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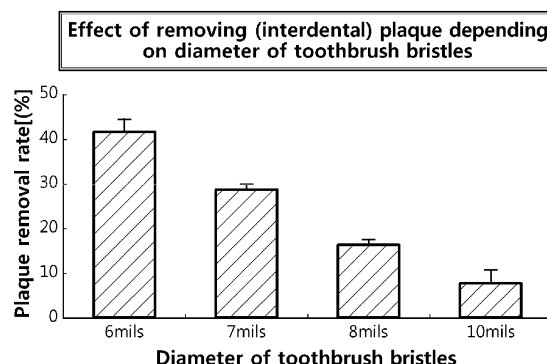
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(54) **TOOTHBRUSH BRISTLES MADE OF POLYKETONE MATERIAL, AND TOOTHBRUSH INCLUDING SAME**

(57) Provided are polyketone toothbrush bristles and a toothbrush comprising the same. The toothbrush bristles are made using a polyketone material having high rigidity, high elasticity and excellent wear resistance and thus shows reduced bristle gap-widening and increased service life. The toothbrush bristles obtained by using the polyketone according to the present disclosure have excellent elasticity and are suitable for removal of plaque on the severely indented tooth surfaces. Particularly, in the case of fine bristles, it is possible to remove interdental plaque, which, otherwise cannot be removed well by the conventional toothbrushes.

FIG. 1



DescriptionTECHNICAL FIELD

5 **[0001]** The present application claims priority to Korean Patent Application No. 10-2016-0125903 filed on September 29, 2016 and Korean Patent Application No. 10-2017-0089694 filed on July 14, 2017 in the Republic of Korea, the disclosures of which are incorporated herein by reference.

[0002] The present disclosure relates to polyketone toothbrush bristles and a toothbrush including the same.

10 **[0003]** More particularly, the present disclosure relates to toothbrush bristles of a polyketone material having high rigidity, high elasticity and excellent wear resistance and thus shows reduced bristle gap-widening and increased service life, and a toothbrush including the same.

[0004] In addition, since a polyketone material is cheaper than nylon or a polyester polymer, particularly polybutylene terephthalate (PBT) used frequently for toothbrush bristles, it is possible to provide toothbrush bristles having high cost efficiency.

BACKGROUND ART

[0005] A toothbrush is a tool used for cleaning an oral cavity including teeth and gingiva and includes a grip and toothbrush bristles, wherein the toothbrush bristles are generally made using an elastic synthetic resin.

20 **[0006]** In general, toothbrush bristles have been made using a polyester polymer (e.g. polyethylene terephthalate (PET), polytrimethylene terephthalate (PTT), polybutylene terephthalate (PBT), or the like).

[0007] Although nylon has an advantage of suitable flexibility, it has high moisture absorbing property to provide a short service life, shows low strength, and thus is required to have a predetermined thickness or more. In the case of polyester-based toothbrush bristles, they have a disadvantage of low flexibility. Such conventional toothbrush bristles

25 show a bristle gap-widening phenomenon even after 1 month to 3 months, and thus requires exchange. **[0008]** Particularly, in the case of fine bristles including a polyester polymer, such as PBT, they have a tapered shape and thus show a bristle gap-widening phenomenon and wearing in earlier time. Therefore, there is an inconvenience in that the toothbrush should be exchanged frequently.

30 **[0009]** Throughout the specification, many documents are referred and references thereof are stated. The disclosures of such documents are incorporated herein for reference so that the present disclosure will be thorough and complete, and will fully convey the scope of the present disclosure to those skilled in the art.

DISCLOSURETechnical Problem

35 **[0010]** The present inventors have conducted intensive studies to solve the bristle gap-widening problem of the existing nylon- and polyester (e.g. PBT)-based toothbrush bristles, particularly the problem of early bristle gap-widening and wearing caused by the thin ends of bristles in the case of fine bristles having a tapered shape. As a result, it has been

40 found that toothbrush bristles having high rigidity, high elasticity and excellent wear resistance can be obtained by using a polyketone material. The present disclosure is based on this finding. **[0011]** The present disclosure is directed to providing toothbrush bristles including polyketone.

[0012] The present disclosure is also directed to providing a toothbrush including the toothbrush bristles.

45 **[0013]** These and other objects and advantages of the present disclosure may be understood from the following detailed description and will become more fully apparent from the exemplary embodiments of the present disclosure.

Technical Solution

[0014] In one aspect of the present disclosure, there are provided toothbrush bristles including polyketone.

50 **[0015]** Toothbrush bristles are ultimately directed to maximizing a tooth-cleaning effect while minimizing damages upon the gingiva. In general, as damages upon the gingiva are minimized more and more, the tooth-cleaning effect is degraded. When using a high-rigidity material to increase the cleaning effect, the gingiva is damaged undesirably. The present inventors have conducted intensive studies to solve the above-mentioned problem. Thus, we have unexpectedly found that when applying a polyketone resin to toothbrush bristles, irritation to the gingiva occurs little while removing

55 plaque excellently by virtue of high rigidity and high elasticity of the polyketone resin. **[0016]** A polyketone resin is a novel type of resin developed recently, is synthesized from carbon monoxide and olefin, and has mechanical properties that belong to the category of high-performance plastics.

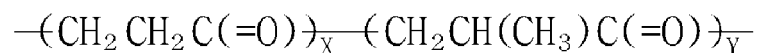
[0017] US Patent No. 4,843,144 discloses a linear alternate polymer synthesized from olefin, such as ethylene or

propylene, with carbon monoxide. The polyketone resin used therein has excellent impact resistance, high repulsion elasticity both at room temperature and low temperature and excellent creep characteristics.

[0018] In the toothbrush bristles according to the present disclosure, the polyketone may have a basic structure including carbon monoxide and olefin.

[0019] The polyketone may be a hybrid polymer of carbon monoxide with ethylene or a terpolymer of carbon monoxide, ethylene and polyketone.

[0020] In addition, the polyketone ingredient may be represented by the following chemical formula:



wherein x:y is 1:10-10:1.

[0021] The polyketone polymer used for the toothbrush bristles according to the present disclosure may have a linear alternate structure, and may include carbon monoxide substantially per each unsaturated hydrocarbon molecule. The ethylenic unsaturated hydrocarbon compound that may be used as a precursor of the polyketone polymer may have 1-20 carbon atoms, preferably 1-10 carbon atoms. More preferably, the ethylenic unsaturated hydrocarbon compound may be ethene or α -olefin (e.g. propene, 1-butene, isobutene, 1-hexene or 1-octene).

[0022] In addition, the polyketone resin may be obtained by liquid phase polymerization of carbon monoxide with olefin using an alcohol solvent in the presence of a catalyst composition including a palladium compound. In this case, the polymer may be recovered through filtering and purification steps after the polymerization. The remaining catalyst composition is removed with a solvent, such as an alcohol or acetone.

[0023] According to an embodiment of the present disclosure, the toothbrush bristles may include a polyketone material.

[0024] According to another embodiment of the present disclosure, the toothbrush bristles may further include at least one water-insoluble polymer material selected from the group consisting of polypropylene, polyethylene, polyethylene terephthalate, polybutylene terephthalate, polytrimethylene terephthalate, polyurethane and nylon.

[0025] For example, the toothbrush bristles according to the present disclosure may include a polyketone blend obtained by blending a linear alternate polymer containing carbon monoxide with at least one ethylenic unsaturated hydrocarbon and at least one water-insoluble polymer material described hereinabove.

[0026] The water-insoluble polymer material is one used for manufacturing conventional toothbrush bristles. Among the water-insoluble polymers, nylon has excellent heat resistance, elastic modulus and strength, but shows high moisture absorbability to cause a change in physical properties or dimension undesirably. Particularly, nylon is disadvantageous in that it undergoes a change in impact resistance when absorbing moisture. To solve this, it is possible to use a blend of nylon with polyketone as a material for the toothbrush bristles according to the present disclosure.

[0027] The polyketone blend may include 60-80 wt% of the linear alternate polyketone polymer and 20-40 wt% of at least one water-insoluble polymer as mentioned above.

[0028] In the polyketone blend, polyketone and at least one water-insoluble polymer may be blended at a weight ratio of 9:1-7:3.

[0029] The polyketone blend may be prepared by melting each of the ingredients at high temperature, followed by compounding. Herein, additional ingredients, such as an antioxidant and UV stabilizer, may be further incorporated.

[0030] According to another embodiment, the toothbrush bristles may further include an ingredient favorable to the tooth health and selected from the group consisting of an anti-inflammatory and anti-bacterial agent, whitening agent, sensitive tooth-alleviating agent, anti-plaque agent, fragrance, bad breath-preventing agent, gingiva health-aid, tooth decay-preventing agent, oral cavity cleaner, xylitol, bamboo salt, bay salt, prepared salt, refined salt, pine salt, steamed salt, molten salt, processed salt and phosphate salt.

[0031] When the toothbrush bristles further include the ingredients favorable to the tooth health as described above, such ingredients are released by tooth cleaning pressure and moisture upon tooth brushing, and act on the teeth or gingiva so that they may help effects of preventing various oral diseases, such as anti-bacterial, anti-inflammatory, anti-plaque and anti-sensitive effects.

[0032] In addition, the toothbrush bristles according to the present disclosure may be provided in the form of fine bristles.

[0033] In the case of fine bristles, they are soft and touch teeth everywhere to clean all corners of teeth, and particularly they show a high cleaning effect between teeth and the gingiva. On the contrary, in the case of general fine bristles, they are worn rapidly and end portions thereof are bent easily, and thus require exchange every 1-2 months. Therefore, it is required to conduct studies to improve the durability of toothbrush bristles, especially fine bristles.

[0034] The polyketone fine bristles according to the present disclosure has high rigidity, high elasticity and excellent wear resistance, and thus is advantageous in that they can be used for a period of use while maintaining the initial state.

[0035] According to an embodiment of the present disclosure, the toothbrush bristles may be provided in the form of general bristles having the same diameter even at the end and round-shaped end portions, or in the form of needle-like

fine bristles having tapered end portions.

[0036] In the case of general bristles, they may have a diameter of 0.1-0.13 mm. In the case of fine bristles, they may be ultrafine bristles having a diameter of 0.02 mm or less, or 0.1 mm or less, at the end portions thereof.

[0037] The general bristles having a diameter of 0.1-0.13 mm may have at least three times larger number of bristles planted densely as compared to general bristles having a diameter of 0.16-0.20 mm, and thus show high elasticity and softness to provide a good cleaning effect to the gingiva and teeth and a high effect of massaging the gingiva. Thus, they can provide a tooth cleaning effect in combination with a gingiva massaging effect, which cannot be provided by general bristles. In the case of fine bristles having a diameter of 0.02 mm or less at the end portions thereof, they are thinner than the gap between the gingiva and teeth, and thus can clean plaque between the gingiva and teeth with ease and provide an effect of preventing gingivitis.

[0038] The toothbrush bristles according to the present disclosure may be obtained by forming fine bristles having a tapered shape and planting them in a toothbrush head in a 'V'-like shape.

[0039] The toothbrush bristles may be planted so that the length of planted bristles, which is the distance from the head top surface to the ends of bristles, may be 5-25 mm, but are not limited thereto.

[0040] The planted fine bristles may have a total length of 10-30 mm or 15-25 mm, a thickness of 0.01-0.1 mm and a planted portion length of 1-15 mm. In addition, the height of fine bristles from the top surface of toothbrush head after planting may be 5-20 mm, but is not limited thereto.

[0041] The toothbrush bristles obtained by using polyketone according to the present disclosure have excellent elasticity and are suitable for removal of plaque on the severely indented tooth surfaces. Therefore, it is possible to remove plaque on the tooth surfaces and between teeth, where the conventional toothbrushes cannot function well.

[0042] In addition, during tooth brushing repeated every day many times, the toothbrush bristles can also perform suitable massaging on the gingiva without irritation or bleeding. Therefore, it is possible to carry out tooth care continuously without a need for performing massage for the health of teeth and gingiva requiring additional time and labor.

[0043] In another aspect of the present disclosure, there is provided a toothbrush including the polyketone toothbrush bristles.

[0044] According to an embodiment, the toothbrush according to the present disclosure may be provided in the form of a product including a toothbrush head made of an elastic member such as rubber or silicone so as to impart the effects of physical cleaning and gingiva massaging.

[0045] According to another embodiment, the toothbrush according to the present disclosure may include: a grip portion having a predetermined thickness and width and a toothbrush head portion linked thereto; polyketone toothbrush bristles formed on the top surface of the toothbrush head portion; and a tip provided in the toothbrush head portion.

[0046] The toothbrush according to the present disclosure may be provided with two or more types of toothbrush bristles made using different materials.

[0047] For example, the toothbrush according to the present disclosure may include: a grip portion having a predetermined thickness and width and a toothbrush head portion linked thereto; the first toothbrush bristles fixed to one part of the head portion and the second toothbrush bristles fixed to the other part of the head portion, wherein the first toothbrush bristles include a polyketone material, and the second toothbrush bristles include at least one water-insoluble polymer material selected from the group consisting of polypropylene, polyethylene, polyethylene terephthalate, polybutylene terephthalate, polytrimethylene terephthalate, polyurethane and nylon.

[0048] The methods for manufacturing toothbrush bristles and ingredients known to those skilled in the art may be applied to the toothbrush according to the present disclosure, except that the toothbrush bristles according to the present disclosure uses polyketone instead of conventional materials, such as nylon and PBT.

Advantageous Effects

[0049] The novel toothbrush bristles according to the present disclosure have higher rigidity and elasticity as compared to the conventional toothbrush bristles, are more helpful to tooth cleaning, show high wear resistance, and can be used for a long time.

DESCRIPTION OF DRAWINGS

[0050]

FIG. 1 is a graph illustrating the plaque removal rate between teeth as a function of diameter of toothbrush bristles.

FIG. 2 shows polyketone toothbrush bristles and nylon toothbrush bristles right after brushing.

BEST MODE

[0051] Hereinafter, the present disclosure will be explained in detail with reference to Examples. The following examples are for illustrative purposes only and it is apparent to those skilled in the art that the scope of the present disclosure is not limited thereto.

Examples1. Comparison of Physical Properties for Polyketone, Nylon and PBT

[0052] Each of Nylon 612 (Dupont, Tynex), polybutylene terephthalate (PBT) (KOLON) or polyketone (Hyosung, M310U and similar grade of M310U), as powder of resin material used for toothbrush bristles, was heated and extrusion molded through a nozzle of extruder, followed by cooling and drying with hot air. Then, toothbrush bristles having a diameter of 0.18 mm were produced by using each material.

(1) Tensile Strength

[0053] After producing toothbrush bristles, tensile strength as the force upon the cutting of bristles, by which the rigidity of one strand of bristle could be evaluated, was determined. Then, evaluation was carried out by comparing the tensile strength of polyketone with that of the conventional material for toothbrush bristles, Nylon 612 or PBT.

[0054] Particularly, according to the standard test method of ASTM D638, both ends of one strand of toothbrush bristle were fixed by a fixing member and the strand was drawn along the axis of the specimen. Then, the force upon the cutting, i.e. tensile strength, was determined.

(2) Elasticity Loss

[0055] In addition, to determine the durability of polyketone, polyketone toothbrush bristles were planted to a toothbrush head to obtain a toothbrush. Then, the toothbrush was compared with toothbrushes using Nylon 612 and PBT in terms of elasticity loss.

[0056] The elasticity loss indicates durability (bristle gap-widening) during the use of a toothbrush. After carrying out reciprocating brushing 5000 times or 10000 times by using a brush machine, the gap-widening was determined according to the following mathematical Formula 1. As the value of elasticity loss is decreased, the difference of a gap in the bristles between before and after brushing is reduced, suggesting that the toothbrush bristles show lower gap-widening.

[Mathematical Formula 1]

$$\text{Elasticity loss (\%)} = (B - A) \times 100$$

A: gap in the bristles before brushing

B: gap in the bristles after brushing

(3) Test Results

[0057] The following Table 1 shows the results of tensile strength (Kgf) and elasticity loss (%) of each type of toothbrush bristle.

[Table 1]

	Item	Polyketone	Nylon 612	PBT
Bristle characteristics	Tensile strength (kgf)	1.76 ± 0.03	0.87 ± 0.05	1.56 ± 0.06
Toothbrush characteristics	Elasticity loss (%) Brushing 5,000 times	6.23	9.49	8.51
	Elasticity loss (%) Brushing 10,000 times	13.43	19.4	15.3

[0058] After the test, polyketone toothbrush bristles show a tensile strength (kgf) 2.0 times higher than the tensile strength of nylon and 1.13 times higher than that of PBT (Table 1), which demonstrates that polyketone maintains high rigidity when it is applied to toothbrush bristles.

[0059] In addition, after carrying out reciprocating brushing 5,000 times, the toothbrush using polyketone toothbrush bristles shows an elasticity loss 34% and 27% lower than the elasticity loss of Nylon 612 and that of PBT, respectively. This suggests that polyketone shows lower gap-widening by 34% and 27% as compared to Nylon 612 and PBT, respectively. Similarly, after carrying out reciprocating brushing 10,000 times, polyketone shows lower gap-widening by 31% and 12% as compared to Nylon 612 and PBT, respectively.

2. Determination of Gingiva Irritation for Polyketone, PBT and PES

[0060] Polymers having high rigidity and excellent wear resistance, like polyketone, include fluoro-resin (PTFE, PVDF), POM, PBT, PES, or the like. However, in the case of fluoro-resin, it is difficult to manufacture toothbrush bristles due to its high melting point. In the case of POM, it is not suitable for toothbrush bristles due to its brittleness. PBT and PES are materials having sufficiently high rigidity and excellent wear resistance, like polyketone. Thus, toothbrush bristles having a diameter of 0.18 mm were produced by using them in the same manner as the above-described example. Herein, the end portions of bristles were planted without any separated processing for fine bristles to obtain toothbrush bristles. Then, the toothbrush bristles using three types of materials were evaluated by professional panels through a survey about gingiva irritation.

[0061] The survey was carried out by allowing 20- to 40-aged 20 females and 20 males to use test toothbrush for 7 days and then comparing the test toothbrush with one another. Before using a new toothbrush, the panels were allowed to have a quiescence of 3 days and to care their teeth as usual during the quiescence. The survey results are shown in the following Table 2 (multiple choices allowed).

[Table 2]

	No pain on gingiva during brushing	Pain on gingiva during brushing	Bleeding during brushing
PBT	21 persons	19 persons	4 persons
PES	13 persons	27 persons	5 persons
Polyketone	35 persons	5 persons	0

[0062] After the test, it can be seen that while polyketone causes little irritation on the gingiva and thus is suitable as a material for toothbrush bristles, PBT and PES cause high gingiva irritation and thus are not suitable for toothbrush bristles.

3. Functional Evaluation of Polyketone and Nylon

[0063] To the same toothbrush pole having 32 holes with a diameter of 1.6 mm, nylon toothbrush bristles and polyketone toothbrush bristles each having a diameter of 5 M (0.127 mm) were planted to provide test toothbrushes. Then, 20- to 40-aged 20 females and 20 males were allowed to use each toothbrush and compared the toothbrushes with each other. Before using a new toothbrush, the panels were allowed to have a quiescence of 3 days and to care their teeth as usual during the quiescence.

[0064] The survey included questions capable of evaluating the elasticity and cleaning effect of each toothbrush and evaluation was carried out in a 5-point scale (higher point means higher satisfaction).

[Table 3]

	Nylon 612	Polyketone
The toothbrush bristles are elastic	2.2	3.9
The toothbrush shows high cleaning effect	2.5	4.0
The toothbrush provides a refreshing feel between teeth	2.2	3.8
Food residue between teeth is removed well	2.4	3.9

[0065] After the test, it can be seen that the polyketone bristles show high elasticity to provide a significantly higher effect of cleaning the tooth surface and interdental portion as compared to the nylon bristles.

4. Determination of Effect of Removing Plaque for Toothbrush Bristles Having Different Diameter

[0066] As the bristles applied to a toothbrush have a smaller diameter, a higher interdental cleaning effect is provided. However, in the case of toothbrush bristles having a small diameter, particularly nylon bristles used frequently according to the related art, the bristles are cut easily, have little elasticity and cause gap-widening with ease.

[0067] In this example, to overcome the above-mentioned disadvantages of nylon bristles, polyketone having high rigidity was applied to develop toothbrush bristles having high elasticity and causing little gap-widening despite a small diameter. Toothbrush bristles having a diameter of 10 mils (0.254 mm), 8 mils (0.203 mm), 7 mils (0.178 mm) and 6 mils (0.152 mm) were produced to determine the effect of removing plaque as a function of diameter of bristles.

[0068] Bacterial film coating on the artificial tooth surface was used after the tooth portion of a gnathostatic model was dipped in a colored polymer for about 10 seconds, taken out therefrom, dried in an isothermal-isohumidity chamber (25°C, 55%) maintaining a predetermined temperature and humidity for 60 minutes, and dried completely. Then, the toothbrushes, to which bristles having a diameter of 10 mils, 8 mils, 7 mils and 6 mils were planted, were used so that the section of bristles of the toothbrush and the narrower surface of the coated gnathostatic model were positioned horizontally with each other to cover the surfaces as much as possible during brushing. A pressure of 300 g was applied to all types of toothbrushes and each toothbrush product was subjected to vertical brushing for 30 seconds alternately with horizontal brushing for 30 seconds, 8 times. Then, the area of the artificial tooth surface was measured before and after removing the bacterial film through a microscope and the rate of plaque removal was evaluated as a percent (%) value. The results are shown in FIG. 1.

[0069] After the test, it can be seen that as the diameter of toothbrush bristles is decreased from 10 mils (0.254 mm) to 6 mils (0.152 mm), the interdental plaque removal rate is improved by about 4.5 times or more.

5. Comparison of Physical Properties of Polyketone vs. Nylon

(1) Tensile Strength

[0070] To evaluate the force upon cutting of one strand of toothbrush bristle, the top end/bottom end of one strand of toothbrush bristle were gripped to a universal test machine (UTM) with an interval of 1 cm and the top end was drawn at a rate of 200 mm/min to measure the force when the strand was cut.

(2) Elasticity Loss

[0071] To evaluate how much toothbrush bristles cause gap-widening, a toothbrush was tested with a brushing evaluation machine by measuring the gap-widening width after brushing 5,000 times. Each of polyketone bristle and nylon bristle was photographed right after brushing. The results are shown in FIG. 2.

(3) Elasticity

[0072] To evaluate elasticity (softness) of toothbrush bristles, one strand of toothbrush bristle was hang on a wire, which allows measurement of applied force at the point corresponding to 1/3 of the strand, and the force was measured.

(4) Test Results

[0073] The test results for tensile strength, elasticity loss and elasticity are shown in the following Table 4.

[Table 4]

Item		Polyketone	Nylon612	Results vs. nylon
Tensile strength (bristle diameter: 0.102 mm)	Tensile strength (kgf)	0.56 ± 0.034	0.56 ± 0.034	40% increased

(continued)

Item			Polyketone	Nylon612	Results vs. nylon
Toothbrush characteristics (bristle diameter: 0.127 mm)	Elasticity loss (%) (brushing 5,000 times)	Right after brushing	23.0%	39.50%	42% improved
		After complete drying	6.1%	11.90%	48.7% improved
	Bristle elasticity (cN)		0.56 ± 0.034	0.56 ± 0.034	40% increased

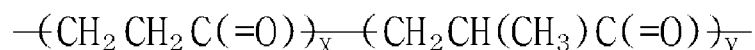
[0074] As can be seen from Table 4, after evaluating the tensile strength of polyketone bristles and that of nylon (diameter: 0.102 mm (4 mils)), polyketone (0.56 kgf) has a tensile strength improved by 40% as compared to nylon (0.40 kgf).

[0075] After evaluating the elasticity loss of polyketone bristles and that of nylon (diameter: 0.127 mm (5 mils)), it can be seen that polyketone shows an elasticity loss improved by 42% and 48.7% right after brushing and after complete drying, respectively, as compared to nylon (* a smaller value indicates lower gap-widening).

[0076] In addition, after evaluating the elasticity of polyketone bristles and that of nylon (diameter: 0.127 mm (5 mils)), it can be seen that polyketone (224.9 cN) shows elasticity increased by 28.8% as compared to nylon (174.6 cN).

Claims

1. Toothbrush bristles comprising polyketone.
2. The toothbrush bristles according to claim 1, wherein the polyketone has a basic structure comprising carbon monoxide and olefin.
3. The toothbrush bristles according to claim 1, wherein the polyketone is a hybrid polymer of carbon monoxide with ethylene or a terpolymer of carbon monoxide, ethylene and polyketone.
4. The toothbrush bristles according to claim 1, wherein the polyketone is represented by the following chemical formula:



wherein x:y is 1:10-10:1.

5. The toothbrush bristles according to claim 1, which consists of polyketone.
6. The toothbrush bristles according to claim 1, which further comprises at least one water-insoluble polymer material selected from the group consisting of polypropylene, polyethylene, polyethylene terephthalate, polybutylene terephthalate, polytrimethylene terephthalate, polyurethane and nylon.
7. The toothbrush bristles according to claim 1, which further comprises at least one selected from the group consisting of an anti-inflammatory and anti-bacterial agent, whitening agent, sensitive tooth-alleviating agent, anti-plaque agent, fragrance, bad breath-preventing agent, gingiva health-aid, tooth decay-preventing agent, oral cavity cleaner, xylitol, bamboo salt, bay salt, prepared salt, refined salt, pine salt, steamed salt, molten salt, processed salt and phosphate salt.
8. The toothbrush bristles according to claim 1, which are fine bristles having a needle-like shape at the end thereof.
9. The toothbrush bristles according to claim 1, which have a diameter of 0.1 mm-0.13 mm.

10. A toothbrush comprising the toothbrush bristles as defined in any one of claims 1 to 9.

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FIG. 1

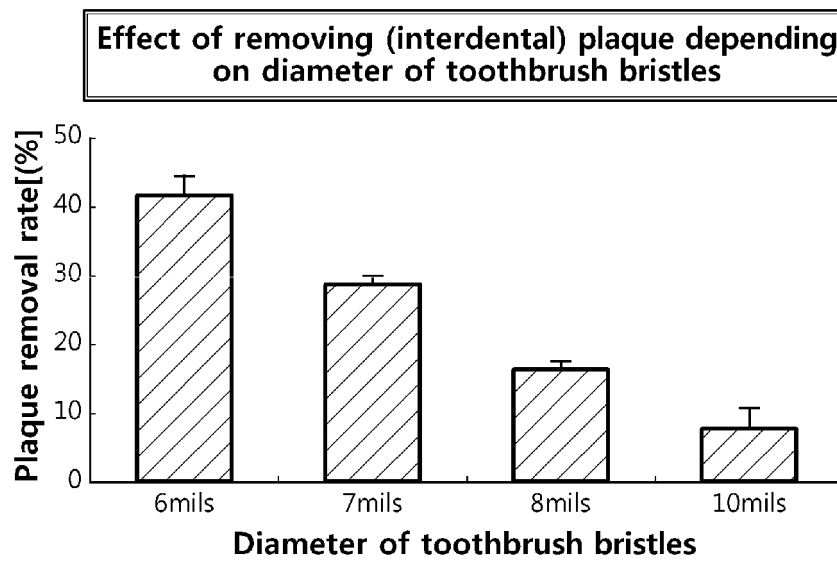
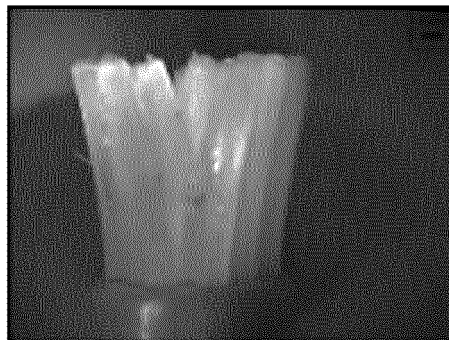
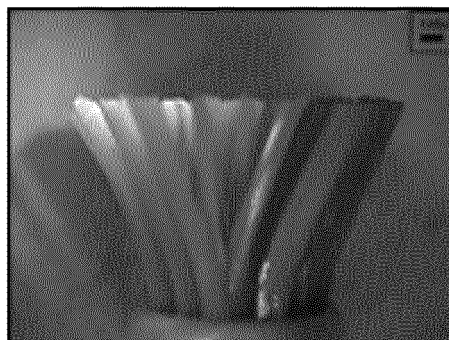


FIG. 2



△Right after brushing: Polyketone



△Right after brushing: Nylon

INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2017/010558

A. CLASSIFICATION OF SUBJECT MATTER

A46D 1/00(2006.01)i, A46B 9/04(2006.01)i, D06M 13/123(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A46D 1/00; B24D 13/14; A46D 1/10; A46B 9/04; A46D 1/04; D01F 6/76; C08G 67/02; C08G 85/00; D06M 13/123

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models: IPC as above

Japanese Utility models and applications for Utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & Keywords: polyketone, toothbrush, toothbrush bristle, brush, fiber, carbon monoxide, olefin, ethylene, propylene

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015-0017888 A1 (HAHL FILAMENTS GMBH.) 15 January 2015 See paragraph [0010]; claims 7-11; figures 3-4.	1,5,10
Y		2-4,6-9
Y	KR 10-2016-0057689 A (HYOSUNG CORPORATION) 24 May 2016 See paragraph [0042]; claims 1-5.	2-4
Y	KR 10-2011-0060431 A (KIM, Eung Wan) 08 June 2011 See paragraph [0011]; claims 1-3.	6-9
A	KR 10-0668572 B1 (ASAHI KASEI FIBERS CORPORATION) 16 January 2007 See the entire document.	1-10
A	KR 20-0251617 Y1 (LEE, Hoon et al.) 17 November 2001 See the entire document.	1-10

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

15 JANUARY 2018 (15.01.2018)

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INTERNATIONAL SEARCH REPORT Information on patent family members

International application No.
PCT/KR2017/010558

Patent document cited in search report	Publication date	Patent family member	Publication date
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REFERENCES CITED IN THE DESCRIPTION

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