US 20170314185A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2017/0314185 A1**

Wijesena et al. (43) **Pub. Date: Nov. 2, 2017**

(54) **NEAR INFRARED ENERGY ABSORBING TEXTILE**

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(21) Appl. No.: **15/141,292**

(22) Filed: **Apr. 28, 2016**

Publication Classification

(51) **Int. Cl.**

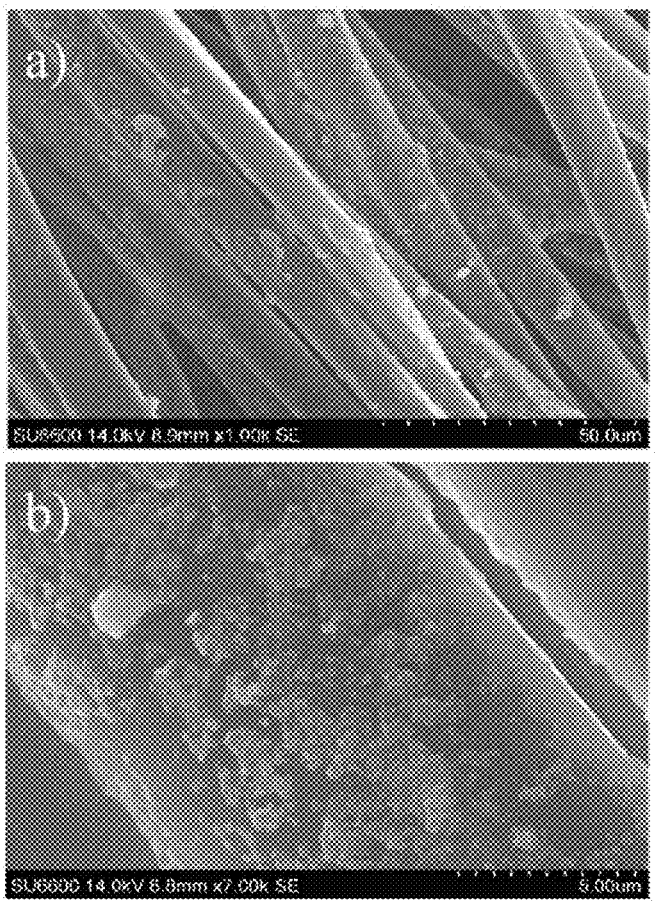
D06M 11/44	(2006.01)
D06M 11/46	(2006.01)
D06M 13/148	(2006.01)
D06M 11/76	(2006.01)
D06M 15/61	(2006.01)
D06M 11/45	(2006.01)
D06M 13/352	(2006.01)
D06M 11/74	(2006.01)

(52) **U.S. Cl.**

CPC ***D06M 11/44*** (2013.01); ***D06M 13/352*** (2013.01); ***D06M 11/46*** (2013.01); ***D06M 11/74*** (2013.01); ***D06M 11/76*** (2013.01); ***D06M 15/61*** (2013.01); ***D06M 11/45*** (2013.01); ***D06M 13/148*** (2013.01); *D10B 2201/02* (2013.01); *D10B 2331/04* (2013.01); *D10B 2401/02* (2013.01); *D10B 2501/00* (2013.01)

(57) **ABSTRACT**

The present invention relates to production of textile with high rate of evaporation of moisture content. In this invention, a textile substrate is coated with Near Infrared (NIR) energy absorbing agent to increase the surface temperature of substrate and enhance the evaporation of moisture from the textile substrate.



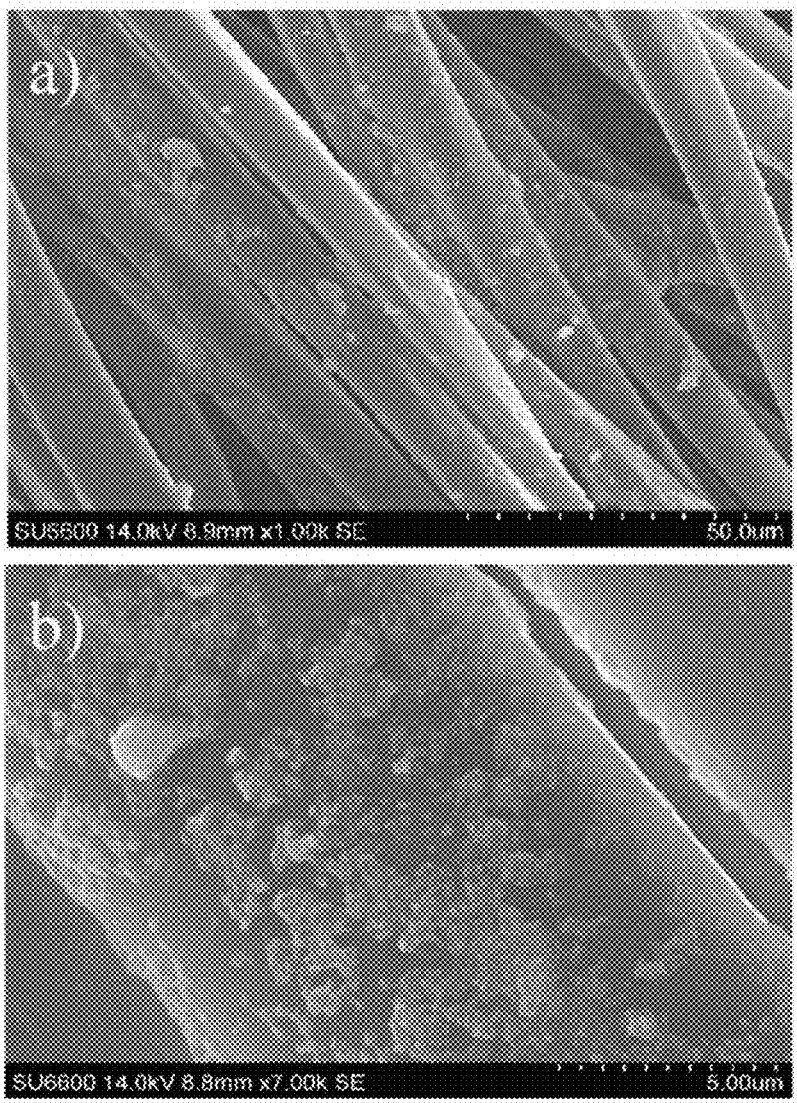

a)
SU5600 14.0kV 8.9mm x1.00k SE
50.0um
b)
SU6600 14.0kV 8.8mm x7.00k SE
5.00um

FIGURE 1

NEAR INFRARED ENERGY ABSORBING TEXTILE

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to the field of textile industry in general, specifically to textile finishes and moisture management. In the present invention, the textile substrate is treated with a composition comprising near infrared energy absorbing agent that provides faster drying of moisture content from the treated textile, leading to quick drying textile material. The present invention relates to the quick drying textile material, a method to obtain the textile material and use of a composition comprising near infrared energy absorbing agent to obtain the textile material.

BACKGROUND

[0002] Moisture management generally refers to the ability of the textile material to absorb gaseous or liquid moisture from body, to transport it to the outer surface and to evaporate the moisture content. This property is a complex combination of a number of different human, material and environmental aspects. Given the same conditions, rate and intensity of the perspiration differs from person to person. The intensity of the perspiration is also different in different areas of the body. The fabric structure, surface chemistry of the fibers, fiber cross section, fiber morphology and surface area of the fibers are known factors that affect moisture management properties.

[0003] A number of attempts have been made to enhance the moisture management property of textiles, by changing the above mentioned parameters. Almost all of these strategies are focused on enhancing the moisture transfer property of the fabric. The commonly used techniques to enhance the moisture transfer property include, the use of micro fibres in packed geometries, engineering the cross section of the fibres to increase the capillaries, use of material blends comprising non-absorbent and absorbent fibres in bi-component knits, multi-layered fabric structures including laminates and various absorbent polymeric structures and use of textile finishing agents to improve moisture management properties such as wicking, etc. However, all these techniques are limited to the transfer of moisture from skin touching fabric surface to outer fabric surface.

[0004] There has not been any research work or a product that has enhanced moisture management property by improving the rate of evaporation of moisture from fabric through increasing the surface temperature of the outer fabric surface to enhance the rate of moisture evaporation

[0005] Accordingly, there is a need to develop textiles with improved moisture management properties and the present invention overcomes the drawbacks of the methods of the prior art by providing textiles that depict enhanced moisture management property by improving the rate of evaporation of moisture, through increasing the surface temperature of the outer fabric surface.

BRIEF SUMMARY OF THE INVENTION

[0006] Accordingly, the present invention relates to a quick dry textile material comprising—a) textile substrate, and b) composition comprising near infrared (NIR) energy absorbing agent; a method for obtaining quick dry textile material comprising textile substrate and composition comprising near infrared (NIR) energy absorbing agent, said method comprising acts of—a) treating the textile substrate with the composition, and b) processing the treated textile substrate to obtain the quick dry textile material; and use of a composition comprising near infrared absorbing agent for obtaining a quick dry textile material.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The present invention may be considered to consist in the foregoing and examples of which have been described with reference to the accompanying drawings in which:

[0008] FIG. **1** depicts Scanning Electron Microscope image of fibers in the treated fabric of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0009] The present invention relates to a quick dry textile material comprising:

[0010] a) textile substrate; and

[0011] b) composition comprising near infrared (NIR) energy absorbing agent.

[0012] In an embodiment of the present invention, the composition is present on at least one surface of the textile material.

[0013] In another embodiment of the present invention, the composition further comprises component selected from the group comprising binder, pigment and finishing agent or any combinations thereof.

[0014] In yet another embodiment of the present invention, the binder is selected from the group comprising acrylic binder, polyurethane binder, vinyl polymer binder, vinyl copolymer binder, natural rubber binder, neoprene rubber binder, epoxy binder, amino resin binder, silicone binder and biopolymer binder, or any combinations thereof.

[0015] In still another embodiment of the present invention, the near infrared (NIR) energy absorbing agent is selected from the group comprising metal, oxide, doped oxide, carbon compound, organic compound and polymer or any combinations thereof.

[0016] In still another embodiment of the present invention, the NIR energy absorbing agent is present in amount ranging from about 0.1% to 10.0% by weight of the textile substrate; and wherein the NIR energy absorbing agent absorbs electromagnetic radiation ranging from about 700 nm to 1500 nm.

[0017] In still another embodiment of the present invention, particle size of the NIR energy absorbing agent ranges from about 1 μm to 500 nm in diameter, preferably from about 10 nm to 100 nm in diameter, and more preferably from about 20 nm to 70 nm in diameter.

[0018] In still another embodiment of the present invention, the textile substrate is selected from the group comprising Cotton, Polyester, Nylon, Polyester-elastomer blend, Nylon elastomer blend, Polyester cotton blend, Aramid Linen, Polyethylene, Polypropylene, Jute, Hemp, Wool, Rayon, Lyocell and Acetate fiber textile, or any combinations thereof.

[0019] In still another embodiment of the present invention, weight of the textile material ranges from about 100 to 250 gram per square meter, preferably about 130 gram per square meter.

[0020] In still another embodiment of the present invention, the textile substrate is pre-treated by process selected from the group comprising scouring treatment, bleaching

treatment, enzymatic treatment, softening treatment, treatment for improved wicking, anti-pilling treatment, anti-static treatment, anti-curling treatment, anti-bacterial treatment, treatment for improvement of wash fastness, treatment for improved draping, raising, burning, quenching, curing, heat setting, polishing, embossing, pressing and creasing or any combinations thereof.

[0021] The present invention also relates to a method for obtaining quick dry textile material comprising textile substrate and composition comprising near infrared (NIR) energy absorbing agent, said method comprising acts of:

[0022] a) treating the textile substrate with the composition; and

[0023] b) processing the treated textile substrate to obtain the quick dry textile material.

[0024] In an embodiment of the present invention, the treating of the textile substrate is by process selected from the group comprising coating, finishing, depositing, spraying, foam application, dyeing, wet padding, screen printing, screen transfer, sublimation, film transfer, roll transfer, electrodeposition, wet exhaustion, chemical vapor deposition and physical vapor deposition, or any combinations thereof.

[0025] In another embodiment of the present invention, the processing comprises act selected from the group comprising heating, washing and drying or any combinations thereof.

[0026] In yet another embodiment of the present invention, the near infrared (NIR) absorbing agent is selected from the group comprising metal, oxide, doped oxide, carbon compound, organic compound and polymer or any combinations thereof.

[0027] In still another embodiment of the present invention, the NIR energy absorbing agent is present in an amount of about 0.1% to 10.0% by weight of the textile substrate; wherein the NIR energy absorbing agent absorbs electromagnetic radiation ranging from about 700 nm to 1500 nm; and wherein particle size of the NIR energy absorbing agent ranges from about 1 μm to 500 nm in diameter.

[0028] In still another embodiment of the present invention, the textile substrate is selected from the group comprising Cotton, Polyester, Nylon, Polyester-elastomer blend, Nylon elastomer blend, Polyester cotton blend, Aramid Linen, Polyethylene, Polypropylene, Jute, Hemp, Wool, Rayon, Lyocell and Acetate fiber textile, or any combinations thereof.

[0029] In still another embodiment of the present invention, the composition further comprises component selected from the group comprising binder, pigment and finishing agent or any combinations thereof.

[0030] In still another embodiment of the present invention, weight of the textile material ranges from about 100 to 250 gram per square meter.

[0031] The present invention also relates to use of a composition comprising near infrared absorbing agent for obtaining a quick dry textile material.

[0032] To overcome the non-limiting drawbacks as stated in the background, the present invention relates to treating of a textile material to enhance moisture management in a textile.

[0033] The present invention also relates to the treated textile material or a garment made of the treated textile material. The treated textile/fabric and the finished garment exhibit quick drying of moisture.

[0034] In an embodiment, treating of the textile material enhances moisture removal from its outer surface.

[0035] In non-limiting embodiments of the present invention, the outer surface of the textile is defined as the surface of the textile facing away from the body of the wearer when the textile is fabricated into a garment.

[0036] In the present invention, a textile material is treated with a near infrared (NIR) energy absorbing agent to enhance moisture removal from the textile. The agent is hereinafter referred to as "NIR energy absorbing agent" or "NIR absorbing agent" or "NIR agent".

[0037] In embodiments of the present invention, the treating of the textile results in the distribution of NIR absorbing agent on the outer surface of the textile.

[0038] In exemplary embodiments of the present invention, the near infrared (NIR) energy absorbing agent is a metal.

[0039] In embodiments of the present invention, the metal is selected from the group comprising silver, gold, platinum, palladium and nickel or any combinations thereof.

[0040] In exemplary embodiments of the present invention, the near infrared (NIR) energy absorbing agent is an oxide.

[0041] In embodiments of the present invention, the oxide is selected from the group comprising tungsten oxide, aluminium oxide, zinc oxide, tin oxide, antimony oxide, bismuth oxide, cerium oxide and cobalt oxide or any combinations thereof.

[0042] In exemplary embodiments of the present invention, the near infrared (NIR) energy absorbing agent is a doped oxide.

[0043] In embodiments of the present invention, the doped oxide is selected from the group comprising indium tin oxide, aluminium doped tin oxide and antimony doped tin oxide or any combinations thereof.

[0044] In exemplary embodiments of the present invention, the near infrared (NIR) energy absorbing agent is a polymer.

[0045] In exemplary embodiments of the present invention, the near infrared (NIR) energy absorbing agent is a carbon compound.

[0046] In embodiments of the present invention, the carbon compound is selected from the group comprising carbon black, graphite, graphene, graphene oxide, reduced graphene oxide, carbon nanotube and fullerene or any combinations thereof

[0047] In exemplary embodiments of the present invention, the near infrared (NIR) energy absorbing agent is an organic compound.

[0048] In embodiments of the present invention, the organic compound is selected from the group comprising cyanine derivative, squaraine derivative, phthalocyanine derivative, porphyrin derivative, and boron dipyrromethane derivative. Here, the organic compound acts as a dye or pigment, thus performing the function of imparting colour to the textile, as well as absorbing near infrared energy.

[0049] In exemplary embodiments of the present invention, the near infrared (NIR) energy absorbing agent is a polymer.

[0050] In embodiments of the present invention, the polymer is a film selected from the group comprising Poly(3,4-ethylenedioxythiophene)-poly(4-styrenesulfonate), polyaniline, polypyrrole, polythiophene, Poly(3,4-

ethylenedioxythiophene)-tetramethacrylate and poly (diiododiacetylene) or any combinations thereof

[0051] In an embodiment of the present invention, the polymer is a nanoparticle.

[0052] In an embodiment of the present invention, the polymer is a film.

[0053] In embodiments of the present invention, the near infrared (NIR) energy absorbing agent is a combination of one or more of metal, oxide, doped oxide, carbon compound, organic compound and polymer.

[0054] In embodiments, the textile is used to prepare a garment by conventionally known industrial methods and the garment exhibits enhanced moisture absorption and removal property.

[0055] In embodiments of the present invention, a composition comprising near infrared (NIR) energy absorbing agent is used to treat the textile substrate.

[0056] In embodiments of the present invention, the composition consists of near infrared (NIR) energy absorbing agent.

[0057] In embodiments, the composition further comprises a binder.

[0058] In embodiments, the composition further comprises a dye or pigment for the purpose of imparting a desired colour. The dye or pigment includes any compound known in the art to perform the function of a dye or a pigment. This dye or pigment does not absorb near infrared energy and only provides colour to the textile.

[0059] In embodiments, the composition further comprises a finishing agent. The finishing agent includes, but is not limited to wetting agent, fabric wicking enhancer, chemical fixer, hydrophilicity modifier and fabric softener. The role of each finishing agent is known in the art.

[0060] In an embodiment of the present invention, the finishing agent is selected from the group comprising Polydimethylsiloxane, organic fatty acid, fatty acid ester, fatty acid wax, Paraffin, polyethelyne compound, fatty acid functionalized organic polymer, Amphoteric fatty acid compound, Amido, Amino Functional Silicone, Amido, Amino functionalized organic polymer, Methyl Hydrogen Silicone, Epoxy Functional Silicone, epoxy functionalized organic polymer, Hydroxy functional Silicone, hydroxy functionalized organic polymer, esterquat, Silicone Polyether, Organic polyether, Epoxy Polyether Silicone, organic epoxy polyether, sulfonated organic polymer, sol gel compound comprising metal and metal alkoxide or any combinations thereof.

[0061] In an embodiment, the composition further comprises water.

[0062] In an embodiment, the composition is also referred to as liquor and comprises NIR energy absorbing agent, and optionally component selected from the group comprising water, binder, finishing agent and pigment or any combinations thereof.

[0063] In an embodiment, liquor ratio defines the ratio between fabric and liquor in a dye bath.

[0064] In an embodiment of the present invention, the composition of the present invention comprises NIR energy absorbing agent and finishing agent.

[0065] In an embodiment of the present invention, the composition of the present invention consists of NIR energy absorbing agent and finishing agent.

[0066] In an embodiment of the present invention, the composition of the present invention comprises NIR energy absorbing agent and binder.

[0067] In an embodiment of the present invention, the composition of the present invention consists of NIR energy absorbing agent and binder.

[0068] In an embodiment of the present invention, the composition of the present invention comprises NIR energy absorbing agent and pigment.

[0069] In an embodiment of the present invention, the composition of the present invention consists of NIR energy absorbing agent and pigment.

[0070] In an embodiment of the present invention, the composition of the present invention comprises NIR energy absorbing agent and water.

[0071] In an embodiment of the present invention, the composition of the present invention consists of NIR energy absorbing agent and water.

[0072] In an embodiment of the present invention, the composition of the present invention comprises NIR energy absorbing agent, water, binder, finishing agent and pigment.

[0073] In an embodiment of the present invention, the composition of the present invention consists of NIR energy absorbing agent, water, binder, finishing agent and pigment.

[0074] The terms "textile" and "fabric" have the same meaning and are used interchangeably throughout the present specification.

[0075] In embodiments of the present invention, the textile before treating with the NIR energy absorbing agent is referred to as "textile substrate".

[0076] In embodiments of the present invention, the textile after treating with the NIR energy absorbing agent is referred to as "textile material" or "quick dry textile material".

[0077] In an embodiment of the present invention, the textile material is prepared as a garment.

[0078] In non-limiting embodiments of the present invention, the textile substrate may already be in the form of a garment before being treated with the composition comprising NIR energy absorbing agent. The garment, treated with NIR absorbing agent, exhibits enhanced moisture management properties.

[0079] In embodiments of the present invention, the textile material, which has already been treated with the composition comprising NIR energy absorbing agent, is fabricated into a garment. The textile material and thus the garment made of the material exhibits enhanced moisture management properties.

[0080] In an embodiment of the present invention, the textile substrate, after being treated with the NIR energy absorbing agent, is processed.

[0081] In an embodiment, the processing comprises act selected from the group comprising heating, washing and drying or any combinations thereof.

[0082] In an exemplary embodiment, the processing comprises acts of:

[0083] a) heating the treated textile substrate;

[0084] b) washing the heated textile substrate with water; and

[0085] c) drying the washed textile substrate.

[0086] In embodiments of the present invention, a quick dry textile material is defined as a textile material that exhibits an improvement of 20% to 120% in drying rate as compared to the drying rate of commercially available

textile material or as compared to a textile material which is not treated with NIR energy absorbing agent (control).

[0087] Evaporation of water from outer fabric surface to the environment is as important as the moisture transfer through the fabric from skin touching fabric surface to outer fabric surface. This is because if the rate of water evaporation from outer fabric surface to environment is less than that of the rate of moisture generated by the body, the fabric will ultimately saturate, losing its ability to manage moisture effectively. This is particularly prominent in high humid, low temperature environments where the water evaporation is lowest.

[0088] Since the evaporation of water from a surface is mainly dependent on environmental conditions such as temperature, humidity and air flow and on surface conditions such as surface temperature and surface texture, most of the prior art techniques are fundamentally limited to transfer of moisture across the textile substrate. The textile material and method of the present invention provide surprising advantages and better results over the prior art.

[0089] The present invention is targeted at increasing the drying rate of the textile material when the material is exposed to near infrared light emitting light source, as the textile material is treated with near infrared energy absorbing agent. The present invention achieves this improved drying rate by generating an additional heat, by converting the near infrared light energy in to heat energy which drives the evaporation.

[0090] In embodiments of the present invention, the near infrared light emitting source is the sun.

[0091] In embodiments of the present invention, the moisture content of a textile or garment is in the form of sweat or perspiration.

[0092] One of the objectives of the method of the present invention is to impart heat on the surface of the textile/fabric, which is absorbed by the moisture on the surface of the textile/fabric through evaporation.

[0093] In embodiments of the present invention, the net result of moisture removal through enhanced evaporation (the function of the NIR absorption) imparts a cooling effect to the wearer.

[0094] In another embodiment, nanoparticles composed of various materials such as metals (Ag, Au, Pt, Cu, etc.) and semiconductors (Indium doped tin oxide, Aluminum doped zinc oxide, Tungsten oxides, etc.) efficiently absorb photon energy when exposed to light. This is due to oscillation of electrons (carriers in the nanoparticles) which convert the absorbed energy by the light source into heat. The heat diffuses away from the nanoparticle and increases the temperature in the surrounding medium. Heating efficiency of these nanomaterials is particularly high when the plasmonic absorption occurs around near infrared (NIR) region (780-2500 nm).

[0095] Certain organic molecules and particles also show strong optical absorption in Infrared frequency range. Absorption occuring at NIR region is particularly important for the present invention as the radiation absorbed in this region is mostly converted to heat. The NIR absorption is generated from fundamental bond vibrations by two distinct processes; overtones and combinations. Overtones are harmonics of the fundamental vibrations that occur in the NIR region. Combinations are more complex and occur due to sharing of NIR energy between two or more fundamental vibrations.

[0096] The NIR energy absorbing agent in the present invention refers to a material that can absorb the electromagnetic radiation in near-infrared wavelength including 700 nm to 2200 nm, more preferably 700 nm to 1500 nm.

[0097] The NIR energy absorbing material however, can absorb energy in the other regions of the electromagnetic radiation like visible and ultraviolet. Nonetheless, to provide sufficient heating effect to the textile/fabric to increase the rate of evaporation of moisture, the energy absorption agent must show adequate absorption at the NIR region of the electromagnetic radiation. This distinguishes the agent disclosed in the present invention from the other energy absorbing materials used to treat textile materials. In particular, dyes are pigments employed in finishing textile materials to impart a desirable color to the material, which acts by absorbing electromagnetic radiation in the visible region of the spectrum. These dyes and pigments show no or very less absorption of NIR, rendering them ineffective in the application disclosed herein.

[0098] Thus, in order to sufficiently absorb NIR radiation/energy and heat up the textile/fabric to induce evaporation of moisture, without significantly deteriorating the properties of the textile material, the energy absorbing agent used in the present invention preferably exhibits absorption characteristics as described below. The energy absorbing material has strong energy absorption characteristics in NIR region, more preferably in the range of 1000 nm. The energy absorbance material may exhibit some energy absorption at 400 to 700 nm, but absorption intensity in the range of 1000 nm region should be higher than that of the absorption intensity at the 400 to 700 nm range.

[0099] In exemplary embodiments, the NIR energy absorbing material or agent is selected from, but is not in anyways limited to, Iridium Tin Oxide, Aluminum doped Tin Oxide, Antimony doped Tin Oxide, Tungsten oxide, Carbon black, Cyanine dye (CAS#:134127-48-3), Reduced graphene Oxide and Carbon nanotube.

[0100] However, the present invention also envisages the use of a compound that is not known or established to be an NIR energy absorbing agent at this stage, but may be recognized at a later stage to be an NIR energy absorbing agent.

[0101] Preferably, the particle size of the NIR energy absorbing agent used in the present invention is within the range of 1 μm to 500 nm in diameter, more preferably the particle size of NIR energy absorbing agent is within the range of 10 nm to 100 nm in diameter, most preferably the particle size of NIR energy absorbing agent is within the range of 20 nm to 70 nm in diameter.

[0102] In an embodiment of the present invention, the NIR energy absorbing agent used is more efficient in NIR energy absorption when the agent is present in the nano dimension. However, an agent with bigger particle size also performs as NIR absorbing agent, absorbs light and generates heat to drive the same process.

[0103] In an embodiment of the present invention, when the NIR agent is present as a nanoparticle, the moisture wicking, hand-feel and printability of the treated textile material is improved.

[0104] As noted above, the NIR energy absorption agent may have slight absorption at visible and ultraviolet range along with significant absorption at the NIR range. Due to the presence of slight visible absorption, the textile substrate treated with the agent of the present invention may appear

slightly out of colour and tone compared to the textile substrate that was not treated. In more preferred embodiment, this slight colour difference is remediated by adding one or more textile dye or a pigment to the composition of the present invention. Therefore, in a more preferred embodiment of the present invention, the treating composition comprises of NIR energy absorbing agent, a binder and one or more colour absorbing pigment. The type and role of the colour absorbing pigment is known to a person skilled in the art.

[0105] In embodiments of the present invention, the NIR energy absorbing agent employed should preferably not absorb, or only very weakly absorb, in the visible region so that there is none or very minimal impact on the color appearance of the fabric or finished garment.

[0106] In embodiments of the present invention, if there is light scattering or residual absorption or both with the NIR energy absorbing agent of the present invention, then the agent is combined with coloring agent/pigment to restore the original color palette of the textile/fabric/garment.

[0107] In the present invention, the methods, preparation and use disclosed employ, unless otherwise indicated, conventional techniques known in the field of textiles, finishes, moisture management, energy, nanotechnology and related fields. These techniques, their principles, and requirements are explained in the literature and known to a person skilled in the art.

[0108] "Drying rate" is one of the parameters used to measure the drying performance of a textile or fabric and is determined in accordance with the AATCC Test Method 201-2013, Drying Rate of Fabrics: Heated Plate Method. Horizontal air flow over the surface of a fabric while on a heated plate set is used to determine the drying rate of a fabric. The test method is modified to include a light source which is calibrated to have a light intensity of 1000 W/m2 measured at the surface of the hot plate. The test method determines the drying rate of the fabric, exposed to a prescribed volume of water while in contact with a heated plate set at 37° C., simulating the skin surface temperature at which the human body starts to perspire. The test method is applicable for a variety of fiber types including knits, wovens and non-wovens.

[0109] Drying rate is the volume (ml) divided by the time taken for the complete evaporation of the specified volume of water according to the AATCC Test Method 201-2013, Drying Rate of Fabrics: Heated Plate Method. Drying rate is depicted in mL/hr.

[0110] The drying rate improvement is the percentage improvement of the drying rate compared to the untreated fabric. It is expressed in terms of %.

[0111] In embodiments of the present invention, the textile material treated with NIR energy absorbing material exhibits an improvement in drying rate ranging from about 20% to 120% when compared to an untreated textile material.

[0112] The test method determines the drying rate of the fabrics under simulated light conditions. The textile material of the present invention exhibits a drying rate improvement of 20% or more as compared to the untreated (control) fabric. More preferably, the textile material of the invention exhibits a drying rate improvement of 50% or more.

[0113] Wet pickup is the increase in weight of the fabric due to absorption of wet chemical in the treated fabric just after a chemical application process (such as printing) typically given as a percentage of initial weight of the fabric.

[0114] The textile material used in the present invention generally comprises a textile substrate made of yarns. The yarn may be formed from a plurality of fibers that may form solely from a single material (e.g. polyester, nylon) or may comprise a blend of material (e.g. polyester elastomer blend, nylon elastomer blend, polyester cotton blend). The textile or fabric can also be formed by different types of yarns with single type of fiber (e.g., polyester fiber and elastomer yarn).

[0115] In an embodiment, the preferred fabric type is polyester and polyester elastomer blend. More preferably, the textile substrate is formed from a single type of yarn.

[0116] In a particularly preferred embodiment, the textile substrate comprises about 30% or more, about 35% or more, about 40% or more, about 45% or more, about 50% or more, about 55% or more, about 70% or more, about 75% or more, about 80% or more, about 85% or more, about 90% or more, or about 95% or more by weight of the polyester fiber based on the total weight of the textile substrate. The polyester fiber present in such an embodiment may be of a blend of two or more different types of polyester fibers (e.g. crimped polyester, cationically dyeable polyester)

[0117] The textile substrate can be of any desired construction irrespective of the specific arrangement of yarns in the material. Preferably, the fabric is a knitted fabric constructed by interlocking of the loops of yarns. More preferably, the construction of the material is selected from the group comprising 1×1 interlock, 1×1 rib, and single jersey. The construction of the material described in the present invention is known to a person skilled in the art.

[0118] The preferred weight of the material is 100 to 250 gram per square meter. More preferably, the weight of the material is 130 gram per square meter. While not wishing to be bound to any particular theory, it appears that low thickness of the fabric contributes in part to faster drying of the fabric.

[0119] In a preferred embodiment, the fabric is provided in a knitted pattern having a 1×1 interlock pattern having 130 gram per square weight.

[0120] The yarns in the textile substrate comprise fibers with both natural and man-made origin. For example, the yarns comprise natural fibers such as Cotton, Linen, Jute, Hemp or Wool. The yarns may also comprise man-made fibers such as Polyester, Nylon, Rayon, Lyocell and Acetate. The fibers in the textile substrate may also comprise of special fiber types and finishes described in, for example, U.S. Patent No. 20060148349 A1 (Naor, Barak & Mois, 2006), European Patent No. EP 1831452 A1 (Naor, Barak & Mois, 2007), European Patent No. 1024879 B1 (Bause, Dondero, Jones, Rohrbach, Unger & Xue, 2003) or fabric constructors described in U.S. Pat. No. 5,315,717 A (Moretz & Brier, 1994) and U.S. Pat. No. 7,361,803 B2 (Miskie, 2008).

[0121] The textile material may also be dyed with a desired dye and treated with an appropriate finishing agent to impart a functional or aesthetic property.

[0122] In embodiments of the present invention, dyeing or finishing of the textile material can be done after the textile material has been treated with NIR energy absorbing agent.

[0123] In a preferred embodiment of the present invention, dyeing or finishing of the textile material is done before the textile material has been treated with NIR energy absorbing agent.

[0124] The treatment with finishing agent includes, but is not limited to, chemical treatments such as scouring, bleach-

ing, enzymatic treatment, softening treatment, treatment for improved wicking, anti-pilling treatment, anti-static treatment, anti-curling treatment, anti-bacterial treatment, treatment for improvement of wash fastness, treatment to improve draping and physical treatments such as raising, burning, quenching, curing, heat setting, polishing, embossing, pressing and creasing. Such chemical and physical treatments may be carried out using the methods and techniques known to those who skilled in the art.

[0125] In embodiments of the present invention, the treatment with the finishing agent is optional.

[0126] The textile substrate disclosed in the present invention may have a suitable weight per unit area. As indicated above, the composition is applied to the textile substrate using different techniques and may cause change of the weight of the final fabric. However, the finish is applied on to the substrate in relatively small quantities and therefore, the weight of the treated fabric with the items disclosed in the present invention and the weight of the untreated fabric will be practically the same.

[0127] For example, the weight of the suitable textile substrate is discussed below. But it should be understood that the below can also be used to specify the textile substrate that has been treated with the methods disclosed in this invention. Also, the specified values are not in any way to limit the applicability of the present invention to unspecified weights. The textile substrate preferably has a weight of about 500 g/m2 or less, more preferably 400 g/m2 or less, more preferably 300 g/m2 or less, more preferably 200 g/m2 or less, more preferably 160 g/m2 or less.

[0128] As indicated above, the material disclosed in the present invention comprises a composition applied to at least one side of the textile substrate. The composition includes an NIR energy absorbing agent. In more preferred embodiment, the composition comprises a binder with the NIR energy absorbing agent. The binder present in the composition makes the NIR energy absorbing agent strongly adhere to the textile substrate. The binder present in the composition may also increase the durability of the composition towards laundering. The binder can be any of the binders typically used in the treatment of textile materials.

[0129] Suitable binders include, but are not limited to, acrylic binder, polyurethane binder, vinyl polymer binder, vinyl copolymer binder, natural rubber binder, neoprene rubber binder, epoxy binder, amino resin binder, silicone binder, biopolymer binder and combinations thereof. The type and amount of binder employed is within the knowledge of a person skilled in the art.

[0130] The NIR energy absorbing agent is applied to the textile substrate to have any suitable amount for the desired water evaporation properties. In order to have practically visible heating to be observed, the NIR energy absorbing agent is incorporated into the textile substrate to have a percentage add on of 0.1% by weight of the textile substrate. More preferably, the NIR energy absorption agent is present in the textile substrate in a percentage of 0.2% or more. Also, to avoid the NIR energy absorbing agent from affecting the physical and aesthetic properties of the textile substrate, the NIR absorbing agent is present at about 10% or less, preferably at about 5% or less, more preferably about 4% or less, more preferably about 3% or less, more preferably about 2% or less, and most preferably about 1% or less by the weight of the textile substrate used for the treatment.

[0131] The proposed solution of the present invention is applied to the textile substrate by any suitable process. The application method is, and not in anyways limited to coating, finishing, deposition, spraying, foam application, dyeing, wet padding, screen printing, screen transfer, sublimation, film transfer, roll transfer, electrodeposition, wet exhaustion, chemical vapor deposition, physical vapor deposition and other suitable methods known to the art.

[0132] Where it is relevant, the NIR energy absorbing agent is applied to a textile material, with a finishing agent. The concentration of NIR energy absorbing agent in the finishing agent is adjusted to obtain the required level of NIR energy absorbing agent in the textile material of the present invention.

[0133] The textile substrate of the disclosed invention may be used to impart improved water evaporation. The water is typically in the form of sweat generated when the wearer engages in some form of physical activity. For an example, the textile substrate of the present invention is used to fabricate the whole garment or specific local components of the garment to exhibit different degrees of water evaporation ability. The textile material is used to produce garment selected from the group comprising, but not limited to T-shirt, Shirt, Pant, Coat and Hood.

[0134] Additional embodiments and features of the present invention will be apparent to one of ordinary skill in the art based upon the description provided herein. The embodiments herein provide various features and advantageous details thereof in the description. Descriptions of well-known/conventional methods and techniques are omitted so as to not unnecessarily obscure the embodiments herein. Further, the invention herein provides for examples illustrating the above described embodiments, and in order to illustrate the embodiments of the present invention, certain aspects have been employed. The examples used herein for such illustration are intended merely to facilitate an understanding of ways in which the embodiments herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the following examples should not be construed as limiting the scope of the embodiments herein.

EXAMPLES

Example 1

[0135] Scoured and bleached cotton fabric samples having 5 g of weight are used in the dyeing process. The fabric GSM (grams per square metre) is 170 grams per square meter and the structure is single jersey. The fabric samples are charged in to a sample dyeing container with 3000 ml of water having 1:15 material to liquor ratio (200 g of fabric) and Indium tin oxide nanoparticles having diameter in the range of 10-40 nm having a weight of 5% on weight of the fabric is also added to the solution. The dyeing capsule temperature is increased gradually up to 80° C. with a rate of 2° C./minute. The temperature is maintained at 80° C. for 45 minutes and upon completion, slowly cooled down to the room temperature (25° C.). The fabric sample is taken out of the container, washed with water and dried (under 105° C. for 10 min). The AATCC Test Method 201-2013, Drying Rate of Fabrics: Heated Plate Method is used to analyze the drying rate performance. Untreated fabric shows an average drying rate of 1.62 ml/h. Average drying rate of the treated

fabric is 2.70 ml/h. The treated fabric sample thus shows a drying rate improvement of 67±8% compared to the untreated fabric.

Example 2

[0136] The same procedure as given in Example 1 is repeated with a change in textile substrate. The textile substrate or fabric used in example 2 is 1×1 rib fabric of cotton having a weight of 162 gram per square meter. The treatment of the fabric is similar to Example 1. The treated fabric is analyzed for the drying rate performance by AATCC Test Method 201-2013, Drying Rate of Fabrics: Heated Plate Method. Untreated fabric shows an average drying rate of 0.99 ml/h. Average drying rate of the treated fabric is 1.57 ml/h. The treated fabric sample thus shows a drying rate improvement of 58±4% compared to the untreated fabric.

Example 3

[0137] The same procedure as given in Example 2 is repeated with a change in NIR energy absorbing agent. In this example, a weight of 5.0% on weight of the fabric, of 70:30 mixture of Aluminum doped zinc oxide and Indium tin oxide is used. The treatment of the fabric is similar to Example 1. The treated fabric is analyzed for the drying rate performance by AATCC Test Method 201-2013, Drying Rate of Fabrics: Heated Plate Method. Untreated fabric shows an average drying rate of 1.62 ml/h. Average drying rate of the treated fabric is 2.36 ml/h. The treated fabric sample thus shows a drying rate improvement of 46±8% compared to the untreated fabric.

Example 4

[0138] The same procedure as given in Example 3 is repeated with a change in NIR energy absorbing agent. In this example, a weight of 5.0% on weight of the fabric of aluminum doped zinc oxide is used. The treatment of the fabric is similar to Example 1. The treated fabric is analyzed for the drying rate performance by AATCC Test Method 201-2013, Drying Rate of Fabrics: Heated Plate Method. Untreated fabric shows an average drying rate of 1.62 ml/h. Average drying rate of the treated fabric is 2.15 ml/h. The treated fabric sample thus shows a drying rate improvement of 33±6% compared to the untreated fabric.

Example 5

[0139] The same procedure as given in Example 4 is repeated, with replacing aluminum doped zinc oxide. Instead, a weight of 2.0% on weight of the fabric of Polyaniline nanoparticles having an average diameter of 20-50 nm is used to treat the fabric. The treatment of the fabric is similar to Example 1. The treated fabric is analyzed for the drying rate performance by AATCC Test Method 201-2013, Drying Rate of Fabrics: Heated Plate Method. Untreated fabric shows an average drying rate of 1.62 ml/h. Average drying rate of the treated fabric is 2.16 ml/h. The treated fabric sample thus shows a drying rate improvement of 34±5% compared to the untreated fabric.

Example 6

[0140] The same procedure as given in Example 5 is repeated with replacing Polyaniline. Instead, 4.0% on weight of the fabric of cyanine dye (CAS#:134127-48-3) is used to treat the fabric. The treatment of the fabric is similar to Example 1. The treated fabric is analyzed for the drying rate performance by AATCC Test Method 201-2013, Drying Rate of Fabrics: Heated Plate Method. Untreated fabric shows an average drying rate of 1.62 ml/h. Average drying rate of the treated fabric is 2.09 ml/h. The treated fabric sample thus shows a drying rate improvement of 29±7% compared to the untreated fabric.

Example 7

[0141] The same procedure as given in Example 6 is repeated with replacing Polyaniline. Instead, 5.0% of carbon black (based on initial weight of fabric) is used to treat the fabric. The treatment of the fabric is similar to Example 1. The treated fabric is analyzed for the drying rate performance by AATCC Test Method 201-2013, Drying Rate of Fabrics: Heated Plate Method. Untreated fabric shows an average drying rate of 1.62 ml/h. Average drying rate of the treated fabric is 2.33 ml/h. The treated fabric sample thus shows a drying rate improvement of 44±4% compared to the untreated fabric.

Example 8

[0142] The same procedure as given in Example 7 is repeated with replacing carbon black. Instead, 2.0% of carbon nanotubes (based on initial weight of fabric) is used to treat the fabric. The treatment of the fabric is similar to Example 1. The treated fabric is analyzed for the drying rate performance by AATCC Test Method 201-2013, Drying Rate of Fabrics: Heated Plate Method. Untreated fabric shows an average drying rate of 1.62 ml/h. Average drying rate of the treated fabric is 2.28 ml/h. The treated fabric sample thus shows a drying rate improvement of 41±4% compared to the untreated fabric.

Example 9

[0143] The same procedure as given in Example 8 is repeated with replacing carbon nanotubes. Instead, 2.0% of reduced graphene oxide (based on initial weight of fabric) is used to treat the fabric. The treatment of the fabric is similar to Example 1. The treated fabric is analyzed for the drying rate performance by AATCC Test Method 201-2013, Drying Rate of Fabrics: Heated Plate Method. Untreated fabric shows an average drying rate of 1.62 ml/h. Average drying rate of the treated fabric is 2.38 ml/h. The treated fabric sample showed a drying rate improvement of 47±6% compared to the untreated fabric.

Example 10

[0144] A solution that is appropriate to be added directly to the composition is prepared by mixing, in the order given.

[0145] Anti-coagulant agent (Propylene glycol): 240 g

[0146] Aluminum doped zinc oxide: 120 g

[0147] Indium doped tin oxide: 60 g

[0148] Then the solution is milled to form a thin liquid solution. Thus formed liquid solution is used in the following formulation added in the listed order.

[0149] HeiQ Maintain RPS: 1100 g (HeiQ Maintain RPS serves the function of a chemical binder in the given formulation).

[0150] HeiQ Soft SHF: 200 g (HeiQ Soft SHF serves the function of a chemical wicking enhancer and a hand feel improving agent).

[0151] Anti-coagulant (Propylene glycol): 6 g

[0152] Ruco Dry DHY: 6 g (Ruco dry DHY is the hydrophobicity modifying agent which is used to regulate the moisture affinity of the print)

[0153] Milled solution: 420 g (Milled solution contains the NIR absorbing agent or agents)

[0154] Colour pigment: 1 g (Colour pigment is used to impart a desired colour to the coating solution)

[0155] Fixer 104 W: 70 g (Fixer 104W is used to accelerate/increase the crosslinking of the binder, thus increasing the durability of the binder.

[0156] The above-mentioned solution is used to screen print 100×100 cm panels of polyester fabrics having area density of 130 g/m2. In fabric screen printing process, a desired pattern of a coating solution is transferred on to the surface of a fabric using a mesh that is open for liquid transfer at certain positions. If the whole mesh is kept open for the liquid transfer, a full area print is applied.

[0157] The wet pickup is kept at a percentage of 10%. Once the printing is made, the samples are first dried at 100° C. followed by 150° C. The treated fabric is analyzed for the drying rate performance by AATCC Test Method 201-2013, Drying Rate of Fabrics: Heated Plate Method. Untreated fabric shows an average drying rate of 1.62 ml/h. Average drying rate of the treated fabric is 2.52 ml/h. The treated fabric sample thus shows a drying rate improvement of 56±4% compared to the untreated fabric.

Example 11

[0158] The same process described in Example 10 is carried out except the features of the polyester fabric. Instead, a polyester fabric having 95% polyester and 5% elastomer with 130 g/m2 area density is used. The treated fabric is analysed for the drying rate performance by AATCC Test Method 201-2013, Drying Rate of Fabrics: Heated Plate Method. Untreated fabric shows an average drying rate of 1.67 ml/h. Average drying rate of the treated fabric is 2.53 ml/h. The treated fabric sample thus shows a drying rate improvement of 52±6% compared to the untreated fabric.

Example 12

[0159] The same process described in Example 11 is carried out except the features of the polyester fabric. Instead, a fabric having 100% polyester with 225 g/m2 area density is used. The treated fabric is analyzed for the drying rate performance by AATCC Test Method 201-2013, Drying Rate of Fabrics: Heated Plate Method. Untreated fabric shows an average drying rate of 1.20 ml/h. Average drying rate of the treated fabric is 1.94 ml/h. The treated fabric sample thus shows a drying rate improvement of 62±3% compared to the untreated fabric.

Example 13

[0160] The same process described in Example 10 is carried out except the screen printing process. Instead of printing of the fabric, wet padding process is carried out set to 60% wet pickup rate. In the wet padding process, the fabric is submerged in the coating solution, then the excess solution is squeezed out using multiple number of rollers, which dictates the wet pick-up percentage. Once the printing is made, the samples are first dried at 100° C. followed by 150° C.

[0161] The treated fabric is analyzed for the drying rate performance by AATCC Test Method 201-2013, Drying Rate of Fabrics: Heated Plate Method. Untreated fabric shows an average drying rate of 1.62 ml/h. Average drying rate of the treated fabric is 2.30 ml/h. The treated fabric sample shows a drying rate improvement of 42±6% compared to the untreated fabric.

Example 14

[0162] The same process as described in example 10 is carried out except the screen printing process. Instead, the coating solution comprising the formulation prepared in example 10 is charged in to the hand held paint sprayer and applied on to a fabric to have 20% wet pickup. The finishing process is followed as per Example 10.

[0163] The treated fabric is analyzed for the drying rate performance by AATCC Test Method 201-2013, Drying Rate of Fabrics: Heated Plate Method. Untreated fabric showed an average drying rate of 1.62 ml/h. Average drying rate of the treated fabric was 2.49 ml/h. The treated fabric sample shows a drying rate improvement of 54±4% compared to the untreated fabric.

Example 15

[0164] The surface morphology of the fibers of the treated fabric samples according to example 10 is characterized using field emission Scanning Electron Microscope (SEM) Hitachi SU6600 Analytical Variable Pressure FE-SEM. The samples are sputter-coated with gold for 30 seconds at 15 mA prior to the observation. The results are shown in the FIG. **1** of the present invention.

[0165] FIG. **1** depicts Scanning Electron Microscope image of the fibers in the fabric treated according to the method disclosed in example 10. FIG. **1***a*) depicts fibers at 1000× magnification and FIG. **1***b*) depicts individual fiber surface shown at 7000× magnification. It is derived from FIGS. **1***a*) and **1***b*) that thin coating of the NIR absorbing agent has been established on the surface of the fabric.

[0166] All the examples of the present invention are carried out using the standard protocols as set out by AATCC standards.

[0167] Therefore it is evident that the present invention is able to successfully overcome the various deficiencies of prior art and provide for modified textile material which due to presence of NIR energy absorbing agent provides quick evaporation of moisture content. Further, the NIR energy absorbing agent used for treating the textile material does not cause any discomfort to the wearer, if a garment is fashioned out of the textile material.

[0168] Additional embodiments and features of the present invention will be apparent to one of ordinary skill in art based on the description provided herein. The embodiments herein provide various features and advantageous details thereof in the description. Descriptions of well-known/conventional methods and techniques are omitted so as to not unnecessarily obscure the embodiments herein.

[0169] The foregoing description of the specific embodiments fully reveals the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications of such

specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments in this invention have been described in terms of preferred embodiments, those of skill in the art will recognize that the embodiments herein can be practiced with modifications within the spirit and scope of the embodiments described herein.

[0170] Throughout the specification, the word "comprise", or variations such as "comprises" or "comprising" wherever used, will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

[0171] With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. The various singular/plural permutations may be expressly set forth herein for sake of clarity.

[0172] Any discussion of documents, acts, materials, devices, articles and the like that has been included in this specification is solely for the purpose of providing a context for the disclosure. It is not to be taken as an admission that any or all of these matters form a part of the prior art base or were common general knowledge in the field relevant to the disclosure as it existed anywhere before the priority date of this application.

[0173] While considerable emphasis has been placed herein on the particular features of this disclosure, it will be appreciated that various modifications can be made, and that many changes can be made in the preferred embodiments without departing from the principles of the invention. These and other modifications in the nature of the invention or the preferred embodiments will be apparent to those skilled in the art from the disclosure herein, whereby it is to be distinctly understood that the foregoing descriptive matter is to be interpreted merely as illustrative of the invention and not as a limitation. It is further understood that the scope of the present invention fully encompasses other embodiments that may become obvious to those skilled in the art and that the scope of the present invention is accordingly limited by nothing other than the appended claims.

1. A quick dry textile material comprising:

a) textile substrate; and

b) composition comprising near infrared (NIR) energy absorbing agent.

2. The textile material as claimed in claim **1**, wherein the composition is present on at least one surface of the textile material.

3. The textile material as claimed in claim **1**, wherein the composition further comprises component selected from the group comprising binder, pigment and finishing agent or any combinations thereof.

4. The textile material as claimed in claim **3**, wherein the binder is selected from the group comprising acrylic binder, polyurethane binder, vinyl polymer binder, vinyl copolymer binder, natural rubber binder, neoprene rubber binder, epoxy binder, amino resin binder, silicone binder and biopolymer binder, or any combinations thereof.

5. The textile material as claimed in claim **1**, wherein the near infrared (NIR) energy absorbing agent is selected from the group comprising metal, oxide, doped oxide, carbon compound, organic compound and polymer or any combinations thereof.

6. The textile material as claimed in claim **1**, wherein the NIR energy absorbing agent is present in amount ranging from about 0.1% to 10.0% by weight of the textile substrate; and wherein the NIR energy absorbing agent absorbs electromagnetic radiation ranging from about 700 nm to 1500 nm.

7. The textile material as claimed in claim **1**, wherein particle size of the NIR energy absorbing agent ranges from about 1 μm to 500 nm in diameter, preferably from about 10 nm to 100 nm in diameter, and more preferably from about 20 nm to 70 nm in diameter.

8. The textile material as claimed in claim **1**, wherein the textile substrate is selected from the group comprising Cotton, Polyester, Nylon, Polyester-elastomer blend, Nylon elastomer blend, Polyester cotton blend, Aramid Linen, Polyethylene, Polypropylene, Jute, Hemp, Wool, Rayon, Lyocell and Acetate fiber textile, or any combinations thereof.

9. The textile material as claimed in claim **1**, wherein weight of the textile material ranges from about 100 to 250 gram per square meter, preferably about 130 gram per square meter.

10. The textile material as claimed in claim **1**, wherein the textile substrate is pre-treated by process selected from the group comprising scouring treatment, bleaching treatment, enzymatic treatment, softening treatment, treatment for improved wicking, anti-pilling treatment, anti-static treatment, anti-curling treatment, anti-bacterial treatment, treatment for improvement of wash fastness, treatment for improved draping, raising, burning, quenching, curing, heat setting, polishing, embossing, pressing and creasing or any combinations thereof.

11. A method for obtaining quick dry textile material comprising textile substrate and composition comprising near infrared (NIR) energy absorbing agent, said method comprising acts of:

a) treating the textile substrate with the composition; and

b) processing the treated textile substrate to obtain the quick dry textile material.

12. The method as claimed in claim **11**, wherein the treating of the textile substrate is by process selected from the group comprising coating, finishing, depositing, spraying, foam application, dyeing, wet padding, screen printing, screen transfer, sublimation, film transfer, roll transfer, electrodeposition, wet exhaustion, chemical vapor deposition and physical vapor deposition, or any combinations thereof.

13. The method as claimed in claim **11**, wherein the processing comprises act selected from the group comprising heating, washing and drying or any combinations thereof.

14. The method as claimed in claim **11**, wherein the near infrared (NIR) absorbing agent is selected from the group comprising metal, oxide, doped oxide, carbon compound, organic compound and polymer or any combinations thereof.

15. The method as claimed in claim **11**, wherein the NIR energy absorbing agent is present in an amount of about 0.1% to 10.0% by weight of the textile substrate; wherein the NIR energy absorbing agent absorbs electromagnetic radia-

tion ranging from about 700 nm to 1500 nm; and wherein particle size of the NIR energy absorbing agent ranges from about 1 μm to 500 nm in diameter.

16. The method as claimed in claim **11**, wherein the textile substrate is selected from the group comprising Cotton, Polyester, Nylon, Polyester-elastomer blend, Nylon elastomer blend, Polyester cotton blend, Aramid Linen, Polyethylene, Polypropylene, Jute, Hemp, Wool, Rayon, Lyocell and Acetate fiber textile, or any combinations thereof.

17. The method as claimed in claim **11**, wherein the composition further comprises component selected from the group comprising binder, pigment and finishing agent or any combinations thereof.

18. The method as claimed in claim **11**, wherein weight of the textile material ranges from about 100 to 250 gram per square meter.

19. Use of a composition comprising near infrared absorbing agent for obtaining a quick dry textile material.

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