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(71) Applicant: **Yang, Yan**
Beijing 101399 (CN)

(72) Inventors:
• **YANG, Yan**
Beijing 101399 (CN)
• **YANG, Tao**
Beijing 101399 (CN)

(74) Representative: **Herzog IP Patentanwalts GmbH**
Steinstraße 16-18
40212 Düsseldorf (DE)

(54) **DOUBLE-SIDED CONSTANT TEMPERATURE FABRIC AND PREPARATION METHOD THEREFOR**

(57) The present application provides a double sided thermostatic fabric and preparation method thereof, including: preparing a fiber with reflective and thermal insulation function (i.e. a second fiber), and using laser etching fiber surface to make threaded fiber, so that it has excellent light reflection and heat reflection properties, the fiber with reflective and thermal insulation function being an outer layer of the fabric; preparing a modified hemp fiber with excellent unidirectional moisture conductivity and thermal conductivity, the modified hemp fiber being an inner layer of the fabric; the inner layer of fabric is combined with the outer layer of the fabric to form a double sided fabric. The present application modifies the surface structure of the fiber and modifies the fiber, so that the prepared fabric can achieve temperature reduction through radiation heat dissipation and unidirectional moisture conduction in hot weather, and achieve thermal insulation through thermal reflection in cold weather, which can be applied to the manufacturing of clothing for human body temperature control, and has the advantages of large-scale batch preparation, low cost and high production efficiency.

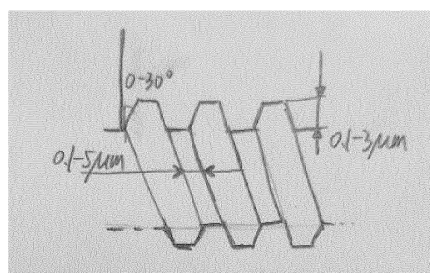


Fig. 1

Description**FIELD**

- 5 **[0001]** The present application relates to the technical field of textile technology, in particular to a double sided thermostatic fabric and a preparation method thereof.

BACKGROUND

- 10 **[0002]** Due to the greenhouse effect and urban heat island effect, global warming intensifies, the occurrence of extreme weather becomes more frequent, and the duration and degree of high temperature weather in summer become more serious. With the high temperature weather, the use and demand of heat pump equipment of refrigeration and air conditioning are increasing year by year. However, the extensive use of traditional refrigeration equipment is prone to generate huge energy consumption, and CFC and HCFC working fluids also have a destructive effect on the ozone layer. Therefore, the research on new environment-friendly refrigeration products has become an important topic for protecting the environment and improving people's quality of life. Among them, thermostatic fabrics can control the temperature of human body by playing the functions of radiation cooling and heat reflection, which is an energy-saving, environment-friendly, convenient and effective thermal management method.

- 15 **[0003]** Thermostatic fabrics mainly use technologies such as radiation cooling, heat reflection, and variable temperature materials to maintain the contact temperature of human skin in a comfortable range, that is, they can keep warm when cold and cool down when hot. Most of the energy of solar radiation is concentrated in the visible and infrared light regions. Through the selection of materials and the design of structures, fabrics with high reflectivity in the 0.3 μ m-2.5 μ m band of solar radiation and high emissivity in the 7 μ m-14 μ m band of human thermal radiation can be manufactured, it enables the human body to conduct radiation and heat transfer between the "atmospheric window" and the low-temperature outer space and the upper atmosphere to obtain the cooling effect. By enhancing the reflection of the material to the sunlight and reducing the transmission and absorption of the sunlight, the heat accumulation of solar radiation can be reduced, and the harm of ultraviolet radiation to human health can be reduced.

- 20 **[0004]** China Taiwan invention patent TW1707906B discloses a graphene thermostatic fabric, which uses special thermal properties and excellent conductivity of graphene to prepare graphene nanoflake suspension solution in a solvent having low boiling point and high surface tension, mixes the graphene nanoflake suspension solution and hydrophobic resin to prepare graphene resin solution, and covers the graphene resin solution and embeds it in the fabric by coating or printing, and the graphene thermostatic layer is formed. When the ambient temperature is high, the graphene thermostatic layer can accelerate the heat dissipation of human skin and achieve the cooling effect. When the ambient temperature is low, the graphene thermostatic layer can homogenize the temperature of different parts of human skin, and achieve the effect of keeping warm and constant temperature by absorbing and releasing the far infrared radiation of human skin. However, at present, the consequences of long-term human exposure to graphene cannot be fully determined. The application of graphene to fabrics in long-term contact with human body lacks the guarantee of safety, and graphene causes great pollution to the environment during the manufacturing process.

- 25 **[0005]** The United States patent US11058161B2 discloses a heat reflective fabric, which contains at least one layer of metal layer, which can reduce the heat loss of external radiation of human body by forming a radiation barrier. Combine the metal layer with the 3D warp knitted fabric with good air gap to expose the low emissivity surface of the metal layer. The 3D warp knitted fabric can provide insulation between the metal layer and other surfaces due to its certain thickness. The fabric can reflect the body heat back into the system to reduce the body heat loss, but it only has the heat preservation effect, and cannot reduce the body temperature in high temperature weather to achieve constant temperature.

- 30 **[0006]** The Chinese invention patent CN104127279B discloses a multifunctional membrane with spontaneous temperature regulation. The membrane includes a functional material carrier layer and an insulation layer close to the skin from the outside to the inside. The functional material carrier layer is a sealed cavity structure composed of impermeable flexible materials, loaded with refrigeration or heating chemical raw materials; the thermal insulation layer is composed of materials with waterproof and thermal insulation properties. If heating chemical raw materials are used, the functional material carrier layer can play a heating effect; if refrigeration chemical raw materials are used, the insulation layer can avoid local frostbite, and the uniform and stable heat exchange between the functional material carrier layer and the skin can play a long-term cooling effect. However, the film lacks the function of air permeability and moisture permeability, and the temperature control effect is time-sensitive, so it cannot be applied to daily wear clothing.

- 35 **[0007]** The Chinese utility model patent CN211747098U discloses an air conditioning suit that can work at a constant temperature, including a jacket made of textiles, a temperature regulating module, a temperature detection sensor, a control module and a lithium battery pack. The air conditioning suit uses semiconductor cooling fins and cooling fans for cooling, there are cooling fins between the semiconductor cooling fins and the cooling fans, and control module is connected to a lithium battery pack, a temperature regulation module, and a temperature detection sensor, uses the

lithium battery pack as the power supply, the temperature detection sensor is used to detect the temperature and feed back the temperature information to the control module, the control module starts the temperature adjustment module according to the set temperature to realize cooling or heating. The air conditioning suit has good refrigeration and heating functions, but the manufacturing process is complex, the cost is high, and the personal thermal management of zero energy consumption cannot be achieved.

[0008] Chinese invention patent CN113136724A discloses a radiation cooling fabric. The fabric contains silk fibers, and the radiation-cooled fabric includes materials attached to the fiber with a refractive index higher than 1.6 and lower than 3.0. The ultraviolet reflectivity is improved by superposing the materials with high refractive index attached to the fiber with the fiber. Compared with the untreated fabric, the reflectivity of ultraviolet light is increased by 42%, making the reflectivity of the whole solar light band reach 95%, the temperature of the treated fabric in the sun can be about 3.6 degrees lower than that of the room temperature, and the temperature on the skin can be about 12 degrees lower than that of the cotton fabric. However, the fabric does not have thermal insulation effect and cannot create a constant temperature environment at low temperature.

[0009] In summary, the existing patents lack a convenient, effective and energy-saving method to prepare thermostatic fabrics with both thermal insulation and cooling functions, so that they can be applied to the daily clothing of human thermal management.

SUMMARY

[0010] In view of this, the embodiment of the present application provides a double sided thermostatic fabric and preparation method thereof, to solve the technical defects in the prior art.

[0011] The present application provides a double sided thermostatic fabric, which comprises a first fiber and a second fiber, the first fiber is hemp fiber; the second fiber is a helical fiber whose surface contains a thread-shaped groove; the first fiber and the second fiber are combined to form the fabric, one side of the fabric is the first fiber, and the other side is the second fiber, when wearing, the first fiber side and the second fiber side can face inward or outward.

[0012] Further, the hemp fiber (natural hemp fiber) is a modified hemp fiber.

[0013] Further, the second fiber comprises a polyester fiber and a sunscreen reflective coating wrapping around the polyester fiber, and the threaded groove is arranged on an outside of the sunscreen reflective coating.

[0014] Further, components of the sunscreen reflective coating include alkyd resin and nano sunscreen particles, and the weight ratio of these two components is 1: (0~0.3).

[0015] Further, the alkyd resin is a silicone modified alkyd resin; preferably, the silicone modified alkyd resin is obtained by polycondensation of polyalkyl silicone resin, polyaryl silicone resin or polyalkyl aryl silicone resin and alkyd resin.

[0016] Further, an outer surface of the spiral fiber presents a tooth shape, which is trapezoidal, rectangular or triangular; preferably, a thread angle of the tooth shape is 0~30 °, and a width from tooth top to tooth bottom is 0.1-3.0 μm, a pitch is 0.1-5.0 μm.

[0017] Further, a particle size range of the nano sunscreen particles is 0.5-10 μm.

[0018] Another inventive concept of the present invention is to provide a preparation method of double sided thermostatic fabric according to any of the above paragraphs. The preparation method comprises:

preparation of the second fiber: method 1: ① melt alkyd resin or dissolve it in solvent, add nano sunscreen particles, and stir for 20-60 minutes; ② make a substance obtained in ① become a viscous semi-solid form; (3) thoroughly remove the solvent or reduce a temperature to make it become a solid film to obtain a sunscreen reflective coating; (4) then, wrap the sunscreen reflective coating around the polyester fiber;

method 2: ① it is consistent with step ① in method 1; ② make the substance obtained in ① become a viscous semi-solid form, (3) coat the viscous semi-solid obtained in step ② around the polyester fiber;

preparation of the double sided thermostatic fabric: weave any of the first fibers and the second fibers described in claims 1-8 into a double sided fabric.

[0019] Further, for the above method 1, the sunscreen reflective coating obtained in step (3) is provided with a threaded groove as described in any one of the above paragraphs;

[0020] Further, for step ② of the method 1 or the method 2 above, a method to become a viscous semi-solid includes: A. adding a thickener; B. if it is dissolution, removing part of the solvent; C. if it is molten, reduce the temperature to make it become viscous.

[0021] Further, adding an adhesive in step ① of method 1 or method 2, which includes at least one of styrene-butadiene rubber, neoprene rubber and nitrile rubber.

[0022] By virtue of the above technical solution, the technical solution provided by the present application has at least

the following advantages: the double sided thermostatic fabric in the application can be worn on both sides, that is, the outer side can face outward but also can face inward, correspondingly, the inner side can face outward but can also face outward, and different wearing methods have different effects.

[0023] Silicone modified alkyd resin has excellent reflectivity, thermal insulation, outdoor weather resistance and ultraviolet resistance. Adding the nano sunscreen particles prepared by uniform precipitation method into the silicone modified alkyd resin in a certain proportion can further improve its sunscreen and light reflection ability. The introduction of screw structure can increase the reflection of sunlight at different incident angles. Hemp fiber not only retains the original characteristics of loose, breathable, fast heat transfer and heat conduction, cool and crisp, sweatless, insect and mildew resistant, and less static electricity, but also has the characteristics of partial hydrophobic, which strengthens its moisture conductivity and moisture dissipation function. It can also play a good role in moisture conductivity and permeability without more moisture conductivity and permeability hole design or reducing the density of the fabric, ensuring that the made fabric has a good thermal insulation effect when wearing on the reverse side. Therefore, the double sided thermostatic fabric provided by the invention can be worn on both sides, and can be selectively cooled under high temperature conditions through radiation heat dissipation and unidirectional moisture conduction, or can be thermally insulated under low temperature conditions through heat reflection. The double layer fabric structure increases heat dissipation and air permeability. By introducing random nanostructures such as air holes, dielectric particles, polymer nanofibers and other random nanostructures into the fabric, it provides strong Michaelis scattering, thus realizing efficient regulation of the solar radiation band. Blending synthetic fiber and natural fiber after improvement can greatly improve the comfort of the fabric. At the same time, based on the difference of hygroscopicity between synthetic fiber and natural fiber, the fabric with unidirectional hygroscopicity can be manufactured to improve the dryness of the fabric.

BRIEF DESCRIPTION OF DRAWINGS

[0024] In order to make the purpose, technical solution and beneficial effects of the present application clearer, the present application provides the following drawings for illustration:
Figure 1 shows the structural diagram of the thread-shaped groove shown in the embodiment of the application.

DETAILED DESCRIPTION

[0025] The specific embodiments of the present application are described below in combination with the attached drawings.

[0026] In the present application, unless otherwise stated, the scientific and technical terms used herein have the meanings commonly understood by those skilled in the art. Moreover, the reagents, materials and operation steps used in this application are widely used in the corresponding fields.

Example 1:

[0027] This example provides a double sided thermostatic fabric capable of temperature adjustment, which includes the first fiber and the second fiber. The two fibers are combined into a double layer fiber structure. Refer to the double layer composite method in the prior art for the composite method in the present application. It is preferred to use the inner warp to connect the outer weft to compound the inner and outer layers to form a double sided fabric.

[0028] The first fiber is hemp fiber, preferably natural hemp fiber. The second fiber is a helical fiber whose surface contains a thread-shaped groove.

[0029] As a further preferred embodiment, the hemp fiber is preferably modified hemp fiber. By using natural hemp fiber, it is healthier for human body and has higher hygroscopicity. By modifying it, the moisture absorption and thermal conductivity can be increased at the same time. It is preferred that the modified hemp fiber is obtained by grafting and copolymerization of hemp fiber and polybutylene succinate (PBS). The modified hemp fiber has good unidirectional moisture conductivity and better thermal conductivity. As the inner layer of the fabric, it has strong practicability and excellent effect.

[0030] As a further preferred embodiment, the modification method is preferably as follows: pretreating hemp fiber with potassium permanganate solution; using decalin as solvent, after mixing succinic acid and butanediol with catalyst SnCl_2 , first react at the temperature of 150-160 °C for 1-2h until the esterification is complete, then raise the temperature to 190-200 °C, add pretreated hemp fiber, and conduct graft copolymerization. After heat preservation for 10-12h, the modified hemp fiber is obtained.

[0031] As a further preferred embodiment, the fineness of the second fiber is 2.0 dtex~5.0 dtex, such as 2.0 dtex, 2.5 dtex, 3.0 dtex, 3.5 dtex, 4.0 dtex, 4.5 dtex, 5.0 dtex, etc., and the fiber diameter range is 15.0-30.0 μm . The fiber with the size range can meet the application of the invention.

[0032] As a further preferred embodiment, the second fiber comprises a polyester fiber and a sunscreen reflective

coating wrapping around the polyester fiber, and the threaded groove is arranged on an outside of the sunscreen reflective coating. Preferably, the polyester fiber is polyethylene terephthalate.

[0033] As a further preferred embodiment, components of the sunscreen reflective coating include alkyd resin and nano sunscreen particles, and the weight ratio of these two components is 1: (0~0.3).

[0034] The alkyd resin is preferably silicone modified alkyd resin.

[0035] As a further preferred embodiment, the silicone modified alkyd resin is obtained by polycondensation of polyalkyl silicone resin, polyaryl silicone resin or polyalkyl aryl silicone resin and alkyd resin.

[0036] As a further preferred embodiment, the outer surface of the spiral fiber is a tooth shape, which is trapezoidal, rectangular or triangular, more preferably trapezoidal and rectangular, most preferably trapezoidal.

[0037] As a further preferred embodiment, the thread angle of the tooth shape is 0-30°, preferably 17-23°, such as 17°, 18°, 19°, 20°, 21°, 22° and 23°; the width from tooth top to tooth bottom is 0.1-3.0 μm, preferably 0.2-1 μm, e.g. 0.2 μm, 0.4 μm, 0.6 μm, 0.8 μm, 1.0 μm; the pitch is 0.1-5.0 μm, preferably 0.5-2 μm, such as 0.5 μm, 0.8 μm, 1.0 μm, 1.3 μm, 1.5 μm, 1.8 μm, 2.0 μm.

[0038] As a further preferred embodiment, the particle size range of the nano sunscreen particles is 0.5-10 μm, preferably 2-6 μm. The particles in this range can balance the sunscreen performance and specific surface area. If it is too small, the sunscreen strength or effect is insufficient, and if it is too large, the specific surface area is small, affecting the sunscreen performance. More importantly, the introduction of nanoparticles of this size into the silicone modified alkyd resin of the invention can provide strong Michaelis scattering, thus realizing efficient regulation of the solar radiation band and helping to regulate the temperature.

[0039] As a further preferred embodiment, the nano sunscreen particles include one or more of the following: TiO₂, ZnO, SiO₂, ZrO₂, CeO₂, MgO, Al₂O₃, Fe₂O₃, Fe₃O₄, MgSiO₃, Al₂SiO₅, BaCO₃, BaSO₄, jade powder, mica powder, quartz sand, dolomite, paraffin, borneol, calcium silicate, polyethylene (PE), TiO₂, ZnO, SiO₂, ZrO₂, CeO₂, MgO, Al₂O₃, Fe₂O₃, Fe₃O₄, MgSiO₃, Al₂SiO₅, BaCO₃, BaSO₄, ZrN, AlN, SiN, BN, Si₃N₄, SiC, Zn (NO₃)₂, phenolic resin, bismaleimide resin, graphite, carbon nanotubes, aluminium-carbon nanotubes, fluororesin, tetrafluoroethylene, silicone modified acrylic resin or fluorocarbon resin, trifluoroethylene, salicylate, benzophenone, benzotriazole, triazine, trimethoxybenzoate, p-aminobenzoic acid, phenyl cinnamate, camphor derivatives, tetrafluoroethylene and perfluoro-2,2-dimethyl-1,3-dichlorocyclohexane copolymer, benzoxazinones in benzamidine.

[0040] The technical solution of this embodiment has the effect of adjusting temperature to a certain extent, and can maintain a relatively constant temperature.

[0041] When the weather is hot and the sun is strong, the second fiber can be worn outward. The specific sunscreen coating outside the second fiber has high reflectivity in the band of solar thermal radiation. More importantly, the specific thread-shaped groove designed on the side where the second fiber is located, especially when the tooth angle is 17-23°, makes the sunlight reflected and refracted in the groove with high efficiency. At the same time, there are some diffuse reflection phenomena, which together have a great effect on cooling. Moreover, the alkyd resin in the second fiber, especially the silicone modified alkyd resin, has a strong thermal insulation effect, and can greatly reduce the external temperature of the tissue into the body. Through the special reflection of the above sunscreen coating, the special structure of the thread-shaped groove and the coordination of alkyd resin, the three have a better effect on cooling and regulating temperature. In addition, the natural modified hemp fiber on the inside also has strong functions of moisture absorption, heat absorption and unidirectional moisture conduction, which is also advantageous to cooling and makes the human body more comfortable. Overall, the effect of cooling and heatstroke prevention is good.

[0042] In cold weather, it is preferred to wear the second fiber inwards, because the wave band of solar thermal radiation does not coincide with the wave band of human thermal radiation, so the specific sunscreen coating on the second fiber has high absorption in the wave band of human thermal radiation, which can play a thermal insulation effect when reverse wearing. The alkyd resin in the second fiber, especially the silicone modified alkyd resin, has a strong thermal insulation effect and can keep the body temperature from being lost to a large extent. More importantly, the hemp fiber on the outside has good light absorption, and has a good supporting effect on the maintenance or improvement of internal problems.

[0043] In this embodiment, the combination or combination of sunscreen particles of a specific size with silicone modified alkyd resin and spiral fibers of a specific structure greatly increases the temperature control effect of the fabric and improves the comprehensive effect

Example 2:

[0044] On the basis of Example 1, this Example is a preparation method of double sided thermostatic fabric, the preparation method is:

Preparation of the second fiber: method 1: ① melt the alkyd resin or dissolve it in solvent (the solubility is 60-100%, that is, it can not be completely dissolved), and then add nano sunscreen particles under heating conditions, stirring for 20-60 minutes; ② make the substance obtained in ① become a viscous semi-solid form; (3) thoroughly remove the solvent

or reduce the temperature to make it become a solid film to obtain the sunscreen reflective coating; (4) then, the sunscreen reflective coating is coated on the periphery of the polyester fiber; the alkyd resin here can be dry or semi-dry. As long as the solvent can partly dissolve the alkyd resin, it will be ok, the solvent can be such as ester, alcohol, ketone solvent.

[0045] Method 2: ① it is consistent with step ① in method 1; ② make the substance obtained in ① become a viscous semi-solid form, (3) coat the viscous semi-solid obtained in step ② around the polyester fiber.

[0046] Preparation of double sided thermostatic fabric: weave the first fibers and the second fibers described into a double sided fabric. The weaving method is based on the double-layer fabric in the prior art. It is preferred to use the inner warp to connect the outer weft to compound the inner and outer layers of fabric to form a double-layer fabric.

[0047] As a further preferred embodiment, for the above method 1, the said thread-shaped groove is arranged on one side of the sunscreen reflective coating obtained in step (3). It is preferred that the threaded fiber made by laser engraving or etching its surface, made the threaded fiber has good light reflection and thermal reflection properties, and is the outer layer of the fabric.

[0048] As a further preferred embodiment, an adhesive is added in step ① of method 1 or method 2, which includes at least one of styrene-butadiene rubber, neoprene rubber and nitrile rubber.

[0049] As a further preferred embodiment, for step ② of method 1 or method 2 above, the method to become a viscous semi-solid includes: A. adding a thickener; B. if it is dissolution, removing part of the solvent; C. if it is molten, reduce the temperature to make it become viscous.

Example 3:

[0050] Experiment example: double sided thermostatic fabric prepared by example 2 of the invention.

[0051] Comparative example 1: without the sunscreen and reflective coating in the experiment example, the others are consistent with the experiment example.

[0052] Comparative example 2: without the nano sunscreen particles in the experiment example, the others are consistent with the experiment example.

[0053] Comparative example 3: instead of adding the alkyd resin in the experiment example, put the polyester fiber in the dip mill, immerse it in the nano sunscreen particles solution, press the nano sunscreen particles into the structural surface of the polyester fiber through the dip roller group, and form the polyester fiber coated with nano sunscreen particles after drying, the rest is consistent with the experiment example.

[0054] Comparative example 4: modify the spiral groove in the experimental example to a rough structure with many bumps on the surface, and the rest is consistent with the experimental example.

[0055] Comparative example 5: modify the modified hemp fiber in the experiment example to hemp fiber, and the others are consistent with the experiment example.

Experimental method:

[0056]

1. At 10 °C, use a hot water bag to simulate the human body, cover the hot water bag with the thermostatic double-sided fabric of example 1 and comparative examples of 1-5, and measure the temperature change of the hot water bag with time to reflect the thermal insulation performance of different thermostatic double-sided fabrics.

[0057] The results are shown in the following table:

	Initial temperature (°C)	15 min temperature (°C)	30 min temperature (°C)
Example	50.0	41.5	34.6
Comparative example 1	50.0	36.4	29.2
Comparative example 2	50.0	38.5	31.0
Comparative example 3	50.0	37.0	30.5
Comparative example 4	50.0	40.8	34.0
Comparative example 5	50.0	39.3	33.7

[0058] 2. Test the solar reflectance and emissivity of example 1 and two-sided thermostatic fabric with comparative examples of 1-5 to reflect its cooling effect.

[0059] The results are shown in the following table:

	0.3-2.5 μm Solar reflectance	8-13 μm Emissivity of atmospheric radiation window
Example	92%	0.93
Comparative example 1	77%	0.85
Comparative example 2	83%	0.87
Comparative example 3	88%	0.90
Comparative example 4	90%	0.85
Comparative example 5	87%	0.86

[0060] 3. Carry out the permeability test for example 1 and the double-sided thermostatic fabric with comparative examples of 1-5. The specific steps are as follows: use the permeability tester, use the constant pressure difference flow measurement method, clamp the sample on the permeability tester, adjust the pressure to form a constant pressure difference on both sides of the sample, and measure the permeability (L/h) of different double-sided thermostatic fabrics through the air flow rate of the given area of the sample vertically within a certain time.

	Permeability (L/h)
Example	23.8
Comparative example 1	24.9
Comparative example 2	23.5
Comparative example 3	24.3
Comparative example 4	20.0
Comparative example 5	18.7

[0061] It can be seen from the above that, in general, the application has better temperature regulation function and better air permeability.

[0062] In the present application, the thermostatic double-sided fabric can be produced in batches. By modifying the surface structure of the fiber and modifying the fiber, the fabric can be cooled by radiation heat dissipation and unidirectional moisture conduction in hot weather, and can be insulated by heat reflection in cold weather, which can be used in the manufacturing of clothing of human temperature regulation.

[0063] In the present application, "up", "down", "front", "back", "left" and "right" are only used to represent the relative position relationship between related parts, not to limit the absolute position of these related parts.

[0064] In the present application, "the first" and "the second" are only used to distinguish each other, not to indicate the importance and order, and the premise of each other's existence.

[0065] In the present application, "equal", "identical" and the like are not strict mathematical and/or geometric restrictions, but also contain errors that can be understood by those skilled in the art and allowed by manufacturing or use.

[0066] Unless otherwise stated, the numerical range in this paper includes not only the entire range within its two endpoints, but also several sub-ranges contained therein.

[0067] The specific preferred embodiments and embodiments of the application are described in detail above in combination with the attached drawings, but the present application is not limited to the above embodiments and embodiments. Within the scope of knowledge of those skilled in the art, various changes can be made without departing from the concept of the application.

Claims

1. A double sided thermostatic fabric, which comprises a first fiber and a second fiber, **characterized in that:**

the first fiber is hemp fiber;

the second fiber is a helical fiber whose surface contains a thread-shaped groove;

the first fiber and the second fiber are combined to form the fabric, one side of the fabric is the first fiber, and

the other side is the second fiber, when wearing, the first fiber side and the second fiber side can face inward or outward.

2. The double sided thermostatic fabric of claim 1, **characterized in that**,

a fineness of the second fiber is 2.0 dtex~5.0 dtex;
the second fiber is a spiral fiber containing a thread-shaped groove made by laser engraving or etching its surface.

3. The double sided thermostatic fabric of claim 1, **characterized in that**, the hemp fiber is a modified hemp fiber.

4. The double sided thermostatic fabric of claim 3, **characterized in that**, the second fiber comprises a polyester fiber and a sunscreen reflective coating wrapping around the polyester fiber, and the threaded groove is arranged on an outside of the sunscreen reflective coating.

5. The double sided thermostatic fabric of claim 4, **characterized in that**, components of the sunscreen reflective coating include alkyd resin and nano sunscreen particles, and the weight ratio of these two components is 1: (0~0.3).

6. The double sided thermostatic fabric of claim 5, **characterized in that**, the alkyd resin is an silicone modified alkyd resin; preferably, the silicone modified alkyd resin is obtained by polycondensation of polyalkyl silicone resin, polyaryl silicone resin or polyalkyl aryl silicone resin and alkyd resin.

7. The double sided thermostatic fabric of claim 6, **characterized in that**, an outer surface of the spiral fiber presents a tooth shape, which is trapezoidal, rectangular or triangular; preferably, a thread angle of the tooth shape is 0~30°, and a width from tooth top to tooth bottom is 0.1-3.0 μm, a pitch is 0.1-5.0 μm.

8. The double sided thermostatic fabric of claim 7, **characterized in that**, a particle size range of the nano sunscreen particles is 0.5-10 μm.

9. A preparation method of the double sided thermostatic fabric of any one of claims 1-8, **characterized in that**: the preparation method comprises:

preparation of the second fiber: method 1: ① melt alkyd resin or dissolve it in solvent, add nano sunscreen particles, and stir for 20-60 minutes; ② make a substance obtained in ① become a viscous semi-solid form; (3) thoroughly remove the solvent or reduce a temperature to make it become a solid film to obtain a sunscreen reflective coating; (4) then, wrap the sunscreen reflective coating around the polyester fiber;
method 2: ① it is consistent with step ① in method 1; ② make the substance obtained in ① become a viscous semi-solid form, (3) coat the viscous semi-solid obtained in step ② around the polyester fiber;
preparation of the double sided thermostatic fabric: weave any of the first fibers and the second fibers described in claims 1-8 into a double sided fabric.

10. The preparation method of claims 9, **characterized in that**, for the above method 1, the sunscreen reflective coating obtained in step (3) is provided with a threaded groove as described in any one of claims 1-8;

preferably, for step ② of the method 1 or the method 2 above, a method to become a viscous semi-solid includes:
A. adding a thickener; B. if it is dissolution, removing part of the solvent; C. if it is molten, reduce the temperature to make it become viscous;
preferably, adding an adhesive in step ① of method 1 or method 2, which includes at least one of styrene-butadiene rubber, neoprene rubber and nitrile rubber.

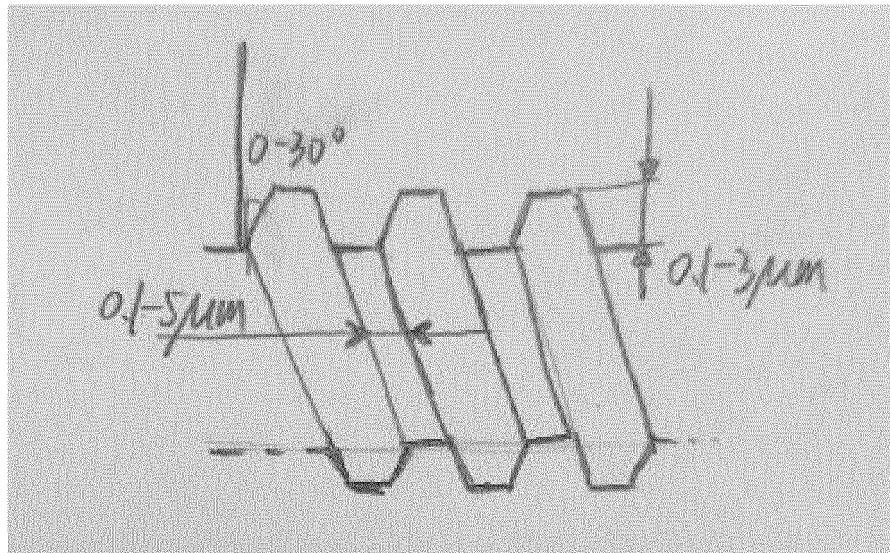


Fig.1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2022/084895

A. CLASSIFICATION OF SUBJECT MATTER

D03D 15/217(2021.01)i; D03D 15/37(2021.01)i; D03D 15/283(2021.01)i; D03D 15/547(2021.01)i; D03D 11/00(2006.01)i; D03D 15/52(2021.01)i; D03D 15/50(2021.01)i; D06M 11/44(2006.01)i; D06M 11/46(2006.01)i; D06M 11/79(2006.01)i; D06M 15/507(2006.01)i; D06M 15/643(2006.01)i; D06M 17/00(2006.01)i; A41D 13/005(2006.01)i; A41D 13/01(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D03D15/-, D03D11/-, D06M15/-, D06M17/-, A41D13/-

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)

CNXTX, CNKI, WPABSC, ENTXTC: 金轮沃德, 杨艳, 杨涛, 织物, 面料, 布料, 保暖, 降温, 恒温, 正穿, 反穿, 反射, 紫外线, 阳光, 螺旋, 槽, 纤维, 双面, 两面, 麻纤维, 醇酸树脂; VEN, ENTXT, WPABS, WEB OF SCIENCE: alkyd resin, insulation, reverse, wear+, wear+ cloth+, high-reflectivity, back side, front side, fabric, cloth, reflect+, UV, ultraviolet, sunlight, sunshine, helix, spiral, spire, screw, trough+, groove?, slot?, fiber?, fibre?, double face, double fold, fibria, hemp, china grass, sisal, ramie.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 201967672 U (JIAXING ZHENGQI HI-NEW-TECH TEXTILE MATERIAL BONDING CO., LTD.) 14 September 2011 (2011-09-14) entire document	1-10
A	CN 213108511 U (HANGZHOU GAOXI TECHNOLOGY CO., LTD.) 04 May 2021 (2021-05-04) entire document	1-10
A	US 5154768 A (NIPPON STEEL CHEMICAL CO.) 13 October 1992 (1992-10-13) entire document	1-10
A	CN 106676709 A (RAINBOW PACKAGE IND CO., LTD.) 17 May 2017 (2017-05-17) entire document	1-10
A	TW 727765 B (NANYA PLASTICS CORP.) 11 May 2021 (2021-05-11) entire document	1-10

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

* Special categories of cited documents:

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“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

14 June 2022

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27 June 2022

Name and mailing address of the ISA/CN

China National Intellectual Property Administration (ISA/
CN)
No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing
100088, China

Authorized officer

Facsimile No. (86-10)62019451

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2022/084895

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	CN 114211829 A (ZHEJIANG UNIVERSITY) 22 March 2022 (2022-03-22) entire document	1-10
A	CN 108741294 A (SUZHOU SUPERLONG AVIATION HEAT RESISTANCE MATERIAL TECHNOLOGY CO., LTD.) 06 November 2018 (2018-11-06) entire document	1-10
A	JP 2018127873 A (NIPPON SYANETSU CO., LTD.) 16 August 2018 (2018-08-16) entire document	1-10
A	CN 103215672 A (DONGHUA UNIVERSITY) 24 July 2013 (2013-07-24) entire document	1-10
A	CN 111886374 A (THE BOARD OF TRUSTEES OF THE LELAND STANFORD JUNIOR UNIVERSITY) 03 November 2020 (2020-11-03) entire document	1-10
A	JP 2020059952 A (KOMATSU MATERE CO., LTD.) 16 April 2020 (2020-04-16) entire document	1-10

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
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CN 213108511 U	04 May 2021	None	
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CN 108741294 A	06 November 2018	None	
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		KR 20200108094 A	16 September 2020
JP 2020059952 A	16 April 2020	None	

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REFERENCES CITED IN THE DESCRIPTION

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- CN 113136724 A [0008]