Studies On The Application Of Nano-Technology In Technical Textiles

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Abstract: The world market of textiles today is becoming highly competitive as compared to the traditional textiles. Consumers nowadays expect textiles and clothing with the functions of higher performance along with long lasting durability. Nano-technology is an emerging technology and this technology promises to impart novel properties in textiles with permanent effects as demanded. The application of nano-technology in the field of textiles has led to the development of Nano-Fibers, Nano-Compositions, Nano-Polymers, Nano-Finishes, etc. Technical textiles are functional textiles which find its application in multi-disciplinary fields like Clothtech, Agrotech, Medtech, Hometech, Buildtech, Indutech, Geotech, Sporttech, Mobiltech, Packtech, Protech, Oekotech etc., Technical textiles finished with nano-technology can provide high durability for textiles because nano-particles have a large area-to-volume ratio and high surface energy, thus presenting better affinity thereby leading to increase in durability of the functions. This paper is mainly focused on the application of nano-technology in the area of technical textiles.

Introduction

Nano-technology is a complex field combining science (biology, chemistry and physics), information technology (computer programming), engineering (electronics and design) and mathematics. Nano-technology is used in many industries like medical, defense and aviation. Impact of nano-technology in textiles and the application of nano-materials have dramatically improved the performance of textiles and clothing to fulfill the needs of society. Functional and performance properties of nano-textiles and technical textiles are totally different from traditional textiles. Most active areas of nanotextile research and development mainly depends on the technical textiles such as odour releasing textiles, self-cleaning fabrics, carbon nanotube for electronic textiles, bioactive wound bandages, conductive textiles, water and stain repellent textiles, ultra violet protective, shape memory polymers for intelligent textiles, photo catalytic textile coatings, and healing textiles etc. The nanomaterials that are used most frequently in textiles are: silver, silicon dioxide, titanium dioxide, zinc oxide, aluminum (hydr)oxides, nanoclay (primarily montmorillo-nite), carbon nanotubes, carbon black. Copper, gold, iron (hydr)oxides, polypyrrole, and polyaniline are of secondary priority. Therefore, nano-technology has the ability to improve the effectiveness of textile products and is expected to have a substantial impact on the development of new applications.

Medical Textiles

Medical Textiles, also known as Medtex or Medtech with ‘sticking plaster’ as symbol-includes the complete range of innovations in the manufacturing, processing and application of medical and hygiene products such as the latest ideas for special bandages, hospital apparels and a variety of conductive textiles. Nanofabrics used in medicine can deliver antibiotics, anticancer drugs, proteins, and DNA in precise quantities. Nonwoven fabrics made by electrospinning have the potential to assist in the growth of organ tissue, bone, neurons, tendons, and ligaments. Polymer nanofabrics can act either as a scaffold to support damaged tissue or as a synthetic substitute for actual tissue. Nanofabrics can be made of natural or synthetic polymers, or a combination of both depending on its end use. Some of the nano-technology used in medtech are silver nanoparticles, phyto nanoparticles, drug nanocapsules, “Lotus Effect” (superhydrophobic) polymer nanofilaments, hydrophilic /hydrophobic titanium dioxide nanocoating.
Protective Textiles

Protective textiles, also known as Protex or Protech with 'helmet' as symbol- includes latest developments in personnel and property protection such as innovative materials for flame resistant clothing, knife proof textiles and ballistic protection clothing. Defence personnel needs protection from lethal weapons, chemical and biological warfare weapons. Nano-technology based materials have extraordinary physical, chemical, mechanical, and electrical properties at nano-level that offers a promising future in this area with their unique characteristics. The nano-technologies such as Intumescent nanocoatings, Carbon nanotube polymer composite, Rare earth nanocomposites, Aerogels, Titanium dioxide nanoparticles, Organic conductive polymers and Metal nanoparticles are used in protech that helps in producing lightweight and comfortable protective clothing and also some new developments like sensor, energy storage, conductivity, and decontaminant fabrics.

Geotextiles

Geotextiles with 'dam separating land from water' as symbol also known as Geotex or Geotech comprises of technical textile products used in Geotechnical applications pertaining to soil, rock, earth, etc. By decreasing diameter of the fiber to the nanoscale, it is possible for a huge increase in the specific surface area at the level of 1000 m²/g. This reduction in size and increase in the surface area to an extent influence the chemical and biological reactivity and electrical activity of the polymer fibers. Separation, filtration, reinforcement, drainage, protection and erosion control are the principle functions of geotextiles which can be enhanced through the nano-technology such as nanoclay formulation, Nanofibrous media (with added functionality) and Titanium dioxide nanoparticles.

Packaging Textiles

Packaging Textiles, also known as Packtex or Packtech with 'package' as symbol includes all significant innovations in the packing, covering and transportation of goods. The nano-technologies like Carbon nanotubes, Zinc oxide nanoparticles, Aerogels, Hydrophilic/ hydrophobic titanium dioxide nano coating can be embedded in packaging fabrics. These enhance the ability of the textile with innovative packaging solutions such as oxygen scavenging, anti-static packaging for computer equipment, etc.

Sports Textiles

Sports Textiles, also known as Sporttex or Sporttech with 'sport shoe' as symbol- includes new products and ideas from the world of sport and leisure. Sports fabrics with improved mechanical properties and odour-reducing antibacterial properties can be obtained using nano textiles. Nanofibres and nanocoatings that has the properties of self cleaning, antimicrobial and UV-blocking such as nano-titanium dioxide /nano-zinc oxide coating, nano-silver are mainly used in the field of sport textiles.

Clothing Textiles

Clothing Textiles, also known as Clothtex or Clothtech with 'tee shirt' as symbol- includes latest developments and advancements in shoe and clothing manufacturing such as the innovative smart materials and structures that can be defined as the materials and structures that sense, react and adapt to environmental conditions or stimuli, such as those from mechanical, thermal, chemical, electrical, magnetic or other sources. "Smart clothes" are clothes in which the textile structures themselves perform electronic or electric functions. This involves electronic components which have been reduced to nanosize being completely fused with the textile material resulting in that textile and non-textile components cannot be differentiated and "foreign particles" can no longer be seen or felt. Nano materials used for intelligent textiles are carbon nanofibres, graphite nanofibres, carbon nanotubes which are classified as single wall carbon nanotubes (SWNT) and multi wall carbon nanotubes (MWNT) and polyamide nanofibres.

Construction Textiles

Construction Textiles, also known as Buildtex or Buildtech with ‘house’ as symbol- includes the textiles used in construction and architectural applications. Carbon nanostructures are now being used in the development of lightweight building materials. The antimicrobial surface treatment for protection of wood against wood-destroying fungi and other degradation phenomena can be applied through nanofiber textiles augmented by incorporated nanoparticles. Other than the antimicrobial treatments, anti-static, uv-blocking and thermal insulation are some important properties to be fulfilled in the field of buildtech.
Conclusion

The enhancement of several attributes of textile materials using nano-technology has made a revolution with tremendous technological, economic and ecologic benefits. The possibilities with nano-technology are immense and numerous. The use of nanoparticles, nanofinishes and nanostructures provides advanced performance and functional characteristics of conventional textiles, in areas such as anti-microbial, anti-bacterial, water repellency, soil-resistance, anti-static, anti-infrared and flame-retardant properties. Functional textiles have contributed a new vista of applications in diverse field of human life. Developments in smart nanotextiles may affect many aspects of our daily lives and produce clothing that is extremely technical and advanced with various aspects as i-wear, musical jackets, space suits, etc. Many of these applications are highly crucial and thus these materials with high performance properties are going to play prominent role in the modern life style. The nanotextiles creates its own range of market in the textile industry over the world.

References


