(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 4 431 646 A1

(12) EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:
18.09.2024 Bulletin 2024/38

(21) Application number: **22911797.3**

(22) Date of filing: **19.12.2022**

(51) International Patent Classification (IPC):
D01D 5/253 *(2006.01)* ***D01F 6/04*** *(2006.01)*
D03D 15/44 *(2021.01)* ***D03D 15/283*** *(2021.01)*

(86) International application number:
PCT/KR2022/020674

(87) International publication number:
WO 2023/121164 (29.06.2023 Gazette 2023/26)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **20.12.2021 KR 20210182731**

(71) Applicant: **Kolon Industries, Inc.**
Seoul 07793 (KR)

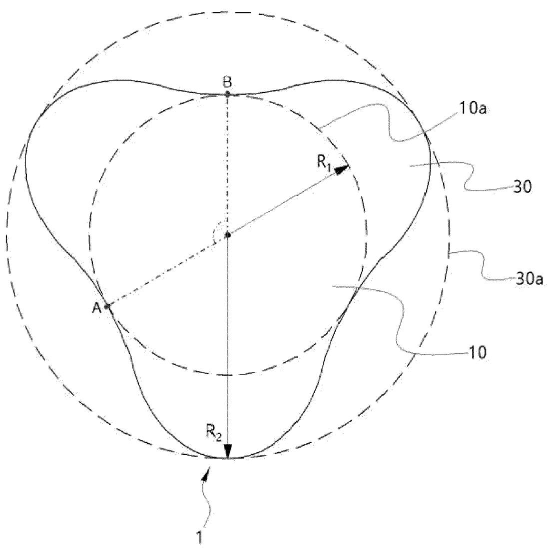
(72) Inventors:
- **PARK, Jung Eun**
  Seoul 07793 (KR)
- **LEE, Young Soo**
  Seoul 07793 (KR)
- **KIM, Seong-Young**
  Seoul 07793 (KR)
- **LEE, Sinho**
  Seoul 07793 (KR)

(74) Representative: **Ter Meer Steinmeister & Partner**
Patentanwälte mbB
Nymphenburger Straße 4
80335 München (DE)

(54) MODIFIED CROSS-SECTION POLYETHYLENE YARN, AND FUNCTIONAL FABRIC COMPRISING SAME

(57) The present invention relates to a shaped cross-sectional polyethylene yarn and a functional fabric including the same, and more particularly, to a shaped cross-sectional polyethylene yarn by which a fabric having a cooling sensation and sweat absorption and quick drying properties may be manufactured, and a functional fabric including the same. A polyethylene yarn according to the present invention includes a filament having a central body and two or more protrusions protruding from the central body based on a cross section perpendicular to a longitudinal direction, wherein a degree of crystallinity of the polyethylene yarn is 56 to 85%.

【FIG. 1】



Processed by Luminess, 75001 PARIS (FR)

Description

[TECHNICAL FIELD]

[0001] The following disclosure relates to a shaped cross-sectional polyethylene yarn and a functional fabric including the same, and more particularly, to a shaped cross-sectional polyethylene yarn by which a fabric having a cooling sensation and sweat absorption and quick drying properties may be manufactured, and a functional fabric including the same.

[BACKGROUND OF ART]

[0002] Recently, in the textile industry, studies on not only improvement of a polymer forming a textile but also differentiation of a cross section of a yarn have been conducted to develop a differentiated material with high added value. In particular, the differentiation of the cross section of the yarn has a large effect in terms of improvement of physical properties of the textile compared to invested time and cost. Thus, the studies on the differentiation of the cross section of the yarn have been intensively conducted.

[0003] Meanwhile, recently, living standards have been improved, and all generations regardless of age have been engaged in various sports activities for self-health management. Therefore, in accordance with an increase in demand for sportswear, various sportswear products have been actively developed. In particular, the development of a textile material for sportswear that may have a combined functionality of lightweightness and air permeability and may thus be used widely from light trekking to sports activities has been urgently required.

[0004] In this regard, "Shaped cross-sectional polyester yarn having excellent sweat absorption and quick drying properties and abrasion resistance and method of manufacturing the same" is disclosed in Korean Patent Publication No. 10-1808459, and "Shaped cross-sectional polybutylene terephthalate fiber having excellent sweat absorption and quick drying properties and stretch properties" is disclosed in Korean Patent Laid-Open Publication No. 10-2011-0076122. In such a shaped cross-sectional fiber (yarn), pores are formed in the yarn composed of a bundle of filaments by shaping a cross section of the filament so that moisture is absorbed and discharged through a capillary action (increasing an absorption rate through the micropores and enlarging a water diffusion surface) by the micropores formed between the filaments. That is, a function of quickly absorbing and discharging sweat, that is, sweat absorption and quick drying properties, are imparted using the capillary action in the yarn.

[0005] However, in the case of the shaped cross-sectional yarn according to the related art, a moisture absorption rate is inferior to a cotton yarn, and moisture generated by sweating or breathing from a user wearing a product (fabric) manufactured using the shaped cross-sectional yarn is not sufficiently absorbed. In addition, the product manufactured using the shaped cross-sectional yarn according to the related art has a low moisture absorption rate, and the amount of moisture discharged to the outside is also small, which makes it is difficult for a wearer to actually feel comfortable.

[0006] In addition, in the case of the product manufactured using the shaped cross-sectional yarn according to the related art, a coefficient of friction between the fabric and the skin due to moisture that is not discharged to the outside during activity of the human body is increased, resulting in generation of heat in the skin. Furthermore, most of the shaped cross-sectional yarns according to the related art are polyester yarns, and do not have a cooling sensation in comparison to the existing polyethylene fibers as described above. Therefore, the wearer feels rather warm and sweats a lot, which may cause discomfort.

[0007] Thus, the development of a novel textile material that quickly absorbs and discharges a large amount of moisture and has a cooling sensation is further required.

[DETAILED DESCRIPTION OF THE INVENTION]

[TECHNICAL PROBLEM]

[0008] An embodiment of the present invention is to provide a shaped cross-sectional polyethylene yarn by which a fabric having a cooling sensation and sweat absorption and quick drying properties may be manufactured, and a functional fabric including the same.

[TECHNICAL SOLUTION]

[0009] In one general aspect, a polyethylene yarn includes a filament having a central body and two or more protrusions protruding from the central body based on a cross section perpendicular to a longitudinal direction, wherein a degree of crystallinity of the polyethylene yarn is 56 to 85%.

[0010] Based on the cross section perpendicular to the longitudinal direction of the polyethylene yarn, a first radius

(R1) of an inscribed circle formed by the central body and a second radius (R2) of a circumscribed circle formed by the central body and the protrusion in the central body may satisfy the following expression:

[Expression] $1.2 \leq R2/R1 \leq 5.0$.

[0011] The polyethylene yarn may have a melt index (MI, @190°C) of 1 to 25 g/10 min when measured at 190°C and 2.16 kg according to ASTM D1238.

[0012] The polyethylene yarn may have a polydispersity index (PDI) of 5 to 30.

[0013] The polyethylene yarn may have a strength of 5 to 15 g/d when measured according to ASTM D2256.

[0014] In another general aspect, a functional fabric includes the polyethylene yarn.

[0015] The functional fabric may have a contact cooling sensation (Q-max) of 0.1 to 0.5 W/cm^2 when measured by bringing a heat plate (T-box) at 30 ± 2°C into contact with the functional fabric at 20 ± 2°C at 20 ± 2°C and 65 ± 2% R.H.

[0016] The functional fabric may have a heat flux of 95 to 150 W/m^2 when measured at 20 ± 2°C and 65 ± 2% R.H.

[0017] The functional fabric may have a moisture absorption rate of 80 to 160 mm/10 min when measured according to a Byreck method that is B Method of KS K 0642 8.26.

[0018] The functional fabric may have a moisture drying rate of 20 to 50 mm/10 min when measured according to A Method of KS K 0642 8.25.

[0019] In still another general aspect, a sweat absorption and quick drying product is manufactured using the functional fabric.

[ADVANTAGEOUS EFFECTS]

[0020] As set forth above, the shaped cross-sectional polyethylene yarn according to the present invention may quickly move and discharge moisture and has an excellent thermal conductivity, such that a fabric having both sweat absorption and quick drying properties and a cooling sensation may be manufactured.

[0021] Further, the functional fabric according to the present invention includes the polyethylene yarn having excellent thermal conductivity and sweat absorption and quick drying properties, such that the functional fabric has a cooling sensation and sweat absorption and quick drying properties, and may quickly discharge moisture generated by sweating or breathing and may dissipate heat to the outside, resulting in a reduction in sensation of dampness and heat. Therefore, a use may feel comfortable.

[BRIEF DESCRIPTION OF DRAWINGS]

[0022]

FIG. 1 is a cross-sectional view of a filament of a shaped cross-sectional polyethylene yarn according to Example 1 of the present invention.

FIG. 2 is a cross-sectional view of a filament of a shaped cross-sectional polyethylene yarn according to Example 2 of the present invention.

FIG. 3 is a schematic view illustrating an apparatus for measuring a contact cooling sensation of a fabric.

FIG. 4 is a photograph illustrating a thermal mannequin test of measuring a heat reflux of the fabric.

FIG. 5 is an optical micrograph obtained by enlarging the cross section of the filament of the shaped cross-sectional polyethylene yarn illustrated in FIG. 1.

[DETAILED DESCRIPTION OF THE EMBODIMENTS]

[0023] Unless otherwise defined, all the technical terms and scientific terms used in the present specification have the same meanings as commonly understood by those skilled in the art to which the present invention pertains. The description for the known function and configuration unnecessarily obscuring the gist of the present invention will be omitted in the following description and the accompanying drawings.

[0024] In addition, unless the context clearly indicates otherwise, the singular forms used in the present specification may be intended to include the plural forms.

[0025] In addition, units used in the present specification without special mention are based on weight, and as an example, a unit of % or a ratio refers to wt% or a weight ratio. Unless otherwise defined, wt% refers to wt% of any one component in a composition with respect to the total weight of the composition.

[0026] In addition, a numerical range used in the present specification includes upper and lower limits and all values within these limits, increments logically derived from a form and span of a defined range, all double limited values, and all possible combinations of the upper and lower limits in the numerical range defined in different forms. Unless otherwise particularly defined in the present specification, all values out of the numerical range that may occur due to the rounding off of the experimental errors or values also fall within the defined numerical ranges.

[0027] In the present specification, the expression "comprise(s)" is intended to be an open-ended transitional phrase having an equivalent meaning to "include(s)," "contain(s)," "have (has)," and "is (are) characterized by," and does not exclude elements, materials, or steps, all of which are not further recited herein.

[0028] Sweat absorption and quick drying properties mean that moisture generated by sweating or breathing is quickly absorbed and dried, and these properties are required in various fields to provide comfort to a human body, such as sportswear, work clothes, and masks.

[0029] In the related art, a cross section of a filament constituting a yarn is shaped to form pores in the yarn composed of a bundle of the filaments, thereby imparting sweat absorption and quick drying properties to the yarn through a capillary action by the micropores formed between the filaments. However, in the case of the shaped cross-sectional yarn according to the related art, a moisture absorption rate is inferior to a cotton yarn, and moisture generated by sweating or breathing from a user wearing a product (fabric) manufactured using the shaped cross-sectional yarn is not sufficiently absorbed. In addition, the product manufactured using the shaped cross-sectional yarn according to the related art has a low moisture absorption rate, and the amount of moisture discharged to the outside is also small, which makes it is difficult for a wearer to actually feel comfortable.

[0030] In addition, in the case of the product manufactured using the shaped cross-sectional yarn according to the related art, a coefficient of friction between the fabric and the skin due to moisture that is not discharged to the outside during activity of the human body is increased, resulting in generation of heat in the skin. Furthermore, most of the shaped cross-sectional yarns according to the related art are polyester yarns, and do not have a cooling sensation in comparison to the existing polyethylene fibers as described above. Therefore, a user wearing a product manufactured using the shaped cross-sectional yarn according to the related art feels rather warm and sweats a lot, which may cause discomfort.

[0031] Therefore, as a result of intensively conducting studies to develop a yarn with high added value that may have significantly excellent sweat absorption and quick drying properties and cooling sensation for a long period of time, the present applicant has found that it is possible to manufacture a product that may provide significantly excellent comfort when worn by a user because it has excellent sweat absorption and quick drying properties and a unique cooling sensation of polyethylene by using a shaped cross-sectional polyethylene yarn having a specific shape, thereby completing the present invention.

[0032] A polyethylene yarn of the present invention includes a filament having a central body and two or more protrusions protruding from the central body based on a cross section perpendicular to a longitudinal direction. A degree of crystallinity of the polyethylene yarn may be 56 to 85%, specifically 60 to 85%, and more specifically 65 to 75%.

[0033] The polyethylene yarn has a structure in which a plurality of filaments having a specific shaped cross section are provided in a bundle, and micropores are formed between the filaments in the yarn by the cross-sectional structure of the filament, such that moisture may be smoothly absorbed and discharged through a capillary action by the micropores. In addition, the polyethylene yarn has a unique excellent thermal conductivity of polyethylene, such that a fabric having sweat absorption and quick drying properties and a cooling sensation may be manufactured.

[0034] FIG. 1 illustrates a filament of the polyethylene yarn according to an exemplary embodiment of the present invention.

[0035] Referring to FIG. 1, the polyethylene yarn includes a filament having a central body and two or more protrusions protruding from the central body based on a cross section perpendicular to a longitudinal direction. As described above, the polyethylene yarn includes a shaped cross-sectional filament, such that micropores may be formed between the filaments in the yarn.

[0036] In an exemplary embodiment of the present invention, the filaments constituting the polyethylene yarn are non-porous, and the pores may be formed in the polyethylene yarn only by gaps between the filaments. That is, a porosity of the polyethylene yarn may be obtained by the micropores formed between the filaments. Specifically, an area occupied by the filaments based on the cross section of the yarn may be 50 to 99% and specifically 60 to 90%, the area being measured along the outer shape of the yarn in a direction perpendicular to the longitudinal direction of the polyethylene yarn. An area excluding this area is an area in which the pores are formed in the yarn, and may be an area porosity of the yarn. The polyethylene yarn having a high porosity by the micropores formed between the filaments may quickly absorb and dry moisture while maintaining a high level of the unique cooling sensation of polyethylene.

[0037] Specifically, the central body may have various cross-sectional shapes, for example, a polygon such as a triangle, a square, or a pentagon, an elliptical shape, and a circular shape, based on the cross section perpendicular to a longitudinal direction of the filament. It is preferable that the central body may have a circular or substantially circular cross-sectional shape and may have an average radius length, as illustrated in FIG. 1. In this case, in the cross section perpendicular to the longitudinal direction of the filament, the radius formed by the central body refers to an inscribed circle of the filament.

[0038] Alternatively, as illustrated in FIG. 2, the cross-sectional shape of the central body may be elliptical based on the cross section perpendicular to the longitudinal direction of the filament. In this case, in the cross section perpendicular to the longitudinal direction of the filament, the radius formed by the central body refers to an inscribed circle of the filament, and may be one selected from a short radius and a long radius of an elliptical shape because the inscribed circle is elliptical. Preferably, the radius may refer to a long radius.

[0039] The protrusions protrude from the central body based on the cross section perpendicular to the longitudinal direction of the filament, and the filament having the protrusions has a shaped form having a cross section perpendicular to the longitudinal direction. In the yarn including these filaments, micropores are formed between the filaments, such that flow paths through which moisture may be absorbed through a capillary action, that is, microchannels (micropores), are formed. Therefore, the yarn may absorb and discharge moisture through the microchannels, such that the yarn may have excellent sweat absorption and quick drying properties.

[0040] The shape of the protrusion is not limited as long as it is a shape in which the protrusion protrudes from the central body, and an end portion of the protrusion may gently protrude in a round shape. The protrusion is not limited as long as it has a size in which the filaments may be spaced from each other in the yarn to the extent that moisture may be absorbed through the capillary action, that is, a length protruding from the central body.

[0041] However, based on the cross section perpendicular to the longitudinal direction of the yarn, it is advantageous in a moisture absorption force through the capillary action when the first radius (R1) of the inscribed circle formed by the central body and the second radius (R2) of the circumscribed circle formed by the central body and the protrusion in the central body satisfy the following expression:

[Expression]

$$1.2 \leq R2/R1 \leq 5.0.$$

[0042] More specifically, the expression may be $1.2 \leq R2/R1 \leq 3.5$ or $1.3 \leq R2/R1 \leq 3$. In the above range, although polyethylene is hydrophobic, moisture absorption of the yarn may be smooth due to a strong capillary force.

[0043] In addition, in the cross section perpendicular to the longitudinal direction of the filament, a ratio of the length of one protrusion to the circumference of the inscribed circle of the filament formed by the central body may be 10% or more, and specifically, 20 to 50%. In this case, the length of the protrusion refers to a length of an arc connecting both ends of the protrusion and contact points of the inscribed circle in the circumference of the inscribed circle. Specifically, the length of the protrusion may refer to $\overline{AB}$ in FIG. 1.

[0044] The number of the protrusions provided may be 2 or more, and specifically, 2 to 5. Preferably, in a case where the central body has a circular shape, when three or more protrusions are provided and the cross section of the filament perpendicular to the longitudinal direction is formed in a trefoil shape, the size of the microchannel may be easily adjusted by adjusting the lengths of the inscribed circle and the circumscribed circle.

[0045] Alternatively, in a case where the central body is an elliptical shape, when four or more protrusions are provided and the cross section of the filament perpendicular to the longitudinal direction is formed in a quatrefoil shape, the size of the microchannel may be easily adjusted.

[0046] The protrusions may be arranged at the same distance from each other along the circumferential direction of the central body, but are not limited thereto. As an example, as illustrated in FIG. 1, when three protrusions are provided, the protrusions may be arranged at the same distance from each other along the circumferential direction of the central body, and when two protrusions are provided, the protrusions may be positioned to be biased toward any one side of the central body.

[0047] Alternatively, as illustrated in FIG. 2, when four protrusions are provided, a pair of protrusions may be arranged symmetrically with each other with respect to the elliptical central body.

[0048] As described above, since a plurality of protrusions protruding from the central body are formed, a ratio of an area occupied by the protrusions to the entire area of one surface of the central body on which the protrusions are formed is preferably 60% or more, and specifically, 80 to 100%. In this case, 100% means that the protrusions are continuously formed in the entire area of one surface of the central body. Specifically, as illustrated in FIG. 1, the end portions of the adjacent protrusions are positioned to be in contact with each other, such that the cross-sectional shape of the filament may be wavy along the circumferential direction of the filament, based on the cross section perpendicular to the longitudinal direction of the filament.

[0049] The polyethylene yarn is composed of the bundle of the plurality of filaments having a shaped cross section as described above, and an area occupied by the filaments based on the cross section perpendicular to the longitudinal direction may be 70 to 99%, and more specifically, 80 to 95%. An area other than the area occupied by the filaments may refer to an area occupied by the micropores, and may refer to an area in which the microchannels are formed. Within the above range, the polyethylene yarn may have a sufficient moisture absorption and discharge ability through the microchannels.

[0050] The polyethylene yarn may include a plurality of filaments. The yarn is not limited as long as it has the number of filaments capable of forming micropores. As an example, the polyethylene yarn may include 40 to 500 filaments each having a fineness of 1 to 3 denier, and may have a total fineness of 100 to 1,000 denier.

[0051] In addition, a density of the polyethylene yarn may be 0.93 to 0.97 g/cm^3, and a degree of crystallinity through spinning may be 60 to 85%, and specifically, 65 to 75%. The degree of crystallinity of the polyethylene yarn may be derived together with a crystallite size at the time of crystallinity analysis using an X-ray diffractometer. When the degree of crystallinity is within the above range, heat is rapidly diffused and dissipated by lattice vibration called phonon in a direction of molecular chains linked via a covalent bond of high-density polyethylene (HDPE), and a function of discharging moisture generated by sweating or breathing is improved, such that a fabric having an excellent cooling sensation may be provided.

[0052] In addition, a melt index (MI, @190°C) of the polyethylene yarn may be, but is not limited to, 1 to 25 g/10 min, specifically, 1 to 20 g/10 min, and more specifically, 1 to 10 g/10 min, when measured at 190°C and 2.16 kg according to ASTM D1238. However, within the above range, the polyethylene yarn may have a relatively excellent strength.

[0053] In addition, a polydispersity index of the polyethylene yarn may be 5 to 30, and specifically, 10 to 20. In this case, a strength measured according to ASTM D2256 may be 5 to 15 g/d, specifically, 6 to 13 g/d, and more specifically, 9 to 12 g/d. Within the above ranges, the polyethylene yarn may have a high thermal conductivity and a stiffness suitable for weavability.

[0054] Hereinafter, a method of manufacturing a polyethylene yarn according to an exemplary embodiment of the present invention will be described in detail with reference to FIG. 1. The method of manufacturing a polyethylene yarn of the present invention is not limited as long as the physical properties of the polyethylene yarn such as PDI, the strength, and the elongation satisfy the above ranges, and an exemplary embodiment will be described below.

[0055] First, a polyethylene melt is obtained by injecting polyethylene in the form of a chip into an extruder 100 and melting the polyethylene.

[0056] The molten polyethylene is transported through a die 200 by a screw (not illustrated) in the extruder 100, and the transported polyethylene is extruded through a plurality of holes formed in the die 200. The number of holes of the die 200 may be determined according to a denier per filament (DPF) and a fineness of a yarn to be manufactured. For example, when a yarn having a total fineness of 75 denier is manufactured, the die 200 may have 20 to 75 holes, and when a yarn having a total fineness of 450 denier is manufactured, the die 200 may have 90 to 450 holes and preferably 100 to 400 holes.

[0057] The melting process performed in the extruder 100 and the extrusion process performed in the die 200 may be changed and applied depending on a melt index of the polyethylene chip. Specifically, the melting process and the extrusion process are performed, for example, at 150 to 315°C, preferably 250 to 315°C, and still preferably 265 to 310°C. That is, the extruder 100 and the die 200 are maintained at 150 to 315°C, preferably 250 to 315°C, and more preferably 265 to 310°C.

[0058] When a spinning temperature is lower than 150°C, the polyethylene is not uniformly melted due to a low spinning temperature, resulting in difficulty in spinning. On the other hand, when the spinning temperature is higher than 315°C, a desired strength may not be exhibited due to thermal decomposition of the polyethylene.

[0059] The polyethylene is solidified by a difference between the spinning temperature and room temperature while the molten polyethylene is discharged through the holes of the die 200 for a shaped cross section to form semi-solidified filaments 11. In the present specification, both the semi-solidified filaments and fully solidified filaments are collectively referred to as "filaments".

[0060] A plurality of filaments 11 are cooled in a cooling zone (or a quenching zone) 300 to be fully solidified. The cooling of the filaments 11 may be performed by an air cooling method.

[0061] The cooling of the filaments 11 in the cooling zone 300 is preferably performed so that the filaments 11 are cooled to 15 to 40°C using a cooling wind having a wind speed of 0.2 to 1 m/sec. When the cooling temperature is lower than 15°C, the elongation is insufficient due to overcooling, which may cause a yarn breakage during a drawing process. When the cooling temperature is higher than 40°C, a deviation in fineness between the filaments 11 is increased due to non-uniformity of solidification, which may cause a yarn breakage during the drawing process.

[0062] In addition, multi-stage cooling is performed at the time of the cooling in the cooling zone, such that more uniform crystallization may be obtained. Therefore, a yarn that further smoothly discharges moisture and sweat and has an excellent cooling sensation may be manufactured. More specifically, the cooling zone may be divided into two or more sections. For example, when the cooling zone includes three cooling sections, it is preferable that the cooling sections are designed so that the temperature is gradually lowered from the first cooling zone to the third cooling zone. Specifically, for example, the temperature of the first cooling zone may be set to 40 to 80°C, the temperature of the second cooling zone may be set to 30 to 50°C, and the temperature of the third cooling zone may be set to 15 to 30°C.

[0063] In addition, a fiber having a smoother surface may be manufactured by setting the highest wind speed in the first cooling zone. Specifically, a cooling wind having a wind speed of 0.8 to 1 m/sec may be used in the first cooling zone, a cooling wind having a wind speed of 0.4 to 0.6 m/sec may be used in the second cooling zone, and a cooling wind having a wind speed of 0.2 to 0.5 m/sec may be used in the third cooling zone. By adjusting the conditions as described above, a yarn having a higher degree of crystallinity and a smoother surface may be manufactured.

[0064] Subsequently, the cooled and fully solidified filaments 11 may be interlaced by an interlacer 400 to form a multi-filament 10.

[0065] As illustrated in FIG. 1, the polyethylene yarn of the present invention may be manufactured by a direct spinning drawing (DSD) process. That is, the multi-filament 10 may be directly transferred to a multi-stage drawing unit 500 including a plurality of godet rollers GR1 to GRn, the transferred multi-filament 10 may be subjected to multi-stage drawing at a total draw ratio of 2 to 20 and preferably 3 to 15, and then, the drawn multi-filament 10 may be wound around a winder 600. In addition, shrinkage drawing (relaxation) of 1 to 5% is applied in the final drawing section at the time of the multi-stage drawing, such that a yarn having more excellent durability may be provided.

[0066] Alternatively, the polyethylene yarn of the present invention may be manufactured by winding the multi-filament 10 as an undrawn yarn and then drawing the undrawn yarn. That is, the polyethylene yarn of the present invention may be manufactured through a two-stage process of melt-spinning polyethylene to manufacture an undrawn yarn and then drawing the undrawn yarn.

[0067] When the total draw ratio applied in the drawing process is less than 2, the polyethylene yarn finally obtained may not have a degree of crystallinity of 60% or more, and pilling may be generated on a fabric manufactured using the yarn.

[0068] On the other hand, when the total draw ratio exceeds 15, a yarn breakage may occur, and a strength of the polyethylene yarn finally obtained is not suitable, such that weavability of the polyethylene yarn are not preferable, and a fabric manufactured using the polyethylene yarn is too stiff. Therefore, a user may feel uncomfortable.

[0069] When a line velocity of the first godet roller GR1 at which a spinning speed of the melt-spinning of the present invention is determined is determined, a line velocity of each of the remaining godet rollers is appropriately determined in the multi-stage drawing unit 500 so that a total draw ratio of 2 to 20 and preferably 3 to 15 may be applied to the multi-filament 10.

[0070] According to an exemplary embodiment of the present invention, heat-setting of the polyethylene yarn by the multi-stage drawing unit 500 may be performed by appropriately setting the temperatures of the godet rollers GR1 to GRn in the multi-stage drawing unit 500 within a range of 40 to 140°C. Specifically, for example, the multi-stage drawing unit may include three or more, and specifically, three to five drawing sections. In addition, each of the drawing sections may include a plurality of godet rollers.

[0071] Specifically, for example, the multi-stage drawing unit may include four drawing sections. The polyethylene yarn may be drawn at a total draw ratio of 7 to 15 in the first drawing section to the third drawing section, and then, the drawn polyethylene yarn may be subjected to shrinkage drawing (relaxation) of 1 to 3% in the fourth drawing section. The total draw ratio refers to a final draw ratio of the fiber passed through the first drawing section to the third drawing section relative to an undrawn fiber.

[0072] More specifically, in the first drawing section, the drawing may be performed at 40 to 130°C, and the total draw ratio may be 2 to 5. In the second drawing section, the drawing may be performed at a temperature higher than that in the first drawing section, and specifically, may be performed at 100 to 150°C, and the drawing may be performed so that the total draw ratio is 5 to 8. In the third drawing section, the drawing may be performed at 100 to 150°C, and the drawing may be performed so that the total draw ratio is 7 to 15. In the fourth drawing section, the drawing may be performed at a temperature equal to or lower than that in the second drawing section, and specifically, may be performed at 80 to 140°C, and shrinkage drawing (relaxation) of 1 to 3% may be performed.

[0073] The multi-stage drawing and heat-setting of the multi-filament 10 are simultaneously performed by the multi-stage drawing unit 500, and the multi-filament 10 subjected to the multi-stage drawing is wound around the winder 600, thereby completing the polyethylene yarn of the present invention.

[0074] A functional fabric according to the present invention includes the polyethylene yarn described above. The functional fabric includes the polyethylene yarn having excellent thermal conductivity and sweat absorption and quick drying properties, such that the functional fabric may have a cooling sensation and sweat absorption and quick drying properties, and may quickly discharge moisture generated by sweating or breathing. When a user wears a product manufactured using such a fabric, moisture and heat may be quickly discharged to the outside to reduce a sensation of dampness and heat, such that the user may feel comfortable.

[0075] The functional fabric according to the present invention may be manufactured using the polyethylene yarn described above alone, and may further include a yarn different from the polyethylene yarn in order to further impart another functionality. It is preferable that the polyethylene yarn is used alone in terms of having both more excellent cooling sensation and sweat absorption and quick drying properties.

[0076] Specifically, a contact cooling sensation of the functional fabric when measured at 20 $\pm$ 2°C and 65 $\pm$ 2% R.H may be 0.1 to 0.5 W/cm^2, and more specifically, 0.15 to 0.3 W/cm^2. In addition, a heat flux of the functional fabric when measured at 20 $\pm$ 2°C and 65 $\pm$ 2% R.H may be 95 to 150 W/m^2, and specifically, 100 to 120 W/m^2. The functional fabric having a cooling sensation may provide an excellent cooling sensation to a user to feel comfortable in a high temperature environment when it is worn by the user after being manufactured or processed into a product later.

[0077] In addition, a moisture absorption rate of the functional fabric when measured by a Byreck method that is B Method of KS K 0642 8.26 may be 80 to 160 mm/10 min, and specifically, 100 to 130 mm/10 min. The functional fabric has a higher moisture absorption rate than a cotton yarn, which has a moisture absorption rate of around 50 mm/10 min under the same conditions, and has a significantly excellent moisture absorption ability.

[0078] In addition, a moisture drying rate of the functional fabric when measured according to A Method of KS K 0642 8.25 is 20 to 50 mm/10 min, and specifically, 30 to 40 mm/10 min, which is a relatively fast moisture drying rate. Therefore, moisture may be smoothly discharged. As described above, the functional fabric having quick moisture absorption rate and moisture drying rate has significantly excellent sweat absorption and quick drying properties capable of quickly absorbing and discharging moisture generated by sweating or breathing.

[0079] The functional fabric may be a woven or knitted fabric having a weight per unit area (that is, an area density) of 150 to 800 g/m^2. When the area density of the fabric is less than 150 g/m^2, the density of the fabric is insufficient and many pores are present in the fabric, and thus, these pores cause deterioration of the cooling sensation of the fabric. On the other hand, when the area density of the fabric is more than 800 g/m^2, the fabric becomes stiff due to an excessively dense structure of the fabric, and thus, the user feels uncomfortable, and a problem in use occurs due to a high weight.

[0080] Such a fabric may be processed into a sweat absorption and quick drying product requiring both sweat absorption and quick drying properties and a cooling sensation. The product may be any textile product according to the related art, and may be preferably summer clothes, sportswear, masks, and work clothes to impart a cooling sensation and sweat absorption and quick drying properties to a human body.

[0081] Hereinabove, although the present invention has been described by specific matters, exemplary embodiments, and drawings, they have been provided only for assisting in the entire understanding of the present invention. Therefore, the present invention is not limited to the exemplary embodiments. Various modifications and changes may be made by those skilled in the art to which the present invention pertains from this description.

[0082] Therefore, the spirit of the present invention should not be limited to the described exemplary embodiments, but the claims and all modifications equal or equivalent to the claims are intended to fall within the scope and spirit of the present invention.

[Measurement of physical properties of yarn]

<1. Weight average molecular weight (Mw) (g/mol) and polydispersity index (PDI)>

[0083] A polyethylene yarn was completely dissolved in the following solvent, and then, a weight average molecular weight (Mw) and a polydispersity index (Mw/Mn: PDI) of the polyethylene yarn were calculated using gel permeation chromatography (GPC).

- Analyzer: HLC-8321 GPC/HT, Tosoh Corporation
- Column: PLgel guard (7.5 × 50 mm) + 2 × PLgel mixed-B (7.5 × 300 mm)
- Column temperature: 160°C
- Solvent: trichlorobenzene (TCB) + 0.04 wt% dibutylhydroxytoluene (BHT) (after drying with 0.1% $CaCl_2$)
- Injector and detector temperature: 160°C
- Detector: RI detector
- Flow rate: 1.0 ml/min
- Injection amount: 300 mL
- Sample concentration: 1.5 mg/mL
- Standard sample: polystyrene

<2. Strength (g/d)>

[0084] A stress-strain curve of the polyethylene yarn was obtained using a universal tensile tester (Instron Engineering Corp., Canton, Mass) according to the ASTM D2256 method. A sample length was 250 mm, a tensile speed was 300 mm/min, and an initial load was set to 0.05 g/d. A strength (g/d) was calculated from a stress and an elongation at a breaking point. The measurement was performed 5 times for each yarn, and an average of the values was calculated.

<3. Degree of crystallinity>

[0085] A degree of crystallinity of the polyethylene yarn was measured using an X-ray diffractometer (XRD) [manufacturer: Malvern Panalytical, model name: EMPYREAN]. Specifically, the polyethylene yarn was cut to prepare a sample having a length of 2.5 cm, the sample was fixed to a sample holder, and the measurement was performed under the following conditions.

- Light source (X-ray source): Cu-Kα radiation
- Power: 45 kV × 25 mA
- Mode: continuous scan mode
- Scan angle range: 10 to 40°
- Scan speed: 0.1°/sec

<4. Melt index>

[0086] A melt index was measured at 190°C and 2. 16 kg according to ASTM D1238.

[Measurement of physical properties of fabric]

<1. Contact cooling sensation>

[0087] Upon request, Korea Apparel Testing & Research Institute (KATRI) measured a contact cooling sensation in a test environment of 20 ± 2°C and 65 ± 2% R.H using KES-F7 (Thermo Labo II) apparatus.

[0088] Specifically, a fabric sample having a size of 20 cm × 20 cm was prepared, and the fabric sample was left under conditions of a temperature of 20 ± 2°C and RH of 65 ± 2% for 24 hours. Subsequently, a contact cooling sensation (Q max) of the fabric was measured in a test environment of a temperature of 20 ± 2°C and RH of 65 ± 2% using KES-F7 THERMO LABO II (Kato Tech Co., Ltd.) apparatus. Specifically, as illustrated in FIG. 3, a fabric sample 23 was placed onto a base plate (also referred to as "Water-Box") 21 maintained at 20°C, and a T-Box 22a (contact area: 3 cm × 3 cm) heated to 30°C was placed onto the fabric sample 23 for only 1 second. That is, one surface of the fabric sample 23 having the other surface in contact with the base plate 21 was instantaneously brought into contact with the T-Box 22a. The contact pressure applied to the fabric sample 23 by the T-box 22a was 6 gf/cm^2. Subsequently, a Q max value displayed on a monitor (not illustrated) connected to the apparatus was recorded. Such a test was repeated 10 times, and an arithmetic mean of the Q max values was calculated.

<2. Heat flux>

[0089] A thermal mannequin was placed in an artificial climate room, and a heat flux was measured in a test environment of 20 ± 2°C and 65 ± 2% R.H.

[0090] Specifically, as illustrated in FIG. 4, a male thermal mannequin was placed in the center of the artificial climate room at 20 ± 2°C and 65 ± 2% R.H. Subsequently, a temperature of the thermal mannequin was set to 33.7°C, and the thermal mannequin was heated by applying power.

[0091] Thereafter, a size 95 of a men's top sample was prepared and then was put on the heated thermal mannequin, and a heat flux (W/m^2), which was the amount of heat energy consumed per unit area (1 m^2) for a unit time (1 min), was measured using a surface temperature of the thermal mannequin and a power value for maintaining the temperature of the thermal mannequin for 30 minutes at one minute intervals.

<3. Moisture absorption rate>

[0092] A moisture absorption rate of the fabric was measured according to B Method of KS K 0642 8.26.

[0093] Specifically, five identical fabric samples having a size of 20 cm × 2.5 cm were prepared, and the samples were fixed by a horizontal bar at a constant height so that one end of the sample touched a water surface of a container in which distilled water at 20 ± 2°C was contained. After 10 minutes have elapsed, heights at which water rose due to a capillary action were measured, and an average value thereof was expressed.

<4. Moisture drying rate>

[0094] A moisture drying rate of the fabric was measured according to A Method of KS K 0642 8.25.

[0095] Specifically, three test pieces having a size of 4 cm × 4 cm were prepared and then immersed in distilled water at 20 ± 2°C in an unfolded state to sufficiently absorb moisture into the test pieces. Thereafter, the test pieces were taken out of distilled water, at the time when no more water droplets fell, the test pieces were mounted on a drying time measuring apparatus, and then, the test pieces were left in a test room under conditions of 20 ± 2°C and 65 ± 2% R.H. A time until the test pieces were naturally dried to constant weights was measured.

[Example 1]

<Manufacturing of polyethylene yarn>

[0096] A polyethylene yarn including 200 filaments and having a total fineness of 150 denier was manufactured.

[0097] First, a polyethylene chip was injected into an extruder 100 and melted. The molten polyethylene was extruded through a die 200 having 200 holes. The die temperature was 270°C. In this case, a nozzle of the die was a Y type.

[0098] Filaments 11 formed while being discharged through the holes of the nozzle of the die 200 were cooled to 50°C by a cooling wind having a wind speed of 0.9 m/sec in a first cooling zone, were cooled to 35°C by a cooling wind having a wind speed of 0.5 m/sec in a second cooling zone, and were finally cooled to 25°C by a cooling wind having a wind speed of 0.4 m/sec in a third cooling zone. After the cooling, the filaments were interlaced by an interlacer into a multi-filament.

[0099] Subsequently, the multi-filament was transferred to a drawing unit 500. The drawing unit 500 was a multi-stage drawing unit including four sections. Specifically, in the first drawing section, the multi-filament was drawn at a maximum drawing temperature of 80°C and a total draw ratio of 3, in the second drawing section, the multi-filament was drawn at a maximum drawing temperature of 120°C and a total draw ratio of 7, in the third drawing section, the multi-filament was drawn at a maximum drawing temperature of 130°C and a total draw ratio of 10, and in the fourth drawing section, the multi-filament was subjected to drawing and heat-setting at a maximum drawing temperature of 120°C so that the multi-filament was shrunk and drawn (relaxed) by 2% relative to the multi-filament in the third drawing section.

[0100] Subsequently, the drawn multi-filament was wound around a winder 600. The winding tension was 0.8 g/d.

[0101] The optical micrograph of the cross section of the manufactured yarn is illustrated in FIG. 5. The physical properties of the manufactured yarn were measured. The results are shown in Table 1.

<Manufacturing of functional fabric>

[0102] The manufactured polyethylene yarn was weaved to manufacture a functional fabric having an area density of 500 g/m^2. The physical properties of the manufactured functional fabric were measured. The results are shown in Table 3.

[Examples 2 to 5]

[0103] A fabric was manufactured in the same manner as that of Example 1, except that the conditions of the yarn were changed as shown in Table 1. In addition, the physical properties of the fabric manufactured in the same manner as that of Example 1 were measured. The results are shown in Table 3.

[Example 6]

[0104] A yarn and a fabric were manufactured in the same manner as that of Example 1, except that a >-< type nozzle was used as the die nozzle in Example 1. In addition, the physical properties of the manufactured yarn and fabric were measured. The results are shown in Tables 1 and 3.

[Comparative Example 1]

[0105] A yarn and a fabric were manufactured in the same manner as that of Example 1, except that a circular nozzle was used as the die nozzle in Example 1. The physical properties of the yarn are shown in Table 2. In addition, the physical properties of the fabric manufactured in the same manner as that of Example 1 were measured. The results are shown in Table 4.

[Comparative Example 2]

[0106] A polyethylene terephthalate (PET) fiber having the same cross-sectional shape and size as those in Example 1 was prepared, and then, a fabric was manufactured in the same manner as that of Example 1. The physical properties of the yarn are shown in Table 2. The physical properties of the fabric manufactured in the same manner as that of Example 1 were measured. The results are shown in Table 4.

[Comparative Example 3]

[0107] A polyethylene terephthalate (PET) fiber having the same cross-sectional shape and size as those in Example 1 and containing titanium dioxide (TiO_2) added as an absorbent additive was prepared, and then, a fabric was manufactured in the same manner as that of Example 1. The physical properties of the yarn are shown in Table 2. The physical properties of the fabric manufactured in the same manner as that of Example 1 were measured. The results are shown in Table 4.

[Comparative Example 4]

[0108] A yarn was manufactured in the same manner as that of Example 1, except that the drawing process of the polyethylene yarn was changed from the multi-stage drawing to single drawing so that the degree of crystallinity satisfied as shown in Table 2 in Example 1. The physical properties of the manufactured fabric were measured. The results are shown in Table 4.

[Table 1]

Classification		Example 1	Example 2	Example 3	Example 4	Example 5	Example 6
Physical properties of yarn	PDI	9.82	10.11	10.23	9.74	9.88	9.71
	Mw (g/mol)	311654	308542	313451	316321	309991	315642
	Degree of crystallinity (%)	75.2	75.7	74.1	74.9	75.3	75.1
	Melt index (g/10 min)	1.1	1.8	1.2	1.5	1.4	1.5
	Strength (g/d)	11.5	11.2	10.8	11.4	11.3	10.6
Cross section of filament	Shape	Trefoil shape	Trefoil shape	Trefoil shape	Trefoil shape	Trefoil shape	Quatrefoil shape
	R2/R1 ratio	2.81	3.10	2.12	2.24	2.79	2.36

[Table 2]

		Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4
Physical properties of yarn	Material	PE	PET	PET + TiO2	PE
	Degree of crystallinity (%)	75.2	48.7	48.7	55.1
	Strength (g/d)	11.5	3.4	3.5	3.4
Cross section of yarn	Shape of cross section	Circular shape	Trefoil shape	Trefoil shape	Trefoil shape
	R2/R1 ratio in cross section	-	1.65	1.78	1.98

[Table 3]

		Example 1	Example 2	Example 3	Example 4	Example 5	Example 6
Physical	Contact cooling	0.2	0.19	0.18	0.17	0.18	0.21

(continued)

		Example 1	Example 2	Example 3	Example 4	Example 5	Example 6
properties of yarn	sensation (W/cm^2)						
	Heat flux (W/m^2)	112	102	107	114	109	114
	Moisture absorption rate (mm/min)	125	108	107	115	112	127
	Moisture drying rate (mm/min)	32	28	26	30	34	31

[Table 4]

		Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4
Physical properties of yarn	Contact cooling sensation (W/cm^2)	0.2	0.12	0.13	0.10
	Heat flux (W/m^2)	114	80	90	87
	Moisture absorption rate (mm/min)	45	99	101	111
	Moisture drying rate (mm/min)	11	24	27	30

[0109] Referring to Tables 1 to 4, in the fabric manufactured using the yarn according to each of Examples of the present invention, it was confirmed that a contact cooling sensation was high and sweat absorption and quick drying properties were excellent. Therefore, the fabric manufactured using the yarn according to each of Examples may provide a significantly excellent cooling sensation to a user.

[0110] On the other hand, in the fabric according to Comparative Example 1, it was confirmed that the numerical value of the contact cooling sensation was similar to those of Examples, but moisture was not quickly removed due to a low moisture absorption rate and a low moisture drying rate, and thus, a cooling sensation felt by a user was deteriorated.

[0111] In Comparative Examples 2 and 3, it was confirmed that the fabric was significantly unlikely to be used as a product having a cooling sensation and sweat absorption and quick drying properties because the contact cooling sensation was deteriorated, and the heat flux and the moisture absorption and drying rates were low.

[0112] Hereinabove, although the present invention has been described by specific matters, exemplary embodiments, and drawings, they have been provided only for assisting in the entire understanding of the present invention. Therefore, the present invention is not limited to the exemplary embodiments. Various modifications and changes may be made by those skilled in the art to which the present invention pertains from this description.

[0113] Therefore, the spirit of the present invention should not be limited to the described exemplary embodiments, but the claims and all modifications equal or equivalent to the claims are intended to fall within the scope and spirit of the present invention.

[Detailed Description of Main Elements]

[0114]

1: Filament 10: Central body
10a: Inscribed circle 30: Protrusion
30a: Circumscribed circle

Claims

1. A polyethylene yarn comprising a filament having a central body and two or more protrusions protruding from the central body based on a cross section perpendicular to a longitudinal direction, wherein a degree of crystallinity of the polyethylene yarn is 56 to 85%.

2. The polyethylene yarn of claim 1, wherein based on the cross section perpendicular to the longitudinal direction of the polyethylene yarn, a first radius (R1) of an inscribed circle formed by the central body and a second radius (R2) of a circumscribed circle formed by the central body and the protrusion in the central body satisfy the following expression:

[Expression]

$$1.2 \leq R2/R1 \leq 5.0.$$

3. The polyethylene yarn of claim 1, wherein the polyethylene yarn has a melt index (MI, @190°C) of 1 to 25 g/10 min when measured at 190°C and 2.16 kg according to ASTM D1238.

4. The polyethylene yarn of claim 1, wherein the polyethylene yarn has a polydispersity index (PDI) of 5 to 30.

5. The polyethylene yarn of claim 1, wherein the polyethylene yarn has a strength of 5 to 15 g/d when measured according to ASTM D2256.

6. A functional fabric comprising the polyethylene yarn of any one of claims 1 to

7. The functional fabric of claim 6, wherein the functional fabric has a contact cooling sensation (Q-max) of 0.1 to 0.5 W/cm^2 when measured at 20 ± 2°C and 65 ± 2% R.H.

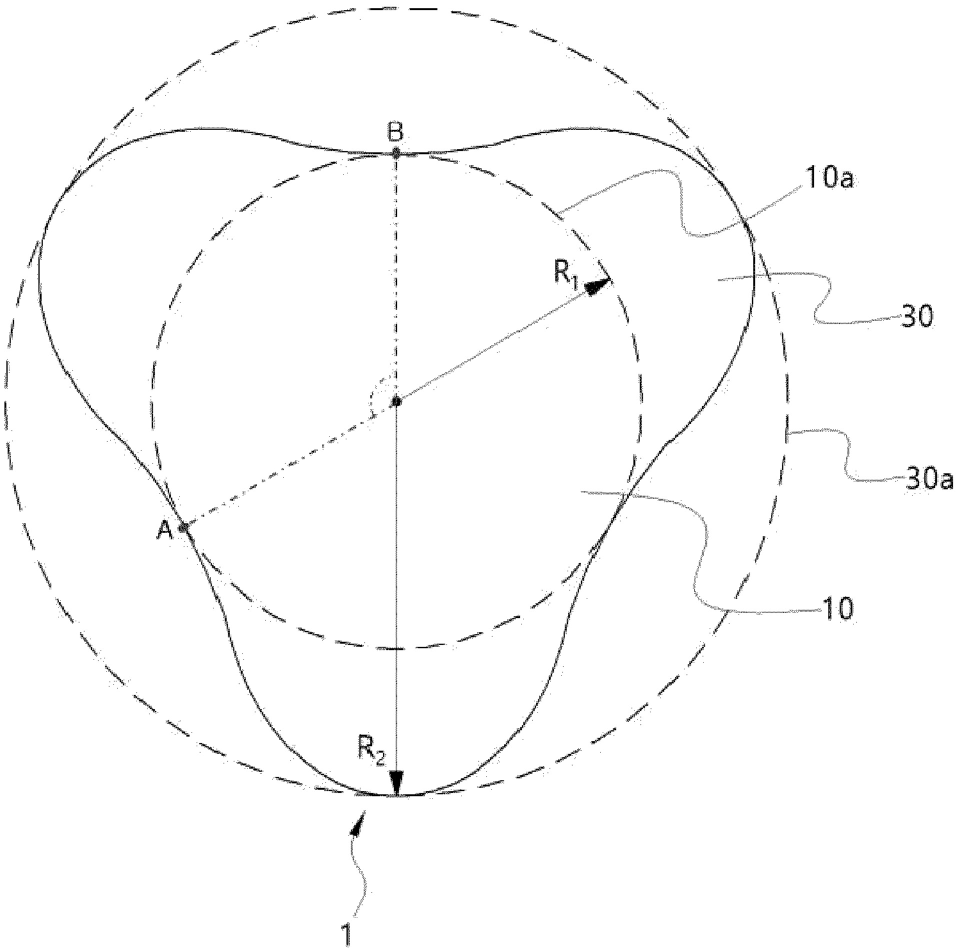
8. The functional fabric of claim 6, wherein the functional fabric has a heat flux of 95 to 150 W/m^2 when measured at 20 ± 2°C and 65 ± 2% R.H.

9. The functional fabric of claim 6, wherein the functional fabric has a moisture absorption rate of 80 to 160 mm/10 min when measured according to a Byreck method that is B Method of KS K 0642 8.26.

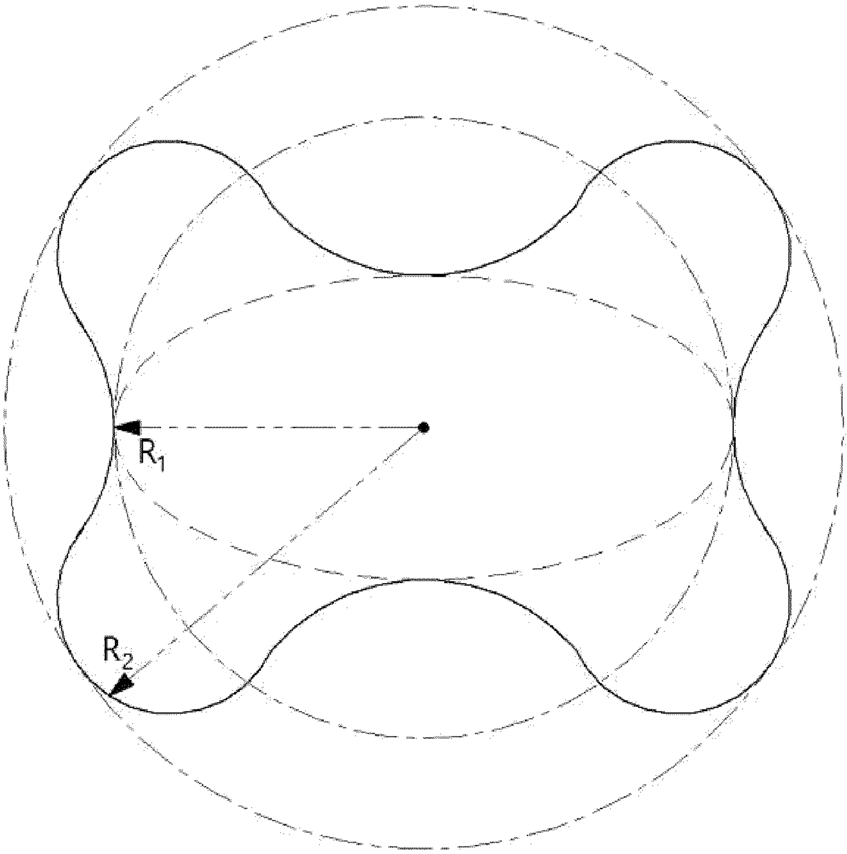
10. The functional fabric of claim 6, wherein the functional fabric has a moisture drying rate of 20 to 50 mm/10 min when measured according to A Method of KS K 0642 8.25.

11. A sweat absorption and quick drying product manufactured using the functional fabric of claim 6.

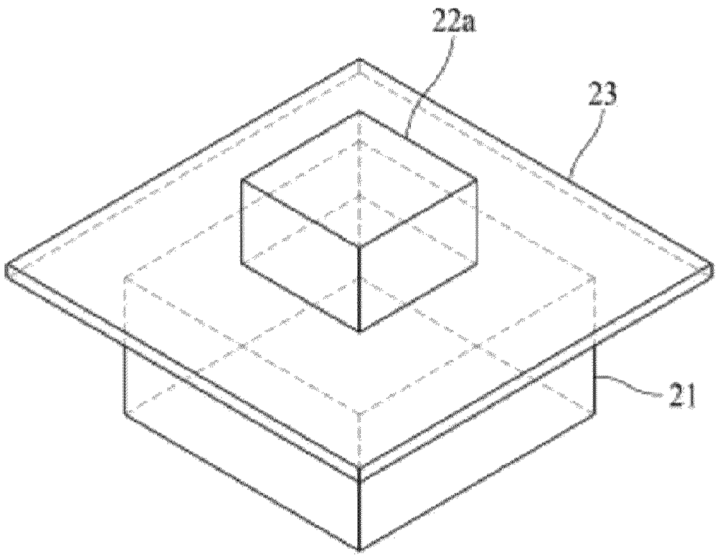
【FIG. 1】



【FIG. 2】

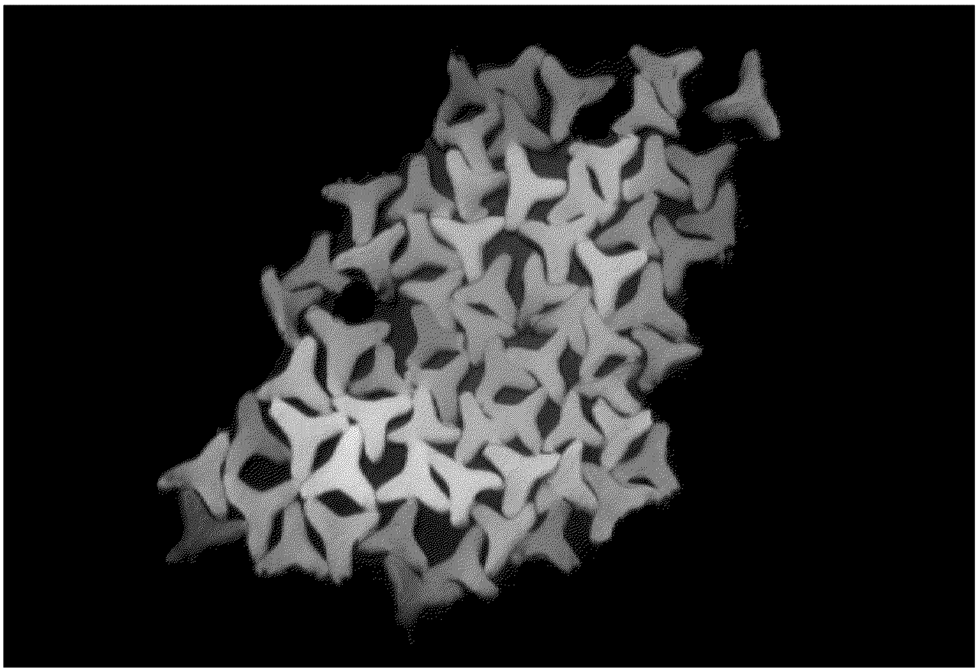


【FIG. 3】



【FIG. 4】

【FIG. 5】



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2022/020674

A. CLASSIFICATION OF SUBJECT MATTER

D01D 5/253(2006.01)i; **D01F 6/04**(2006.01)i; **D03D 15/44**(2021.01)i; **D03D 15/283**(2021.01)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)

D01D 5/253(2006.01); D01D 10/02(2006.01); D01D 5/088(2006.01); D01F 6/04(2006.01); D03D 15/00(2006.01); D04B 1/14(2006.01)

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: 폴리에틸렌 원사(polyethylene yarn), 필라멘트(filament), 돌기(protrusion), 흡한속건(quick dry)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2019-0005605 A (HUVIS CORPORATION) 16 January 2019 (2019-01-16) See claim 1; paragraphs [0021]-[0038]; and figure 1.	1-11
Y	KR 10-2020-0002119 A (KOLON INDUSTRIES, INC.) 08 January 2020 (2020-01-08) See paragraphs [0001]-[0139].	1-11
Y	WO 2013-168543 A1 (TEIJIN LIMITED) 14 November 2013 (2013-11-14) See paragraph [0038]; table 1; and figure 2.	2
Y	KR 10-2007-0028688 A (JUNG, Hyung Hee et al.) 13 March 2007 (2007-03-13) See paragraphs [0030] and [0052]-[0058]; and figure 6.	9-10
A	KR 10-2020-0036171 A (KOLON INDUSTRIES, INC.) 07 April 2020 (2020-04-07) See entire document.	1-11

☐ 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
"D" document cited by the applicant in the international application
"E" earlier application or patent but 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)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 March 2023	**21 March 2023**
Name and mailing address of the ISA/KR **Korean Intellectual Property Office** **Government Complex-Daejeon Building 4, 189 Cheongsa-ro, Seo-gu, Daejeon 35208**	Authorized officer
Facsimile No. **+82-42-481-8578**	Telephone No.

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2022/020674

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
KR 10-2019-0005605 A	16 January 2019	KR 10-2430564 B1	09 August 2022
KR 10-2020-0002119 A	08 January 2020	KR 10-2202592 B1	12 January 2021
WO 2013-168543 A1	14 November 2013	CN 104271819 A	07 January 2015
		TW 201402891 A	16 January 2014
		WO 2013-168543 A1	07 January 2016
KR 10-2007-0028688 A	13 March 2007	KR 10-0758638 B1	14 September 2007
KR 10-2020-0036171 A	07 April 2020	KR 10-2167737 B1	19 October 2020

Form PCT/ISA/210 (patent family annex) (July 2022)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- KR 101808459 **[0004]**
- KR 1020110076122 **[0004]**