(54) Title: FIBERS HAVING LOW AND HIGH COEFFICIENTS OF FRICTION SURFACES

(57) Abstract: The present invention relates to fibers having both relatively low and relatively high coefficient of friction characteristics. The fibers of the present invention are useful for toothbrush bristles and dental floss.
TITLE OF THE INVENTION

FIBERS HAVING LOW AND HIGH COEFFICIENTS OF FRICTION SURFACES

RELATED APPLICATIONS

This is a continuation-in-part of application Ser. No. 09/661,235, filed on September 13, 2000, which, in turn, is a divisional of application Ser. No. 09/021,325, filed on February 10, 1998, both of which are incorporated herein by reference.

FIELD OF THE INVENTION

This invention relates to fibers having both a relatively low coefficient of friction surface and a relatively high coefficient of friction surface and methods for producing such fibers. The fibers may be used as dental floss and may be incorporated into articles such as tooth brushes, floss picks and apparel.

BACKGROUND OF THE INVENTION

A major health concern involves gum disease and the resulting decay or loss of teeth. Gum disease, normally referred to as gingivitis, is caused by bacterial action from the formation of plaque about the teeth and/or the entrapment of food particles in the spaces between and under the teeth. Removal of plaque and entrapped food particles reduces the risk of gingivitis, and improves oral hygiene as well. Brushing and flossing are the two ways that plaque and entrapped food can be removed from the teeth and gums.

Tooth brushes and dental floss are made from fibers. Fibers are typically structures whose length is significantly greater than any of their other dimensions, usually their length is at least 100 times as large as their diameter. Fibers may be natural, synthetic, organic or inorganic. Often, the bulk polymers from which synthetic fibers are formed, may be useful as plastics or films depending upon the type and degree of molecular orientation, and the relative dimensions of the finished structure.

Dental floss is conventionally made from sinuous strands of filaments that are bulked together. The filaments are generally of the same type and can contain
additives, such as flavorings, or compounds that make it easier for the floss to be inserted between the teeth.

Dental floss is available in either a waxed or unwaxed variety. Waxed dental floss is generally comprised of multifilament yarns coated with a white or colorless wax usually having a melting point of from about 140 to 200° F. It is believed by some that flossing with a waxed floss may leave residues of wax on the teeth which may be harmful, whereas others merely do not like the waxy sensation in their mouths. Unwaxed dental floss is generally composed of multifilament yarns twisted together and coated with a non-wax bonding material. While satisfactory for many users, such floss presents problems for some who find it difficult to insert the floss in tight spaces between the teeth. This is due in part to the inability of the various filaments to easily slide over one another as the floss is forced between contacting teeth as well as in part due to the absence of wax. The sliding of the filaments over the tooth surface and over one another is inhibited by the nature of the materials from which commercially available floss products are made. These include a plurality of individual filaments made from substances such as nylon 6, nylon-6, 6-rayon, polyester, acetate polymers, polypropylene and similar plied multifilament yarns, as well as cotton, wool and other staple yarns.

With respect to the fibers claimed and disclosed in the present invention, reference is made to U.S. Pat. No. 5,904,152. This patent relates to dental flosses, including multicomponent coextruded filaments and/or filaments having a multilobal cross-section. The flosses are capable of bulking.

Further, U.S. Patent No. 5,518,012 relates to expanded PTFE dental floss. The floss contains a fiber of increased thickness so that the floss is maintained in an unfolded orientation.

U.S. Patent No. 5,209,251 relates to dental floss produced from expanded PTFE and coated with a microcrystalline wax to increase the friction coefficient of the floss.

U.S. Patent No. 5,033,488 relates to porous, expanded PTFE coated with microcrystalline wax. The floss may also contain one or more actives and/or dentally acceptable agents.
The flosses discussed in these references contain a base fiber coated with a wax for ease of insertion between the teeth and gums. Such low frictional wax flosses, however, do not incorporate a relatively higher coefficient of friction portion that imparts to the floss an abrasive characteristic for, for example, dislodging and removing food particles.

Fibers are usually produced by drawing, spinning or stretching a bulk material so that the molecules are predominantly aligned in the drawn, spun, or stretched direction. Subsequent drawing of the fiber below its melt temperature significantly alters the fiber's mechanical properties.

Fibers may also be produced by slitting an oriented film or sheet. If prepared from oriented sheet, the slit sheet will require subsequent drawing to obtain the required fiber properties.

Most synthetic fibers may be produced as long continuous filament or as staple. Staple is produced by cutting continuous filament into short lengths. Most natural fibers are produced as staple, with silk being a notable exception.

Continuous filament and staple are often post treated to alter their surface characteristics. Such surface treatments may include scouring by surface active agents to remove surface impurities, sizing by a surface coating to protect the fiber during weaving, dyeing to modify the color of the fiber and lubricating by refined petroleum products to reduce static and the coefficient of friction.

It is apparent in the prior art that coating a staple or filament will usually provide a fiber having a surface completely covered by the coating. In cases where a low coefficient of friction is desired, this may sometimes be undesirable. For applications in which a low coefficient of friction might be needed on the top and/or bottom surface of a fiber, uniformly low friction fibers and uniformly coated fibers might not provide the optimum balance of properties for application in dental floss and tooth brushes.

Furthermore, uniformly low friction fibers or uniformly coated fibers may not provide desired properties for use in apparel. Most apparel is made out of many materials, natural and man-made. They include cotton, wool, silk, linen, leather, vinyl, nylon - polyamides and polyamide co-polymers, LYCRA SPANDEX in different filament configurations, orlon polyvinylidene fluoride, such as KYNAR
and polyester, for example, polyethylene terephthalate, glycol modified polyesters, such as PETG, KODURA, rayon, orlon cellulosic fiber blends, and the like, as well as blends of the above.

Of course, apparel, either directly or indirectly, contacts the body surface of the wearer. The movement of the wearer causes frictional contact between the wearer's body surface and the apparel. This frictional contact can cause irritation, blisters, and callouses and is particularly a problem in sporting apparel wherein the formation of irritations, blisters, and callouses is exacerbated by the rapid and/or repetitious body movements related to the particular activity. Additionally, it is noted that most apparel has specific areas of high body surface/apparel contact which produces a majority of the irritations, blisters, and callouses.

One way to overcome the problems caused by frictional contact between an article of clothing and the wearer is to make the clothing from low friction fabric. Such fabric may be made from fibers that have a low friction outer surface.

However, when the low friction fibers are woven together to produce a fabric the low fiber-to-fiber coefficient of friction is likely to decrease fabric stability by enabling the fibers to easily slide among themselves. This problem is recognized in U.S. Patent No. 5,035,111 to Hogenboom et al. Hogenboom attempts to overcome the problem by spinning yarns or fibers having a low coefficient of friction with yarns or fibers having a high coefficient of friction. However, Hogenboom does not disclose modifying the fibers themselves. Moreover, Hogenboom's fibers are not made through coextrusion, lamination, and/or coating of a film, sheet or fiber, whereby only a portion of the fiber surface exhibits a low coefficient of friction.

OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the present invention to provide a fiber having both relatively low and relatively high coefficient of friction areas.

It is a further object of the present invention to provide a dental floss with a relatively low coefficient of friction area and a relatively high coefficient of friction area that imparts the dental floss with the ability to easily get between teeth yet effectively clean away plaque and tartar.
It is still another object of the present invention to provide a fiber comprising a relatively low coefficient of friction portion and a relatively high coefficient of friction portion, wherein the relatively low coefficient of friction portion is adjacent to the relatively high coefficient of friction portion.

It is another object of the present invention to provide a fiber comprising a relatively low coefficient of friction portion and a relatively high coefficient of friction portion, such that when the fiber is viewed in cross-section, the relatively low coefficient of friction portion makes up about 50% of the total cross-sectional area and the relatively low coefficient of friction portion is adjacent to the relatively high coefficient of friction portion.

It is another object of the present invention to provide a dental floss comprising a continuous relatively high coefficient of friction portion spaced between two continuous relatively low coefficient of friction portions, such that each continuous portion traces a path along the length of the fiber.

It is another object of the present invention to provide a dental pick comprising a continuous relatively high coefficient of friction portion spaced between two continuous relatively low coefficient of friction portions, such that each continuous portion traces a path along the length of the pick.

It is yet another object of the present invention to provide a dental floss comprising a plurality of filaments, wherein each filament comprises a relatively low coefficient of friction portion and a relatively high coefficient of friction portion.

It is still another object of the present invention to provide a dental floss comprising a plurality of filaments, wherein each filament comprises a relatively low coefficient of friction portion and a relatively high coefficient of friction portion, and wherein the total low coefficient of friction portion of the plurality of filaments makes up about 50% of the cross sectional area of the floss.

It is yet another object of the present invention to provide a dental floss comprising first and second filaments, wherein the first filament has a relatively high coefficient of friction and the second filament has a relatively low coefficient of friction, wherein the first and second filaments are each 50% of the total volume of
the dental floss, and wherein the first and second filaments are substantially evenly dispersed throughout the dental floss.

Yet another object of the present invention is to provide a dental floss comprising an inner core surrounded by an outer core, wherein the inner core comprises filaments having a relatively high coefficient of friction, and wherein the outer core comprises filaments having a relatively low coefficient of friction.

It is still another object of the present invention to provide a method of producing fibers having low coefficient of friction surfaces or smooth surfaces for incorporating into fabrics while retaining the properties desirable for weaving the fiber into a fabric.

Specifically, it is an object of the present invention to provide a fiber having low coefficient of friction surfaces that retains the fabric stability after being woven into a fabric.

More specifically, it is an object of the present invention to produce through coextrusion, lamination, and/or coating a fiber having at least one low coefficient of friction surface and one relatively high coefficient of friction surface.

It is still another object of the present invention to provide a durable high tensile-strength fiber having at least one low coefficient of friction surface and being suitable for use in weaving a fabric having at least one low coefficient of friction surface.

An aspect of this invention is to provide fibers prepared from oriented film or sheet. The film/sheet is formed through coextrusion, lamination, and/or coating such that the top and/or bottom surfaces have a different coefficient of friction than the center or internal layer(s) of material. Such fibers may be twisted in preferred sequences and/or orientations such that the center layer(s), having a higher coefficient of friction, interact with other members of the fabric construction to provide increased woven fabric construction stability. This stability is realized by having the higher coefficient of friction surfaces of the coextruded, laminated, and/or coated fiber contact additional surfaces of the gross fabric structure.

Another aspect of this invention is to partially coat a "base fiber" with a low coefficient of friction material such that the coated surface of the base fiber has a lower coefficient of friction than the non-coated surface. Like the fibers prepared
from film or sheet, the partially coated fibers may be twisted in preferred sequences
and/or orientations such that the non-coated surfaces, having a higher coefficient of
friction than the coated surfaces, interact with other members of the fabric
construction to provide increased woven fabric construction stability.

Still another aspect of this invention is to provide coextruded, laminated,
and/or coated fibers in which the core layer/base fiber has shock absorbing
characteristics (e.g., core layer(s) are open or closed celled foams). Such fibers
provide increased cushioning values in addition to a low coefficient of friction on
their treated surfaces.

Yet another aspect of this invention is to provide fibers in which the core
layer/base fiber provides desirable thermal characteristics. For example, the core
layer/base fiber may include an insulating material for restricting the escape of heat
energy, or a radiant material for facilitating the escape of heat energy.

It is apparent that the fibers of the present invention may be used to create
fabrics having enhanced woven fabric stability, shock absorption capacity and/or
thermal properties. Thus the present invention provides for a decrease in intra- and
extra- fabric coefficient of friction, while at the same time increasing fabric stability
and enhancing thermal characteristics.

By using low coefficient of friction materials during either the coextrusion,
lamination, and/or coating processes, a novel fiber is produced, with at least a
portion of the surface of the novel fiber exhibiting low coefficient of friction
characteristics and the remaining surface portion of the fiber exhibiting relatively
higher coefficient of friction characteristics.

The novel fiber can be incorporated into a fabric to produce a fabric having a
smooth surface, and the smooth surface fabric can, in turn, be incorporated into
clothing to produce clothing having a smooth surface.

Other objects, features and advantages according to the present invention
will become apparent from the following detailed description of the illustrated
embodiments when read in conjunction with the accompanying drawings.
BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross sectional view of a fiber having low coefficient of friction surfaces according to the present invention; wherein the coefficient of friction of the top surface is the same as the coefficient of friction of the bottom surface, and both the top and bottom surfaces have a coefficient of friction that is lower than the coefficient of friction of the center layer/side surface.

Fig. 2 is a cross sectional view of a fiber having low coefficient of friction surfaces according to the present invention; wherein the coefficient of friction of the top surface is different from the coefficient of friction of the bottom surface, and either one of, or both of, the top and bottom surfaces has a coefficient of friction that is lower than the coefficient of friction of the center layer/side surfaces.

Fig. 3 is a cross sectional view of a fiber having low coefficient of friction surfaces and an expanded center layer according to the present invention; wherein the coefficient of friction of the top surface is different from the coefficient of friction of the bottom surface, and either one of, or both of, the top and bottom surfaces has a coefficient of friction that is lower than the coefficient of friction of the center layer/side surfaces.

Fig. 4 is an isometric view of a base fiber that is partially coated with a low coefficient of friction material according to the present invention.

Fig. 5 is a cross sectional view of a tooth brush bristle having relatively low and relatively high coefficient of friction surfaces according to the present invention.

Fig. 6 is a monofilament dental floss having relatively low and relatively high coefficient of friction surfaces according to the present invention.

Fig. 7 is a multifilament dental floss having a plurality of filaments wherein each of the filaments have both relatively low and relatively high coefficient of friction surfaces according to the present invention.

Fig. 8 is a multifilament dental floss having a plurality of filaments wherein about 50% of the filaments have a relatively low coefficient of friction and about 50% of the filaments have a relatively high coefficient of friction according to the present invention.

Fig. 9 is a multifilament dental floss having an inner core of predominantly relatively high coefficient of friction filaments surrounded by an outer layer of
predominantly relatively low coefficient of friction filaments according to the present invention.

Fig. 10 is a floss pick having both a low coefficient of friction portion and a relatively high coefficient of friction portion according to the present invention.

**DETAILED DESCRIPTION**

The fibers of the present invention may be used to provide improved dental flosses and toothbrush bristles. One of the advantages of such improved flosses and bristles is that they are more effective at cleaning plaque from the teeth. Other advantages include ease of gripping, ease of insertion between the teeth, and low cost.

The fibers of the present invention may be comprised of mono- or multi-filaments. In one embodiment, reference is made to Fig. 6 wherein a monofilament dental floss is presented having relatively low and relatively high coefficient of friction surfaces according to the present invention.

In another embodiment, reference is made to Fig. 7 wherein a multifilament dental floss is presented having a plurality of filaments wherein each of the filaments have both relatively low and relatively high coefficient of friction surfaces according to the present invention.

In a further embodiment, reference is made to Fig. 8 wherein a multifilament dental floss is presented having a plurality of filaments wherein about 50% of the filaments have a relatively low coefficient of friction and about 50% of the filaments have a relatively high coefficient of friction according to the present invention.

In a still further embodiment, reference is made to Fig. 9 wherein a core of relatively high coefficient of friction fibers are surrounded by fibers having a relatively low coefficient of friction. The low friction fibers assist in the ease of insertion of the floss between the teeth. During the insertion process, the low friction fibers partially separate exposing the relatively high coefficient of friction fibers to the gums. The high friction fibers come into contact with the, for example, food particles between the teeth and gums and remove the particles and massage the gums.
The fiber of the present invention is produced by known methods in the art. The fiber of the present invention is preferably produced by slitting oriented film or sheet, and more preferably produced by orienting and slitting extruded film or sheet, the extruded film or sheet being formed via a coextrusion process. Alternatively, a single or multi-layer film or sheet may be laminated to other materials such that its top and/or bottom surfaces are different from the core layer(s). As an additional alternative, a single or multi-layer film may be coated with one or more materials such that its top and/or bottom surfaces are different from the core layer(s). As still another alternative, a "base fiber" may be partially coated with a low coefficient of friction material such that the coated surface of the base fiber has a lower coefficient of friction than the non-coated surface. A still further method includes extrusion. Some fibers suitable for use in the current invention are discussed in U.S. Patent Application Serial No. 09/021,325, which is incorporated herein by reference.

Another method includes sheath and core. In the sheath and core method, exemplified in Fig. 9, the floss comprises an outer sheath which is soft, slippery, or abrasive, to improve the ease of insertion, comfort and cleaning capability, respectively, of the floss, and an inner core that provides other desired physical properties, such as strength and resiliency and/or serves as a carrier for additives, such as flavors, scents and medicaments. Thus, the sheath may comprise one or more relatively low coefficient of friction components, whereas the core may comprise one or more relatively high coefficient of friction components.

In the film/sheet embodiment, low coefficient of friction materials are used to form the top and/or bottom surfaces of the film or sheet, such that the top and/or bottom fiber surfaces exhibit low coefficient of friction characteristics. Accordingly, the fibers that result from slitting the film/sheet having top and/or bottom surfaces that exhibit low coefficient of friction characteristics, and side surfaces that exhibit relatively higher coefficient of friction characteristics.

The relatively high coefficient of friction portion is comprised of polyester, nylon, acrylics, aramids, polyethylene, polyurethane and plastic copolymers. Suppliers include, for example, DuPont, Nylestar, Wellman and Foss. One of ordinary skill in the art would understand in light of the present disclosure that more
than one relatively high friction polymeric component may be used, such as, for example, a blend of two, three or four different polymeric components may be used.

The materials that may be used to form relatively low coefficient of friction portion include, but are not limited to, polytetrafluoroethylene (PTFE), boron, HALAR™, molybdenum sulfide, ultrahigh molecular weight silicone, siloxane, silicone/silane modified polymers, graphite, fluorinated high molecular weight polyolefins or cyclic organic compounds, non-modified polyolefins, or other fluorinated polymers. Suppliers of such low low-friction materials include, for example, DuPont, Dow Corning, Ausimont and General Electric.

The low coefficient of friction materials must exhibit surface properties that reduce the coefficient of friction. Preferably, the low coefficient of friction material is selected from the group consisting of silicone, silicone copolymers, silicone elastomers, polytetrafluoroethylene, homopolymers and copolymers thereof, graphite, boron, polypropylene and polyethylene.

The most preferred low coefficient of friction material added during coextrusion/lamination/coating and later incorporated into dental floss, tooth brushes, or a fabric that comprises an article of clothing is a polytetrafluoroethylene ("PTFE"), also known by its trademark Teflon™. PTFE is a linear polymer with each polymer chain having a low coefficient of friction. PTFE is a fluorocarbon polymer, which is defined in the Condensed Chemical Dictionary, 8th Edition, as including polytetrafluoroethylene, polymers of chlorotrifluoroethylene, fluorinated ethylenepropylene polymers, polyvinylidene fluoride, hexafluoropropylene, etc. Also preferred for the present invention are polymers and copolymers based on chlorotrifluoroethylene, poly (vinyl fluoride) and poly (vinylidene fluoride).

Copolymers of ethylene and/or additional low coefficient of friction silicone polymers are also acceptable.

Moreover, the fibers of the invention may also comprise additives. Such additives include, for example, anti-microbials, baking soda, peroxide abrasives, flavorings and pigments. The advantages of such additives include, for example, whitening of the teeth, ease of handling and pleasing taste.

The "exposed surfaces" of a fiber according to the present invention are formed as a result of slitting the oriented film/sheet, or as a result of only partially
coating the base fiber. As mentioned above, these exposed surfaces can have a higher coefficient of friction than the "unexposed surfaces", due to the exposure of the core material/base fiber. More specifically, the exposed surfaces have coefficients of friction ranging from 1.10 to 5.00 or more times the coefficient of friction of the unexposed surfaces. The exposed surface coefficient of friction depends upon the exposed area, the chemical make-up of the exposed area and the surface characteristics of the exposed area. Advantageously, the fibers of the invention are less prone to detract from the stability and durability of fabric then are coated filament or stable, because unlike coated filament and stable, the fibers of the invention have exposed surfaces of a relatively high coefficient of friction.

In the film/sheet embodiment, typical exposed surfaces consist of "tie-layers" such as adhesives (e.g., Admer™ and Bynel™) adjoining the primary strength layers. Fillers, such as mica, calcium carbonate, talc or other particulates may be added to any of the layers to affect adhesion, barrier and/or ergonomic factors.

Combinations of fillers and foaming agents may also be used as the core layers. The core layers may also consist of engineering resins (e.g., Nylon, Polyester) or natural fibers, modified to improve the performance of such layers.

Moreover, the core layers/base fiber may be selected to impart the fiber of the invention with desirable characteristics. In one embodiment, the core layer/base fiber has shock absorbing characteristics (e.g., core layer(s) are open or closed celled foams) to provide increased cushioning values in addition to a low coefficient of friction on the treated surface. In another embodiment, the core layer/base fiber provides desirable thermal characteristics in addition to a low coefficient of friction on the treated surface. For example, the core layer/base fiber may include an insulating material for restricting the escape of heat energy, or a radiant material for facilitating the escape of heat energy.

Additionally in the film/sheet process, by using materials having different coefficients of friction for respective sides of the film/sheet the resulting coefficient of friction of the fiber can be controlled so that the coefficients of friction of the top and bottom surfaces of the fiber differ. In turn, such fibers may be used to form a fabric wherein the coefficient of friction of the top and bottom surface of the fabric differ. For example, any of the previously mentioned low friction materials can be
used to create the low friction surface of the fabric, while a high friction material
such as rubber, cotton, elastomers, polyacrylates, polymethacrylates, and
polyurethanes can be used to create the relatively high friction surface of the fabric.
More generally, the relatively high friction materials may include any materials
having a coefficient of friction greater than 0.3. In one possible embodiment a
bathing suit can be designed to have a low coefficient of friction on the suit surface
exposed to water, to increase swimming speed, and a high coefficient of friction on
the surface exposed to the wearer, to minimize suit movement on the body. Such a
bathing suit could readily be produced using fabrics made up of fibers obtained from
the previously described films/sheets.

Exemplary embodiments of the invention are illustrated in Figs. 1 to 10 in
which Figs. 1-4 are discussed in Ser. No. 09/661,285. Fig. 5 is one embodiment of
the present invention and depicts a cross sectional view of a tooth brush bristle
having relatively low and relatively high coefficient of friction surfaces. Fig. 6 is
another embodiment of the present invention and depicts a monofilament dental
floss is contemplated having relatively low and relatively high coefficient of friction
surfaces. Fig. 7 is yet another embodiment of the present invention and depicts a
multifilament dental floss having a plurality of filaments wherein each of the
filaments have both relatively low and relatively high coefficient of friction surfaces.

Fig. 8 is still another embodiment of the present invention and depicts a
multifilament dental floss having a plurality of filaments wherein about 50% of the
filaments have a relatively low coefficient of friction and about 50% of the filaments
have a relatively high coefficient of friction. Fig. 9 is a further embodiment of the
present invention and depicts a multifilament dental floss having an inner core of
predominantly relatively high coefficient of friction filaments surrounded by an
outer layer of predominantly relatively low coefficient of friction filaments. Fig. 10
is a still further embodiment of the present invention and depicts a floss pick having
both a low coefficient of friction portion and a relatively high coefficient of friction
portion.

One embodiment according to the present invention is a multilayered fiber
with one surface having a low coefficient of friction characteristic and a second
surface having a "hand enhanced" characteristic. Fabrics woven from such
multilayered fibers are ideal for use in socks, garments, wound treatments, diving apparel and other garments or devices in which a low coefficient of friction material is undesirable on the inner surface as it would feel uncomfortable on the skin, but is desirable on the outer surface because it would permit more movement or gliding action.

Multilayered fibers could be produced in which the low coefficient of friction surface is opposed by a surface which is porous to allow either the migration of medicines into the skin or the absorption of moisture from the skin. Uniformly low coefficient of friction coated continuous filament or staple would be significantly less desirable in such applications because the uniformly low coefficient of friction filament/staple is more costly.

The fibers of the present invention, which are made from one or more low coefficient of friction materials, are more cost effective than standard low coefficient of friction filaments and staple. This is because only a portion of the invention’s fibers contain low coefficient of friction material, while many of the standard low coefficient of friction filaments and staple are completely coated or surrounded with low coefficient of friction materials. Since low coefficient of friction material is a premium product and the fibers of the invention contain less such material than the standard low coefficient of friction filaments and staple, the fibers of the invention are relatively cheaper than the standard low coefficient of friction filaments and staple.

Another embodiment of the present invention, as seen in Fig. 10, is a dental pick comprising a relatively high coefficient of friction portion spaced between two, continuous, relatively low coefficient of friction portions, such that each continuous portion traces a path along the length of the pick. It is envisioned that the thickness of the dental pick is from about 5 mil to about 100 mil; preferably, from about 8 mil to about 30 mil; most preferably, from about 12 mil to about 20 mil. The relatively high coefficient of friction portion is comprised of polyester, nylon, acrylics, aramids, polyethylene, polyurethene and plastic copolymers. Suppliers include, for example, DuPont, Nylestar, Wellman and Foss. One of ordinary skill in the art would understand in light of the present disclosure that more than one relatively polymeric component may be used, such as, for example, a blend of two, three or
four different polymeric components may be used. The relatively low coefficient of friction portion is comprised of, but is not limited to, PTFE, boron, HALAR™, molybdenum sulfide, ultrahigh molecular weight silicone, siloxane, silicone/silane modified polymers, graphite, fluorinated high molecular weight polyolefins or cyclic organic compounds, non-modified polyolefins, or other fluorinated polymers. Suppliers of the low friction portion include, for example, DuPont, Dow Corning, Ausimont and General Electric.

Although preferred embodiments of the present invention and modifications thereof have been described in detail herein, it is to be understood that this invention is not limited to those precise embodiments and modifications, and that other modifications and variations may be affected by one skilled in the art without departing from the spirit and scope of the invention as defined by the appended claims.
WHAT IS CLAIMED IS:

1. A fiber comprising a relatively low coefficient of friction portion and a relatively high coefficient of friction portion, wherein the relatively low coefficient of friction portion is adjacent to the relatively high coefficient of friction portion.

2. A fiber comprising a relatively low coefficient of friction portion and a relatively high coefficient of friction portion, wherein when the fiber is viewed in cross-section, the relatively low coefficient of friction portion is about 50% of the total cross-section of the fiber, and wherein the relatively low coefficient of friction portion is adjacent to the relatively high coefficient of friction portion.

3. A dental floss comprising a continuous relatively high coefficient of friction area spaced between two continuous relatively low coefficient of friction areas.

4. A dental floss comprising a plurality of filaments, wherein each filament comprises a relatively low coefficient of friction portion and a relatively high coefficient of friction portion.

5. A dental floss comprising a plurality of filaments, wherein each filament comprises a relatively low coefficient of friction portion and a relatively high coefficient of friction portion, and wherein the total low coefficient of friction portion of the plurality of filaments is about 50% of the cross sectional area of the floss.

6. A dental floss comprising first and second filaments, wherein the first filament has a relatively high coefficient of friction and the second filament has a relatively low coefficient of friction, wherein the first and second filaments are each about 50% of the total volume of the dental floss, and wherein the first and second filaments are substantially evenly dispersed throughout the dental floss.
7. A dental floss comprising an inner core surrounded by an outer core, wherein the inner core comprises filaments having a relatively high coefficient of friction, and wherein the outer core comprises filaments having a relatively low coefficient of friction.

8. A method of producing a fiber, comprising the steps of:
   forming a sheet of material through coextrusion, said coextruded sheet having at least a first outer layer, a second outer layer, and a center layer;
   wherein said center layer is made up of a material having a higher coefficient of friction than the material making up at least one of said outer layers; and
   orienting and slitting the coextruded sheet to form fibers, such that the top surface of said fibers are made-up of the same material as said first outer layer, the bottom surface of said fibers are made up of the same material as said second outer layer, and the side surfaces of said fibers are made up of the same material as said center layer.
FIG. 1

CENTER LAYER (COF = C)

TOP SURFACE (COF = A)

BOTTOM SURFACE (COF = A)

FIG. 2

CENTER LAYER (COF = C)

TOP SURFACE (COF = A)

BOTTOM SURFACE (COF = B)

FIG. 3

EXPANDED CENTER LAYER (COF = C)

TOP SURFACE (COF = A)

BOTTOM SURFACE (COF = B)

KEY

\[ t \text{ AND } T \text{ INDICATE THICKNESS OF FIBER}; \ T > t \]

A, B, C INDICATE DISTINCT COEFFICIENTS OF FRICTION

\[ A \neq B \neq C \]

SUBSTITUTE SHEET (RULE 26)
FIG. 9
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : D02G 3/00
US CL : 428/364; 132/321
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)
U.S. : 428/364; 132/321

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 4,924,811A (AXELROD) 15 May 1990 (15.05.1990), column 1, lines 14-30 and 35-43</td>
<td>1-7</td>
</tr>
<tr>
<td>X</td>
<td>US 5,209,251 A (CURTIS et al.) 11 May 1993 (11.05.1993), whole document</td>
<td>1-7</td>
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Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
  *A* document defining the general state of the art which is not considered to be of particular relevance
  *E* earlier application or patent published on or after the international filing date
  *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
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