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(54) THERMAL INSULATION FIBRE AND TEXTILE MADE THEREFROM

(57) Disclosed are a thermal insulation fiber, a thermal insulation textile and a use of a fiber containing a nano unit in manufacturing a thermal textile. The thermal insulation fiber includes a conventional fiber; and a nanounit. Based on a total weight of the convention fiber, the nano unit is of a content of O.lwt % to 3wt%, so as to improve an insulation rate of the thermal insulation fiber; the nano unit comprises a microparticle having a size of 300nm to 8000nm; and the microparticle comprises at least one of a mixture of Ti and Ce, a mixture of Ti and Mg, and a mixture of Ti, Ce, Mg, Si and Ca.

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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims a priority to and benefits of Chinese Patent Application Serial No. 201310069914.9, filed with the State Intellectual Property Office of P. R. China on March 5, 2013, the entire content of which is incorporated herein by reference.

FIELD

[0002] The present disclosure relates to a fiber and a textile, and more particularly to a thermal insulation fiber and a textile made of the thermal insulation fiber.

BACKGROUND

[0003] In the related art, for a vast majority of traditional textile fibers and textiles, their thermal insulation performances are improved by increasing an amount of the fibers and enhancing a thickness and a weight of the fiber textile. For example, mainstream thermal underwear sold in the current market has disadvantages of a heavy weight and a large thickness, thus resulting in an irreparable defect in term of wearing comfort.

[0004] In addition, a heat storage material is used to improve the thermal insulation performance of the fiber textile. The so-called heat storage material is a novel chemical material being capable of storing heat. For the heat storage material, a phase transformation occurs at a specific temperature along with heat absorption or release, which may be used to control an ambient temperature or to be stored as a thermal energy. Its principle and technical solution have significant differences as compared with the thermal insulation. For example, a hygroscopic calorific fiber, one of the heat storage materials, has an excellent hygroscopic performance, which is capable of converting a kinetic energy of water molecules perspired from a human body into a thermal energy, thereby improves a sensible temperature, because an increased temperature enables perspired moistures to be evaporated more easily.

[0005] However, it is relatively limited to improve the thermal insulation performance by the hygroscopic calorific fiber. Besides, cost of such material is relative expensive.

SUMMARY

[0006] An object of the present disclosure is to provide a thermal insulation fiber and a textile made of the thermal insulation fiber with better thermal insulation performance and lower cost, which are easy to be manufactured and industrialized.

[0007] In an aspect, the present disclosure provides in embodiments a thermal insulation fiber, including:

a conventional fiber; and
a nano unit,
wherein based on a total weight of the convention fiber, the nano unit is of a content of O.lwt % to 3wt%, so as to improve an insulation rate of the thermal insulation fiber;
the nano unit includes a microparticle having a size of 300nm to 8000nm; and
the microparticle includes at least one of a mixture of titanium (Ti) and cerium (Ce), a mixture of Ti and magnesium (Mg), and a mixture of Ti, Ce, Mg, silicon (Si) and calcium (Ca).

[0008] Alternatively, the conventional fiber includes a chemical fiber, and the chemical fiber includes at least one of an artificial fiber and a synthetic fiber.

[0009] Alternatively, based on the total weight of the convention fiber, the nano unit is of a content of 1.5wt % to 3wt%; and the nano unit includes the microparticle having a size of 300nm to 4000nm.

[0010] Alternatively, in the nano unit, the microparticle includes:

Ti being of a content of 500 weight units to 10000 weight units; and Ce being of a content of 60 weight units to 300 weight units, or
Ti being of a content of 500 weight units to 10000 weight units; and Mg being of a content of 10 weight units to 500 weight units, or
Ti being of a content of 500 weight units to 10000 weight units; Ce being of a content of 60 weight units to 300 weight units; Ca being of a content of 50 weight units to 500 weight units; Mg being of a content of 10 weight units to 500 weight units; and Si being of a content of 50 weight units to 3000 weight units.

[0011] Alternatively, wherein based on the total weight of the convention fiber, the nano unit is of a content of 0.1wt % to 1.5wt%; and the nano unit includes the microparticle having a size of 4000nm to 8000nm.

[0012] Alternatively, in the nano unit, the microparticle includes:

Ti being of a content of 500 weight units to 10000 weight units; and Ce being of a content of 60 weight units to 300 weight units, or

Ti being of a content of 500 weight units to 10000 weight units; and Mg being of a content of 10 weight units to 500 weight units, or

Ti being of a content of 500 weight units to 10000 weight units; Ce being of a content of 60 weight units to 300 weight units; Ca being of a content of 50 weight units to 500 weight units; Mg being of a content of 10 weight units to 500 weight units; and Si being of a content of 50 weight units to 3000 weight units.

[0013] Alternatively, in the nano unit, the microparticle further includes:

K being of a content of 50 weight units to 100 weight units;
Sn being of a content of 100 weight units to 500 weight units; and
S being of a content of 50 weight units to 100 weight units.

[0014] In another aspect, the present disclosure provides in embodiments a thermal insulation textile at least including a part of the thermal insulation fiber described above.

[0015] In yet another aspect, the present disclosure provides in embodiments a use of a fiber containing a nano unit in manufacturing a thermal textile, wherein the fiber containing the nano unit is any one of the thermal insulation fiber described above.

[0016] According to above embodiments, the present disclosure has the following advantages. The thermal insulation fiber according to embodiments of the present disclosure includes the conventional fiber and the nano unit, the nano unit is of a content of 0.1wt % to 3wt%, so as to improve an insulation rate of the thermal insulation fiber, the nano unit includes a microparticle having a size of 300nm to 8000nm, so that the thermal insulation performance and a Clo value of the fiber according to embodiments of the present disclosure are improved significantly as compared with a conventional textile being of a same weight and made of a same weave. Besides, the fiber according to embodiments of the present disclosure has advantages of low manufacturing cost, simple manufacturing process and being easy to be industrialized as compared with a thermal insulation fiber in the related art.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Above and/or additional aspects and advantages of embodiments of the present disclosure will become apparent and more readily appreciated from the following descriptions made with reference to the drawings, in which:

Fig. 1 is a diagram showing a thermal insulation rate of a textile obtained in Example 1 of the present disclosure as compared with that of textiles obtained in comparative experiments.

DETAILED DESCRIPTION

[0018] Reference will be made in detail to examples of the present disclosure. The examples described herein with reference to drawings are explanatory, illustrative, and used to generally understand the present disclosure, and cannot be construed to limit the present disclosure. If the specific technology or conditions are not specified in the examples, a step will be performed in accordance with the techniques or conditions described in the literature in the art or in accordance with the product instructions. If the manufacturers of reagents or instruments are not specified, the reagents or instruments may be commercially available

Example 1

[0019] Table 1 and Fig.1 illustrate testing data and a diagram thereof showing a thermal insulation rate of a textile obtained in Example 1 of the present disclosure as compared with that of textiles obtained in comparative experiments, respectively.

(1) Title: thermal insulation performance experiment

(2) Object: testing the thermal insulation performances of the fiber and the textile made of the fiber. In order to improve the thermal insulation performances thereof, air which does not readily conduct heat is injected between

fibers, so as to inhibit heat dissipation.

(3) Method: tests are conducted based on "JIS L1096 Testing methods for woven and knitted fabrics". Using a warmth retaining tester, a hot plate setting at a certain temperature (36±0.5°C) and test piece are combined as one group. After 2 hours, a heat energy **A** dissipated from the test piece is obtained. Besides, a heat energy **B** dissipated from the test piece when not combined with the hot plate is also obtained after 2 hours. The thermal insulation rate (%) is calculated according to the following formula:

$$\text{Thermal insulation rate } (\%) = (1\text{-A/B}) \times 100$$

(4) Test organization: Japanese statutory testing organizations - General Foundation BOKEN spinning quality rating agencies in eastern business

(5) Test samples:

5.1 the fiber according to embodiments of the present disclosure, includes a conventional fiber and a nano unit, wherein based on a total weight of the convention fiber, the nano unit is of a content of 2.9wt%, so as to improve an insulation rate of the thermal insulation fiber; the nano unit includes a microparticle having a size of about 300nm; and the microparticle includes Ti being of a content of 9000 weight units, Ce being of a content of 60 weight units, and other trace elements as required in accordance with the related art.

[0020] The nano unit of the present disclosure can be added into the conventional fiber by any one of existing methods for manufacturing a fiber. A method for manufacturing the fiber used in the present disclosure includes the following steps: A). making a natural polymer material, a natural inorganic material (such as viscose), a synthetic polymer material or a synthetic inorganic material (such as nylon and acrylic material) as a spinning melt or solution; B). adding the nano unit including Ti and Ce into the spinning melt or solution; and C). forming the fiber after extruded through a spinneret. Other steps are the same as the method for manufacturing the fiber in the related art, which is not described in details herein.

[0021] It would be appreciated that the nano unit may include Ti and Ce at any other ratio by weight units. Through a large number of repeated tests by the inventor, the fiber including the nana unit at various ratios may have an excellent thermal insulation performance. The present example merely selected one group of experiment data from numerous experiments for illustration (being similarly hereinafter).

[0022] In addition, the microparticle of the present disclosure may be an oxide or a nitride under a normal temperature state, or may be other forms capable of existing stably, such as a compound or a monomer.

[0023] It should be noted that, "weight unit" used herein is alternatively a weight ratio of "microgram/kilogram"; or may be other weight units in accordance with practical requires (being similarly hereinafter).

5.2 Comparative experiment:

[0024]

a sample obtained in comparative experiment 1: a hygroscopic calorific underwear sold by Aeon, its test method is same as the "Method" described above;

a sample obtained in comparative experiment 2: a hygroscopic calorific underwear sold by Uniqlo, its test method is same as the "Method" described above;

a sample obtained in comparative experiment 3: a hygroscopic calorific underwear sold by Shimala, its test method is same as the "Method" described above;

a sample obtained in comparative experiment 4: a 100% wool underwear sold by Ito Yokado, its test method is same as the "Method" described above; and

a sample obtained in comparative experiment 5: a 100% cashmere sweater sold by Uniqlo, its test method is same as the "Method" described above.

(6) Test results:

[0025]

Stable 1: data obtained by measuring the thermal insulation performances of the textiles

	gram weight (g/m^2)	thermal insulation rate (%)	clo value	explanation
Textile obtained according to the present disclsoure	150	43.7	0.46	Textile including the thermal insulation fiber
Textile obtained in comparative experiment 1	150	18.7	0.16	hygroscopic calorific underwear sold by Aeon
Textile obtained in comparative experiment 2	150	15.4	0.13	hygroscopic calorific underwear sold by Uniqlo
Textile obtained in comparative experiment 3	150	20.5	0.18	hygroscopic calorific underwear sold by Shimala
Textile obtained in comparative experiment 4	340	35.4	0.32	100%wool underwear sold by Ito Yokado
Textile obtained in comparative experiment 5	220	41.5	0.41	100% cashmere sweater sold by Uniqlo

[0026] The diagram showing the thermal insulation rate of the textile obtained in Example 1 as compared with that of the textiles obtained in comparative experiments is shown in Fig.1. When comparing the textile obtained in Example 1 and the textiles obtained in comparative experiments 1 to 3 which are of same weights, it can be seen that the textile obtained in Example 1 has the thermal insulation performance more than twice as that of other textiles. It would be appreciated that "gram weight" is a commonly-used unit for evaluating textile and silk products, referring to a weight per square meter and representing as "g/m^2". The gram weight is a vital indicator of the knitted fabric.

[0027] Further, each of the textiles obtained in comparative experiments 1 to 3 has a thermal insulation rate much higher than a vast majority of underwear sold in the market.

[0028] According to a provision of "FZ/T 73022-2004 knitted thermal underwear" in China, an outer package for thermal underwear should be labeled with indicators marking the thermal insulation rate and content, particularly, the "thermal insulation rate" is not allowed to less than 30%. In fact, for a vast majority of the so-called thermal underwear, their thermal insulation rates are improved by increasing the gram weight (i.e. increasing the thickness and the weight of underwear).

[0029] The textile made of the thermal insulation fiber according to embodiments of the present disclosure achieves an unexpected technical effect. According to embodiments of the present disclosure, the thermal underwear being of a same gram weight as compared with that of conventional underwear achieves a thermal insulation rate much higher than the conventional underwear. Referring to Table 1 and Fig.1, it can be seen from a comparison between the textile obtained in Example of the present disclosure and the textile obtained in comparative experiments 4 and 5: the textile made of the fiber according to embodiments of the present disclosure is of the thermal insulation rate even much higher than that of the woolen or cashmere product with a much lower weight gram. In other words, the underwear made of the thermal insulation textile according to the present disclosure may be used to replace the woolen or cashmere sweater.

[0030] It should be noted that, a difference between the "thermal insulation" of the present disclosure and the "heat storage and preservation" in the related art lies in that: the "heat storage and preservation" refers to a process of providing a heat energy to a heat storage product only from an external heat source (or an internal substance generating heat) and storing the heat in the heat storage product; while a working principle of the thermal insulation fiber according to the present disclosure is to reflect a heat energy generated by a human body back as much as possible by the nano unit, and maintain reflected heat energy insulated from external environment. In addition, above experiments of the present disclosure aim to the thermal insulation performance of underwear textile, and there is no energy supplement or supply from an external heat source (such as sunshine), therefore the present disclosure also provides in embodiments a use of fibers containing the nano unit in manufacturing a warm textile.

Example 2:

[0031] A difference between the present example and Example 1 lies in that: a test sample is a thermal insulation fiber, including a conventional fiber; and a nano unit, wherein based on the total weight of the convention fiber, the nano unit is of a content of 0.2wt%; the nano unit includes a microparticle having a size of 8000nm; and the microparticle includes Ti being of a content of 500 weight units, Ce being of a content of 300 weight units, K being of a content of 100

weight units, Sn being of a content of 100 weight units and S being of a content of 100 weight units. The nano unit of the present disclosure can be added into the conventional fiber by any one of existing methods for manufacturing a fiber.

[0032] The test result of the present example is: the textile containing the thermal insulation fiber of the present disclosure having a gram weight of 150 g/m^2 is of the thermal insulation ration of 43.2%. Other comparative examples are the same in Example 1, which is not described herein in details.

[0033] A diagram showing a thermal insulation rate of a textile obtained in Example 2 as compared with that of textiles obtained in comparative experiments is not shown.

Example 3:

[0034] A difference between the present example and Example 1 lies in that: a test sample is a thermal insulation fiber, including a conventional fiber; and a nano unit, wherein based on the total weight of the convention fiber, the nano unit is of a content of 1.5wt%; the nano unit includes a microparticle having a size of 4000nm; and the microparticle includes Ti being of a content of 10000 weight units, and Mg being of a content of 10 weight units. The nano unit of the present disclosure can be added into the conventional fiber by any one of existing methods for manufacturing a fiber.

[0035] The test result of the present example is: the textile containing the thermal insulation fiber of the present disclosure having a gram weight of 150 g/m^2 is of the thermal insulation ration of 43.5%. Other comparative examples are the same in Example 1, which is not described herein in details.

[0036] A diagram showing a thermal insulation rate of a textile obtained in Example 3 as compared with that of textiles obtained in comparative experiments is not shown.

Example 4:

[0037] A difference between the present example and Example 1 lies in that: a test sample is a thermal insulation fiber, including a conventional fiber; and a nano unit, wherein based on the total weight of the convention fiber, the nano unit is of a content of 1.6wt%; the nano unit includes a microparticle having a size of 5000nm; and the microparticle includes Ti being of a content of 500 weight units, Mg being of a content of 500 weight units, K being of a content of 80 weight units, Sn being of a content of 300 weight units and S being of a content of 70 weight units. The nano unit of the present disclosure can be added into the conventional fiber by any one of existing methods for manufacturing a fiber.

[0038] The test result of the present example is: the textile containing the thermal insulation fiber of the present disclosure having a gram weight of 150 g/m^2 is of the thermal insulation ration of 43.1%. Other comparative examples are the same in Example 1, which is not described herein in details.

[0039] A diagram showing a thermal insulation rate of a textile obtained in Example 4 as compared with that of textiles obtained in comparative experiments is not shown.

[0040] In addition, the present example also provides another method for manufacturing the thermal insulating fiber, including a step of manufacturing fiber masterbatch. The nano unit is added during manufacturing the fiber masterbatch, and then a fiber is obtained thereafter. Other steps involving in the method for manufacturing the fiber of the present example are same as the method for manufacturing the fiber in the related art, which is not described in details.

Example 5:

[0041] A difference between the present example and Example 1 lies in that: a test sample is a thermal insulation fiber, including a conventional fiber; and a nano unit, wherein based on the total weight of the convention fiber, the nano unit is of a content of 1.8wt%; the nano unit includes a microparticle having a size of 3000nm; and the microparticle includes Ti being of a content of 500 weight units, Mg being of a content of 500 weight units, Ce being of a content of 100 weight units, Ca being of a content of 300 weight units, Si being of a content of 1700 weight units, K being of a content of 50 weight units, Sn being of a content of 500 weight units, and S being of a content of 50 weight units. The nano unit of the present disclosure can be added into the conventional fiber by any one of existing methods for manufacturing a fiber.

[0042] The test result of the present example is: the textile containing the thermal insulation fiber of the present disclosure having a gram weight of 150 g/m^2 is of the thermal insulation ration of 43.7%. Other comparative examples are the same in Example 1, which is not described herein in details.

[0043] A diagram showing a thermal insulation rate of a textile obtained in Example 5 as compared with that of textiles obtained in comparative experiments is not shown.

[0044] In addition, another object of the present disclosure is to provide a thermal insulation textile, such as a knitted or woven product, which includes at least a part of the above fibers, or may be fully made of the thermal insulation fiber of the present disclosure.

[0045] Yet another object of the present disclosure is to provide a use of a fiber containing the nano unit in manufacturing

a warm textile. The fiber containing the nano unit is any one of the thermal insulation fibers described above. The thermal insulation fiber of the present disclosure may have other uses in other or similar fields, however, in the present disclosure, the multi-group experiments are sufficient to prove that the thermal insulation fiber of the present disclosure has a better thermal insulation performance under the same conditions (for example, the same gram weight), therefore can be effectively used in the field of warm textile manufacture.

[0046] It is obvious that one skilled in the art can use a thermal insulation fiber of the present disclosure and textile made from the fiber to constitute various types of textile fibers and textiles and the corresponding preparation methods.

Industrial Applicability

[0047] The thermal insulation fiber according to embodiments of the present disclosure has advantages of better thermal insulation, lower cost, being easy to be manufactured and industrialized as compared with the existing thermal fiber, and can be effectively used in manufacturing the thermal insulation textile.

[0048] Although explanatory embodiments have been shown and described, it would be appreciated by those skilled in the art that the above embodiments cannot be construed to limit the present disclosure, and changes, alternatives, and modifications can be made in the embodiments without departing from spirit, principles and scope of the present disclosure.

[0049] Reference throughout this specification to "an embodiment," "some embodiments," "one embodiment", "another example," "an example," "a specific example," or "some examples," means that a particular feature, structure, material, or characteristic described in connection with the embodiment or example is included in at least one embodiment or example of the present disclosure. Thus, the appearances of the phrases such as "in some embodiments," "in one embodiment", "in an embodiment", "in another example," "in an example," "in a specific example," or "in some examples," in various places throughout this specification are not necessarily referring to the same embodiment or example of the present disclosure. Furthermore, the particular features, structures, materials, or characteristics may be combined in any suitable manner in one or more embodiments or examples.

Claims

1. A thermal insulation fiber, comprising:

   a conventional fiber; and
   a nano unit,
   wherein based on a total weight of the convention fiber, the nano unit is of a content of O.lwt % to 3wt%, so as to improve an insulation rate of the thermal insulation fiber;
   the nano unit comprises a microparticle having a size of 300nm to 8000nm; and
   the microparticle comprises at least one of a mixture of titanium (Ti) and cerium (Ce), a mixture of Ti and magnesium (Mg), and a mixture of Ti, Ce, Mg, silicon (Si) and calcium (Ca).

2. The thermal insulation fiber according to claim 1, wherein the conventional fiber comprises a chemical fiber, and the chemical fiber comprises at least one of an artificial fiber and a synthetic fiber.

3. The thermal insulation fiber according to claim 2, wherein based on the total weight of the convention fiber, the nano unit is of a content of 1.5wt % to 3wt%; and the nano unit comprises the microparticle having a size of 300nm to 4000nm.

4. The thermal insulation fiber according to claim 3, wherein in the nano unit, the microparticle comprises:

   Ti being of a content of 500 weight units to 10000 weight units; and Ce being of a content of 60 weight units to 300 weight units, or
   Ti being of a content of 500 weight units to 10000 weight units; and Mg being of a content of 10 weight units to 500 weight units, or
   Ti being of a content of 500 weight units to 10000 weight units; Ce being of a content of 60 weight units to 300 weight units; Ca being of a content of 50 weight units to 500 weight units; Mg being of a content of 10 weight units to 500 weight units; and Si being of a content of 50 weight units to 3000 weight units.

5. The thermal insulation fiber according to claim 2, wherein based on the total weight of the convention fiber, the nano unit is of a content of O.lwt % to 1.5wt%; and the nano unit comprises the microparticle having a size of 4000nm to

8000nm.

6. The thermal insulation fiber according to claim 5, wherein in the nano unit, the microparticle comprises:

Ti being of a content of 500 weight units to 10000 weight units; and Ce being of a content of 60 weight units to 300 weight units, or
Ti being of a content of 500 weight units to 10000 weight units; and Mg being of a content of 10 weight units to 500 weight units, or
Ti being of a content of 500 weight units to 10000 weight units; Ce being of a content of 60 weight units to 300 weight units; Ca being of a content of 50 weight units to 500 weight units; Mg being of a content of 10 weight units to 500 weight units; and Si being of a content of 50 weight units to 3000 weight units.

7. The thermal insulation fiber according to claim 4 or 6, wherein in the nano unit, the microparticle further comprises:

K being of a content of 50 weight units to 100 weight units;
Sn being of a content of 100 weight units to 500 weight units; and
S being of a content of 50 weight units to 100 weight units.

8. A thermal insulation textile, at least comprising a part of the thermal insulation fiber according to any one of the preceding claims.

9. A use of a fiber containing a nano unit in manufacturing a thermal textile, wherein the fiber containing the nano unit is the thermal insulation fiber according to any one of the preceding claims.

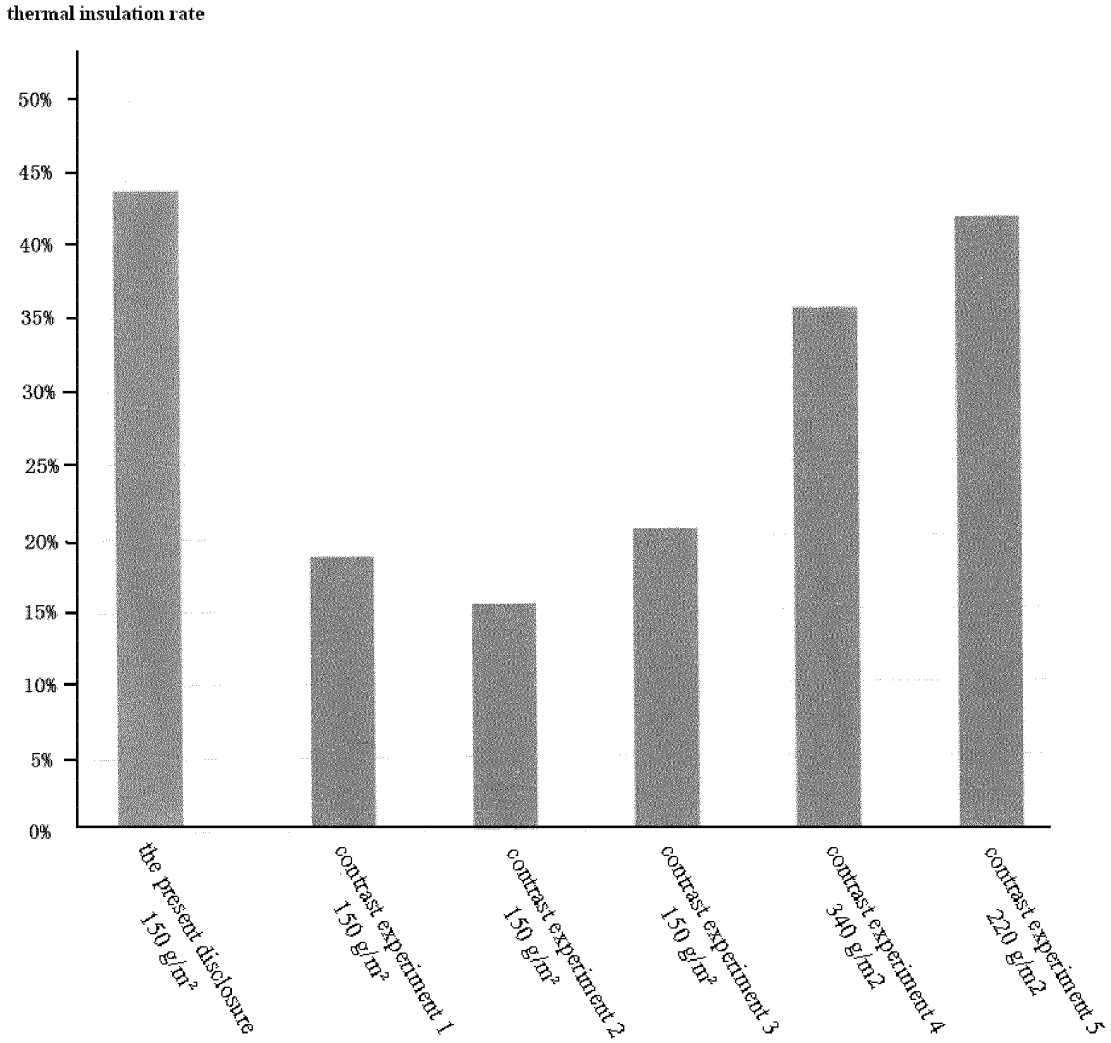
thermal insulation rate
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
the present disclosure 150 g/m²
contrast experiment 1 150 g/m²
contrast experiment 2 150 g/m²
contrast experiment 3 150 g/m²
contrast experiment 4 340 g/m2
contrast experiment 5 220 g/m2

Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/074113

A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet
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)

IPC: D01F

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)

CNABS, CNKI, VEN, EI: mao yingjun, heat insulation fiber, heat preservation, heat insulation, fiber, nanometer, nano+, ti, titanium, ce, cerium, grain, particle, nanoparticle, mg, magnesium

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 102677205 A (MAO, Yingjun) 19 September 2012 (19.09.2012) claims 1-7, description, paragraphs [0002]-[0011]	1-9
Y	CN 102677204 A (MAO, Yingjun) 19 September 2012 (19.09.2012) claims 1-7, description, paragraphs [0002]-[0011]	1-9
Y	CN 102677206 A (MAO, Yingjun) 19 September 2012 (19.09.2012) claims 1-7	1-9
Y	CN 102677203 A (MAO, Yingjun) 19 September 2012 (19.09.2012) claims 1-8	1-9
Y	CN 101709511 A (MAO, Yingjun) 19 May 2010 (19.05.2010) claims 1-3	1-9

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent 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
14 November 2013 (14.11.2013)	12 December 2013 (12.12.2013)
Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer PENG, Fei Telephone No. (86-10) 62084685

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/074113

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
claim 1 a heat insulation fiber;
claim 8 a heat insulation textile;
claim 9 the application of a fiber containing nano unit in preparation of the heat insulation textile.

The same or corresponding technical features between claim 8 or 9 and claim 1 is the heat insulation fiber as claim 1. It is found that the same or corresponding technical features mentioned above do not make contribution to prior art, therefore, any two among claims 1, 8 and 9 do not have same or corresponding special technical features, that is , any two among claims 1, 8 and 9 are not so linked as to form a single general inventive concept and do not have unity of invention as required by the Rule 13.1 PCT.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA /210 (continuation of first sheet (2)) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2013/074113

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 102677205 A	19.09.2012	None	
CN 102677204 A	19.09.2012	None	
CN 102677206 A	19.09.2012	None	
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/074113

A. CLASSIFICATION OF SUBJECT MATTER

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

D01F 1/10 (2006.01) i

D01F 1/02 (2006.01) i

D01F 2/08 (2006.01) i

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