a photocatalyst having a nano size in a number of micro pores of the activated carbon.

(0027) The photocatalyst used in the present invention includes a visible-light photocatalyst, wherein the visible-light photocatalyst has excellent antimicrobial activity in a visible-light wavelength region, high photochemical activity due to surface characteristics of nano particles, and excellent stability, such that an artificial filament containing charcoal powder adsorbing the photocatalyst may have excellent antimicrobial activity and deodorization performance and continuously exhibit performance over a long period of time due to excellent stability.

(0028) As the visible-light photocatalyst used in the present invention, a material capable of being generally used in the art, for example, titanium dioxide, zinc oxide, silver oxide, titanium oxynitride, or the like, may be used. It is preferable to use titanium oxynitride.

(0029) According to the present invention, an average particle size of the photocatalyst-supported activated carbon powder may be 300 to 1500 meshes. In the case in which the particle size of the activated carbon powder is less than 300 meshes, it is difficult to mix the activated carbon powder with a resin material, and in the case in which the particle size is more than 1500 meshes, there is no room into which the photocatalyst penetrates.

(0030) According to a method for preparing the photocatalyst-supported activated carbon powder, activated carbon powder on which titanium oxynitride is supported may be prepared by stirring and mixing a mixture in which activated carbon powder and titanium oxynitride are mixed in an organic solvent for 0.5 to 4 hours, vacuum-drying the mixture at 20 to 70°C, and then sintering the mixture at 180 to 250°C.

(0031) The titanium oxynitride may be supported on the activated carbon powder at a content of 5 to 35 wt%. In the case in which the content is more than the above-mentioned range, adsorption performance is deteriorated, such that there is no economical efficiency, and in the case in which the content is less than the above-mentioned range, it is difficult to obtain the desired physical properties.

(0032) The photocatalyst-supported activated carbon powder may be contained in both of the core part (island component) and the sheath part (sea component), but when the photocatalyst-supported activated carbon powder is added to
the sea component, the antimicrobial activity and deodorization performance of charcoal may be maximally exhibited. [0033] The kind of inorganic particles is not limited as long as the object of the present invention may be achieved, but it is preferable to use any one or a mixture of at least two selected from zeolite, silica-alumina, calcium phosphate, zirconium phosphate, calcium carbonate, silica gel, titanium dioxide, zinc oxide, zirconium carbide, magnesium oxide, silicon dioxide, and aluminum oxide.

[0034] The additive may have an average particle size of preferably 0.1 to 10um, and more preferably 5 to 20um. In the case in which the average particle size of the additive is less than 0.1um, it may be difficult to obtain detergency to be desired in the present invention, and in the case in which the average particle size is more than 10um, tensile strength of the manufactured bristles on a toothbrush may be deteriorated.

[0035] It is preferable that the additive is added at a content of 0.1 to 20 parts by weight based on 100 parts by weight of the polymer resin forming the core part or the sheath part. In the case in which the content is less than 0.1 part by weight, formation of uneven portions to be desired is insufficient, such that it is impossible to obtain sufficient detergency, and in the case in which the content is more than 20 parts by weight, strength of the filament may be deteriorated. Further, in the case in which the additive is contained in both of the core part and the sheath part, it is preferable that the additives are added so as to satisfy the above-mentioned range, respectively.

[0036] The bristles on a toothbrush according to the present invention may contain at least one antimicrobial material in order to effectively block proliferation of microbes and fungi even under a very moist condition. As the antimicrobial material, organic materials and inorganic materials may be all used.

[0037] As the inorganic material capable of being used as the antimicrobial material, it is preferable to use an inorganic material in which ions of at least one metal selected from gold, platinum, silver, or copper are supported on at least one carrier of zeolite, silica-alumina, calcium phosphate, zirconium phosphate, calcium carbonate, silica gel, titanium dioxide, zinc oxide, zirconium carbide, magnesium oxide, silicon dioxide, and aluminum oxide. Alternatively, the metal ion or nano metal 0.1 to 10um, and more preferably 5 to 20um may be preferably used.

[0038] Here, the inorganic material has an average particle size of preferably 0.1 to 10um, and more preferably 5 to 20um. In addition, the inorganic material acts as an insoluble material at the time of performing the tapering process to serve to increase uneven portions of the surface.

[0039] The silver ion powder, which is prepared by containing silver in a natural glass component soluble in water, mixing and dispersing the silver at about 1,300°C, and then rapidly cooling the mixture, has advantages in that even in the case of using the silver ion powder for a long period of time, there is no problem such as oxidation, welding, adsorption, and the like, and even in the case of mixing the silver ion powder with a polymer resin, the silver ion powder may be easily dispersed. In addition, there is no risk that the silver ion will be eluted, such that the antimicrobial activity may be exhibited in water as well as a contact surface.

[0040] A particle shape, a particle size, or the like, of the silver ion powder is not limited, but it is preferable that the silver ion powder has an average particle size of 1 to 20um and a spherical shape. The silver ion powder may also act as an insoluble material at the time of performing the tapering process to increase uneven portions of the surface.

[0041] The kind of organic materials capable of being used as the antimicrobial material is not limited as long as it does not have toxicity to the human body. In addition, the organic material may be added at the time of polymerizing a polymer resin for spinning.

[0042] As the organic material, chlorides such as benzalconium chloride, benzenethionium chloride, cetyl pyridinium chloride, or the like, or a guanidine based compound may be preferably used. Preferably, cetyl pyridinium chloride, 1,1-hexamethylen bis(5-(4-chlorophenyl) biguanide) hydrochloride, polyhexamethylen biguanide hydrochloride, 1-methyl-2-nitro-5-(3-tetrahydrofuryl) methyl] guanidine, polyearamidylenequain dinium, polyhexamethyleneguanidinium, polyhexamethyleneguanidine, polyhexamethyleneguanidine phosphate, or the like, may be used. The organic antimicrobial material acts in a manner in which the organic antimicrobial material forms a cation on surfaces of the bristles on a toothbrush in the presence of water, and the cation electrically pulls an anion formed on a cell surface of a microbe to destroy a cell wall by attractive force.

[0043] The antimicrobial material may be contained in a content of preferably 0.1 to 10 parts by weight based on 100 parts by weight of the polymer resin configuring the core part or the sheath part. It is preferable that 0.1 to 3 parts by weight of the inorganic antimicrobial material and 0.1 to 2 parts by weight of the organic microbial material are mixed and added, and more preferably, as the organic antimicrobial material, the guanidine based compound is used.

[0044] In addition, according to the present invention, in order to form a split type fine filament, only the island component may remain by dissolving the sea component. It is preferable that the sea component is dissolved by at least one alkaline solution selected from a sodium hydroxide solution, an ammonium hydroxide solution, a calcium hydroxide solution, and a potassium hydroxide solution. A length of the dissolved sea component may be freely adjusted as long as the object of the present invention may be achieved. The length of the dissolved sea component is preferably 1 to 90 percent of the entire length from a distal end of the bristles on a toothbrush in an axial direction, and more preferably 1 to 50 percent of the entire length.

[0045] In addition, according to the present invention, a tapering process may be performed using an alkaline solution, or the like, in order to form uneven portions of the surfaces and thinning distal ends of the bristles on a toothbrush. At the time of performing the tapering process, it is preferable that a different kind of tapering solution is used depending on the kind of resin forming the bristles on a toothbrush. That is, in the case in which the polymer resin is polyamide such as nylon, or the like, it is preferable to use an acidic solution such as a hydrochloric acid solution, a nitric acid solution, a sulfuric acid solution, or the like, phenol, or the like, and in the case in which the polymer resin is polyester, it is preferable to use an alkaline solution such as a sodium hydroxide solution, an ammonium hydroxide solution, a calcium hydroxide solution, a potassium hydroxide solution, or the like. As the taper solution, at least one solution may be used, and the tapering process may be performed at least one time depending on the kind of polymer resin forming the core part and the sheath part.
Hereinafter, a method for manufacturing bristles on a toothbrush according to the present invention will be described.

Preferably, the method for manufacturing bristles on a toothbrush according to the present invention may include:

a) manufacturing a core-sheath type filament composed of a core part and a sheath part, having inorganic particles;

b) cutting the filament;

c) immersing one end of the filament in step b) in a processing tank filled with a tapering solution; and

d) immersing the other end of the filament in step c) in a processing tank filled with an alkaline solution.

First, step a) is a step of manufacturing the core-sheath type filament composed of the core part and the sheath part. The filament may be manufactured by a melting and extruding process using a general spinning method such as a melt spinning method, a dry spinning method, a wet spinning method, a dry jet-wet spinning method, or the like. In this case, it is preferable that a spinneret installed in a spinning machine includes a spinneret distribution plate having a core portion at a central portion thereof for preventing adhesion between polymers of the island component and a discharge hole collecting and discharging polymers passing through a plurality of island and sea component supply parts. In addition, in order to diversify a cross-sectional shape of the filament, the spinneret installed in the spinning machine may preferably have a circular shape, a dumbbell shape, a cross shape, a disk shape, a chevron shape, a triangular shape, a tetragonal shape, a hexagonal shape, an octagonal shape, a trapezoidal shape, a cone shape, and the like, and as the spinning machine, a composite spinning machine may be preferably used. The number of island components is preferably 1 to 20, and more preferably 2 to 10. In the case in which the number of island component is more than 20, a diameter of the island component becomes excessively thin, such that it is difficult to obtain desired strength.

In addition, the core part and the sheath part may be spun so as to have different colors by further adding a dye in addition to the antimicrobial material or inorganic particle at the time of preparing a spinning solution. The kind of dye is not limited as long as the object of the present invention may be achieved, but preferably, an organic or inorganic pigment may be used. It is preferable that the pigment is added at a content of 0.01 to 2 parts by weight based on 100 parts by weight of the entire spinning solution of the sea component or island component.

In a melting and extruding process of step a), extrusion is performed through a nozzle provided with a plurality of (32 to 300) spinnerets (diameter: 0.5 to 2 mm) having the above-mentioned shape in the spinning machine heated to 220 to 300°C. After extrusion, a drawing process may be performed in order to increase flexibility and strength of the filament. This drawing process is determined by a winding speed, and it is preferable that the filament is drawn at a draw ratio of 3 to 6 times at 150 to 220°C. It is preferable that the drawing process may be performed 1 to 4 times.

It is preferable that a thickness (diameter) of the composite filament manufactured in step a) is 0.02 to 1.0 mm. In the case in which the diameter is less than 0.02 mm, strength may be deteriorated, and in the case in which the diameter is more than 1.0 mm, the filament may be undrawn, and penetration between the teeth may be deteriorated at the time of brushing the teeth.

Next, step b) is a step of cutting the composite filament manufactured in step a). A binding process of the composite filaments for forming a bundle may be performed in advance. In this case, it is preferable in view of easiness of a subsequent process that a thickness of the bundle is 40 to 60 mm.

The composite filament is cut so as to have the same length as that of a completed product at the time of a tapering process or a length longer than that of the completed product by about 1 to 20 mm. Since a toothbrush is manufactured by implanting the composite filament into a handle of toothbrush before the tapering process, it is preferable to adjust a length of the bundle in consideration of this process.

Then, step c) is a step of immersing one end of the filament cut in step b) in the processing tank filled with the alkaline solution (tapering solution). In the case in which the polymer forming the filament is polyamide such as nylon, or the like, it is preferable to use an acidic solution such as a hydrochloric acid solution, a nitric acid solution, a sulfuric acid solution, or the like, having a concentration of 10 to 30%, phenol having a concentration of 5 to 10%, and the like, and in the case in which the polymer resin is polyester, it is preferable to use an alkaline solution such as a sodium hydroxide solution, an ammonium hydroxide solution, a potassium hydroxide solution, and the like, having a concentration of 40%. The tapering process may be preferably performed at 80 to 140°C. In this case, a length of a tapered portion may be adjusted depending on a length of an immersed portion.

In addition, a cross-sectional area of the other end to be tapered may be adjusted by adjusting the number of immersing process. The immersing process may be preferably performed 2 to 20 times for 10 to 60 seconds each time. The cross-sectional area of the tapered filament may be gradually thinned toward the other end by repeating the immersing process, and a filament having a thin distal end to be desired in the present invention may be manufactured.

The tapering process forms uneven portions of a surface of the filament while decreasing the cross-sectional area of the other end of the filament, thereby making it possible to improve detergency to be desired in the present invention. Detergency may be improved by variously adjusting a time of the tapering process, a concentration of the solution, and a length of an immersed portion of the filament.

In step d), the other end of the filament of step c) may be immersed in the processing tank filled with the tapering solution. The step d) may be performed through the same process as in step c).

When the tapering process is terminated, a tapered portion may be formed by washing to remove a hydrolyzed portion. The washing may be performed 2 to 3 times using flowing water, and an alkali neutralization process using dilute sulfuric acid may be further performed during the washing process.

The method for manufacturing bristles on a toothbrush may further include, after the step is terminated, implanting the filament manufactured in step d) into a toothbrush handle. The kinds and functions of a toothbrush handle are not limited as long as the object of the present invention may be achieved. The toothbrush handle may be manufactured using at least one material selected from a synthetic
resin material, a metal material, a ceramic material, and a plastic material. The toothbrush handle may be made of one material or a combination of at least two materials. For example, the toothbrush handle is made of the metal material and then a case made of an elastic material is covered thereon, or the like, such that, the toothbrush handle may be made of the material in any form.

An implanting part of the filament may be formed in a central portion of the filament, and the implanting part of the filament may be freely changed depending on a shape of the toothbrush handle and an implanting position.

Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings. However, in describing the present invention, a description of the known function or configuration will be omitted in order to elucidate the gist of the present invention, and since the following description is provided only as an example for describing the present invention in detail, the present invention is not limited thereto.

FIG. 1 illustrates cross sections 10, 20, 30, 40, 50, 60, 70, and 80 of single filaments of the bristles on a toothbrush according to an exemplary embodiment of the present invention, manufactured using spinnerets having various shapes. Here, circles 11, 21, 31, 41, 51, 61, 71, and 81 positioned at the center of each of the cross sections indicate core parts, and portions 12, 22, 32, 42, 52, 62, 72, and 82 enclosing the core parts indicate sheath parts.

FIG. 2 is a perspective view of a bristle on a toothbrush manufactured by a spinneret having a dodecagonal shape 30 in FIG. 1. A bristle 90 on a toothbrush at the left side of FIG. 2 indicates a bristle on a toothbrush manufactured by spinning without forming a core part, and a bristle 100 on a toothbrush at the right side of FIG. 2 indicates a bristle on a toothbrush composed of a core part 101 and a sheath part 102, manufactured by the method for manufacturing bristles on a toothbrush according to the present invention.

FIG. 3 illustrates bristles on a toothbrush obtained by tapering the bristles on a toothbrush of FIG. 2. A bristle on a toothbrush obtained by tapering the bristle 90 on a toothbrush of FIG. 2 is illustrated at the left side of FIG. 3, and a bristle on a toothbrush obtained by tapering the bristle 100 on a toothbrush of FIG. 2 is illustrated at the right side of FIG. 3. As illustrated in FIG. 3, it may be appreciated that the bristle on a toothbrush obtained by the method according to the present invention has uneven portions on the surface thereof.

FIGS. 4 to 7 illustrate cross sections 10, 20, 30, and 40 of single filaments of the bristles on a toothbrush according to an exemplary embodiment of the present invention, manufactured using spinnerets having various shapes. The cross sections may be represented by island components 11, 21, 31, and 41, and sea components 12, 22, 32, 42, respectively, and the island components and the sea components may be replaced by each other.

FIG. 8 is a perspective view of a filament having the cross section of FIG. 6. Here, a filament before removing a sea component 52 is illustrated in the left side of FIG. 8, and a shape of the filament in which the sea component 52 is removed and an island component 51 is exposed to the outside at a predetermined portion of the filament is illustrated in the right side of FIG. 8.

FIG. 9 is a perspective view of a filament having the cross section of FIG. 7, similarly in FIG. 8. Here, a filament before removing a sea component 62 is illustrated in the left side of FIG. 9, and a shape of the filament in which the sea component 62 is removed and only an island component 61 remains at a predetermined portion of the filament is illustrated in the right side of FIG. 9.

FIGS. 10 and 11 illustrate toothbrushes 130 and 140 into which the filaments of FIG. 11 are implanted. First, FIG. 7 illustrates a toothbrush 130 having a shape in which a sea component of an implanting part is not partially dissolved and a sea component of a distal end of the filament is removed. The toothbrush having the shape of FIG. 7 has relatively strong elasticity and the fine distal end of the filament has flexibility, such that cleansing performance, interdental penetration, and tooth or gum protection functions may be improved.

FIG. 11 illustrates a toothbrush having a shape in which the sea component is entirely removed and only the island component remains. A toothbrush having a shape as in FIG. 10 may have soft bristles on a toothbrush having a unique shape by completely removing the sea component to thereby be used in an anchorless toothbrush, and have a shape of the bristles on a toothbrush that is most suitable for toothbrushing, such that a gum protection function may be improved as compared to a general toothbrush.

Advantageous Effects

A toothbrush manufactured by a method for manufacturing bristles on a toothbrush according to the present invention has a core-sheath double structure and various cross-sectional shapes, has uneven portions formed on a surface thereof by a tapering process while containing inorganic particles, thereby making it possible to implement more excellent cleansing performance and penetration as compared to existing bristles on a toothbrush. In addition, the toothbrush contains inorganic or organic antimicrobial materials, such that the toothbrush may have a semi-permanent antimicrobial activity which is difficult to find in an existing toothbrush.

DESCRIPTION OF DRAWINGS

FIG. 1 illustrates cross sections of a bristle on a toothbrush manufactured according to an exemplary embodiment of the present invention.

FIG. 2 is a perspective view of a bristle on a toothbrush manufactured so as to have a dodecagonal shape 30 among the cross sections of FIG. 1.

FIG. 3 is a perspective view of a bristle on a toothbrush obtained by tapering the bristle on a toothbrush of FIG. 2.

FIGS. 4 to 7 illustrate cross sections of bristles on a toothbrush manufactured according to an exemplary embodiment of the present invention.

FIG. 8 is a perspective view of a filament having the cross section of FIG. 6.

FIG. 9 is a perspective view of a filament having the cross section of FIG. 7.

FIGS. 10 and 11 are side views of toothbrushes into which bristles on a toothbrush manufactured according to exemplary embodiments of the present invention are implanted.

DETAILED DESCRIPTION OF MAIN ELEMENTS

10, 20, 30, 40, 50, 60, 70, 80: cross section of bristle on toothbrush
mixed with the core part forming material and the sheath part forming material at a weight ratio of 5:5, respectively. The core part forming material was put into a first extruder having a temperature of 260°C, and the sheath part forming material was put into a second extruder having a temperature of 250°C, and then mixed in a composite die, such that a filament was discharged through a spinneret. The spinneret had a circular shape, and a core-sheath type filament was manufactured by simultaneously spinning. The spun filament was subjected to a cooling process and a drawing process, and then manufactured as a bundle having a diameter of 50 mm. The manufactured bundle was cut to have a length of 30 mm, and then immersed in an alkaline solution having a concentration of 30% at 120°C, thereby performing a tapering process. The immersing was performed two times.

After the immersing of the bundle was terminated, the same process as in the tapering process was performed on the other end of the bundle that was not tapered, such that the other end was tapered. The filament subjected to the tapering process was washed with flowing water two times, neutralized using dilute sulfuric acid, and then washed again, thereby manufacturing a tapered filament bundle of which a distal end was fined in a drill shape. Antimicrobial activity of the manufactured bundle was measured and shown in Table 1 and usability of a toothbrush manufactured by implanting the manufactured bundle was measured and shown in Table 2.

Example 2

A filament bundle was manufactured using the same process and conditions as in Example 1 except that a shape of the spinneret was a dodecagonal shape. Antimicrobial activity of the manufactured bundle was measured and shown in Table 1 and usability of a toothbrush manufactured by implanting the manufactured bundle was measured and shown in Table 2.

Example 3

A filament bundle was manufactured using the same process and conditions as in Example 2 except for using 2 Kg of polyethylene terephthalate (PET) having a weight average molecular weight of 40,000 as the core part forming material. Antimicrobial activity of the manufactured bundle was measured and shown in Table 1 and usability of a toothbrush manufactured by implanting the manufactured bundle was measured and shown in Table 2.

Example 4

A filament bundle was manufactured using the same process and conditions as in Example 2 except for using 2 Kg of nylon 6,10 having a weight average molecular weight of 32,000 as the sheath part forming material. Antimicrobial activity of the manufactured bundle was measured and shown in Table 1 and usability of a toothbrush manufactured by implanting the manufactured bundle was measured and shown in Table 2.

Example 5

A filament bundle was manufactured using the same process and conditions as in Example 2 except for preparing 80 g of polyhexamethylene guanidine phosphate (Guacil TX, SK chemical) and 8 g of an inorganic antimicrobial agent (CWT-A, Jishim Tech) having an average particle size of 5 μm as antimicrobial materials, and adding to and mixing with
the core part forming material and the sheath part forming material at a weight ratio of 5:5, respectively. Antimicrobial activity of the manufactured bundle was measured and shown in Table 1 and usability of a toothbrush manufactured by implanting the manufactured bundle was measured and shown in Table 2.

Example 6

[0107] 2 kg of polybutylene terephthalate (PBT) having a weight average molecular weight of 75,000 as an island component polymer and 2 kg of a polyethylene glycol-polyester copolymer (weight average molecular weight: 40,000) in which polyethylene glycol was copolymerized at a content of 30 wt % as sea component polymer were prepared, and 80 g of calcium carbonate (Kwangsun Chemical) having an average diameter of 10 μm as an uneven portion forming material and 80 g of polyhexamethylene guanidine phosphate (Guanic TX, SK chemical) as an antimicrobial material were prepared and added to and mixed with the sea component polymer and the island component polymer at a weight ratio of 5:5, respectively. A monofilament was manufactured by supplying the sea component polymer and the island component polymer to an extruder type composite spinning machine in a state in which a weight ratio of the sea component and the island component was set to 50 wt %: 50 wt % and spinning the sea component polymer and the island component polymer at a spinning temperature of 280° C, so as to have the shape 30 composed of the sea component 31 and the island component 32 of FIG. 6.

[0108] After the manufactured monofilament was cooled and drawn during a winding process, the wound monofilaments were tied into a bundle, thereby manufacturing a bundle having a diameter of 40 mm. The manufactured bundle was cut to have a length of 30 mm, and then immersed in an alkaline solution having a concentration of 30% at 120° C, thereby performing a tapering process on the island component while dissolving the sea component. After the immersing of the bundle was terminated, the same process as in the tapering process was performed on the other end of the bundle that was not tapered, such that the sea component was removed. The filament subjected to the tapering process was washed with flowing water two times, neutralized using dilute sulfuric acid, and then washed again, thereby manufacturing a tapered filament bundle of which a distal end was fined in a drill shape. Antimicrobial activity of the manufactured bundle was measured and shown in Table 1 and usability of a toothbrush manufactured by implanting the manufactured bundle was measured and shown in Table 2.

Example 7

[0109] A filament bundle was manufactured using the same process and conditions as in Example 1 except for using a spinneret having a shape 40 in which the sea component 41 and the island component 42 of FIG. 7 were included during a manufacturing process of the filament. Antimicrobial activity of the manufactured bundle was measured and shown in Table 1 and usability of a toothbrush manufactured by implanting the manufactured bundle was measured and shown in Table 2.

Comparative Example 1

[0110] 2 Kg of PBT was used as a filament forming material and spun alone without forming a sheath part. The uneven portion forming material was not added, and 80 g of polyhexamethylene guanidine phosphate was added as an antimicrobial material, thereby preparing a spinning solution. A temperature of a spinning machine was 260° C, and a spinneret had a circular shape. The spun filament was subjected to a cooling process and a drawing process and then manufactured as a bundle having a diameter of 50 mm. The manufactured bundle was cut to have a length of 30 mm, and then immersed in an alkaline solution having a concentration of 30% at 120° C, thereby performing a tapering process. The immersing was performed two times.

[0111] After the immersing of the bundle was terminated, the same process as in the tapering process was performed on the other end of the bundle that was not tapered, such that the other end was tapered. The filament subjected to the tapering process was washed with flowing water two times, neutralized using dilute sulfuric acid, and then washed again, thereby manufacturing a tapered filament bundle of which a distal end was fined in a drill shape. Antimicrobial activity of the manufactured bundle was measured and shown in Table 1 and usability of a toothbrush manufactured by implanting the manufactured bundle was measured and shown in Table 2.

Comparative Example 2

[0112] A filament bundle was manufactured using the same process and conditions as in Comparative Example 1 except for not adding the antimicrobial agent. Antimicrobial activity of the manufactured bundle was measured and shown in Table 1 and usability of a toothbrush manufactured by implanting the manufactured bundle was measured and shown in Table 2.

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>Bacteriostatic Reduction Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Staphylococcus aureus</td>
</tr>
<tr>
<td>Example 1</td>
<td>89.1</td>
</tr>
<tr>
<td>Example 2</td>
<td>97.2</td>
</tr>
<tr>
<td>Example 3</td>
<td>97.3</td>
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<td>Example 4</td>
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<td>Example 5</td>
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<tr>
<td>Example 6</td>
<td>98.7</td>
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<tr>
<td>Example 7</td>
<td>98.1</td>
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<tr>
<td>Comparative Example 1</td>
<td>94.2</td>
</tr>
<tr>
<td>Comparative Example 2</td>
<td>15.2</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>Evaluation Category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Feeling of Tooth Brushing</td>
</tr>
<tr>
<td>Example 1</td>
<td>4.2</td>
</tr>
<tr>
<td>Example 2</td>
<td>4.5</td>
</tr>
<tr>
<td>Example 3</td>
<td>4.3</td>
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<tr>
<td>Example 4</td>
<td>4.3</td>
</tr>
<tr>
<td>Example 5</td>
<td>4.8</td>
</tr>
<tr>
<td>Example 6</td>
<td>4.3</td>
</tr>
<tr>
<td>Example 7</td>
<td>4.4</td>
</tr>
<tr>
<td>Comparative Example 1</td>
<td>3.7</td>
</tr>
<tr>
<td>Comparative Example 2</td>
<td>2.4</td>
</tr>
</tbody>
</table>

[0113] *Evaluation Criteria
[0114] 5: very excellent
[0115] 4: excellent
[0116] 3: fair
[0117] 2: poor
[0118] 1: very poor
[0119] As shown in Table 1, it may be appreciated that in Examples 1 to 7, the antimicrobial activity was significantly excellent as compared to Comparative Example 2. In addition, it may be appreciated that in Examples 2 to 7 in which the spinneret was changed, the antimicrobial activity was slightly excellent as compared to Example 1 and Comparative Example 1 in which the circular spinneret was used. The reason may be that a surface area of the spun filament was increased, such that an amount of antimicrobial material with a cation that was exposed to the surface was increased.

[0120] Further, it may be appreciated that in Examples 1 to 7, feeling of the tooth-brushing and the detergency were significantly excellent as compared to Comparative Examples 1 and 2 as shown in Table 2. Particularly, it may be appreciated that in Examples 5 to 7, since the inorganic particles and the inorganic antimicrobial material were formed as the uneven portions and at the same time, a surface area of the filament was increased, more excellent detergency and antimicrobial activity were exhibited.

[0121] As described above, according to the present invention, the filament may have the core-sheath structure and a surface area of the filament may be increased by variously adjusting a shape of the spinneret at the time of spinning the filament. In addition, the bristles on a toothbrush having excellent antimicrobial activity and detergency may be manufactured by forming the uneven portions of the surface thereof by the tapering process and adjusting the cross-sectional area of the distal end of the filament.

[0122] Exemplary embodiments of the present invention were described above, but the present invention may include various changes, modifications, and equivalents. It will be appreciated that the present invention may be similarly applied by modifying the exemplary embodiments. Therefore, the above-mentioned contents are not for limiting the present invention defined by the accompanying claims.

1. A method for manufacturing bristles on a toothbrush, the method comprising:
   a) manufacturing a core-sheath type filament composed of a core part and a sheath part;
   b) cutting the filament;
   c) immersing one end of the filament in step b) in a processing tank filled with a tapering solution; and
   d) immersing the other end of the filament in step c) in a processing tank filled with an alkaline solution.

2. The method of claim 1, wherein the bristles on the toothbrush have a cross-sectional shape comprising at least one of the following: a dumbbell shape, a cross shape, a disk shape, a chevron shape, a triangular shape, a tetragonal shape, a trapezoidal shape, and a corn shape.

3. The method of claim 1, wherein the bristles on the toothbrush have a shape comprising at least one of the following: a circular shape, a dumbbell shape, a cross shape, a disk shape, a chevron shape, a triangular shape, a tetragonal shape, a trapezoidal shape, and a corn shape.

4. The method of claim 1, wherein the core part or the sheath part is made of a polymer resin comprising at least one of the following: polyester, a thermoplastic rubber, an elastomer, silicone, BPA-free bio plastic, polyoxymethylene, nylon 4, nylon 6, nylon 7, nylon 9, nylon 11, nylon 12, nylon 4,6, nylon 6,6, nylon 6,10, nylon 6,12, and a polyester copolymer polymer resin.

5. The method of claim 1, wherein the core part, the sheath part, or both of the core part and the sheath part further contain an additive including organic particles, inorganic particles, or a mixture thereof.

6. The method of claim 5, wherein the organic particles comprise any one or at least two selected from green tea extracts, barley sprout extracts, ginkgo biloba extracts, pine needle extracts, bamboo extracts, activated carbon, xylitol, and a water soluble polymer, and the inorganic particles are any one or at least two selected from zeolite, silica-alumina, calcium phosphate, zirconium phosphate, calcium carbonate, silica gel, titanium dioxide, zinc oxide, zirconium carbide, magnesium oxide, silicon dioxide, and aluminum oxide.

7. The method of claim 6, wherein any one or at least two metals selected from gold, silver, platinum, and copper is further supported on the inorganic particles.

8. The method of claim 5, wherein the additive has an average particle size of 0.1 to 10 μm.

9. The method of claim 1, wherein an antimicrobial material is further added at a content of 0.1 to 10 parts by weight based on 100 parts by weight of the core part, the sheath part, or the core part and the sheath part.

10. The method of claim 9, wherein an antimicrobial material is a guanidine based compound or silver ion powder.

11. A toothbrush using bristles on a toothbrush manufactured by the method of claim 1.