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Smart Fashion for the Future through Biotech and Nanotechnogy - An Overview

Dr. Mamatha G Hegde[1]

[1]Asst. Professor, Dept of Fashion Design, Faculty of Art and Design, M. S. Ramaiah University of Applied Sciences, Bangalore 560 054, Karnataka, India

Abstract: **Textiles are important parts of our lives from cradle to grave. The future of clothing is about to change in a big way, and smart textiles are paving the way for this change. Global world today needs innovative inter-disciplinary research in fashion by moving beyond traditional boundaries. Innovative medical textiles into which therapeutic substances can be integrated will play an important role in the treatment of wounds and skin. Fabrics that contain micro-fabricated bio-environments and biologically activated fibres will have genetically engineered bacteria incorporated into them. Nano technological developments as Nano-layer surface coating , Sol-gel technology helps to prevent the formation of dangerous microorganisms on hospital and healthcare textiles, such as scrubs, uniforms, laboratory coats, curtains and gowns. Scientists are working on Nano electronic devices that can be embedded into textiles to provide special support systems for individuals in dangerous professions or sports. Smart clothing respond to the environmental changes and manifest their functions according to the change. The burgeoning interest in Nano technology opens a floodgate of opportunities for developing new and innovative products in the textile sector. To apply all the research in the multidisciplinary sector into a fashion needs a transforming methodology to make the innovation socially significant and meaningful.**

Keywords**: Inter-disciplinary research, Innovative medical textiles, Nano technology, Smart textiles.**

I. INTRODUCTION

Mother earth is slowly dying because of the pressure loaded by humans, so there is an urgent need for saving the earth by developing innovative eco technogies. The future research should focus on sustainable product development by utilizing the natural resources, Industrial by-products and use of less energy and man power. Textiles are important parts of our lives from cradle to grave. The future of clothing is about to change in a big way, and smart textiles are paving the way for this change. Global world today needs innovative inter-disciplinary research in fashion by moving beyond traditional boundaries. Significant for this research is the interdisciplinary approach, in the interaction and integration between textile design and technology, chemical engineering, microbiology, biochemistry, food industry, physics, material science, computer science and fashion technology are of concern today[(1)]. Merge of investigations from all these disciplines is important for the future fashion.

Biotechnology integrates with the textile industry to carry out many innovative projects and become integral part of our everyday life through production many high-tech fabrics i.e.; fabrics for the treatment of wounds, drug-releasing medical textiles, fabric with moisturizer, perfume, antibacterial, antiviral, fabrics for measuring and monitoring of vital parameters such as blood pressure, pulse, breathing, drug producing bandages, protective clothing with highly sensitive cellular sensors and anti-aging properties. In the field of biomedical technology, biologists and engineers work in close cooperation in the development of biomaterials and implants as well as methods for tissue regeneration such as absorbable, three-dimensional, shape able fleeces in which autologous cartilage cells can be grown. Such implants can be used to counteract the wear and tear of bones and cartilage (arthritis) or to promote the growth of the kind of bone required for dental implants. Wound treatment for the diabetic patient is of concern today in the medical sector. This is a major application area for wound healing textiles.

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In Germany, two million patients every year suffers from severe and chronic wounds. Innovative medical textiles into which therapeutic substances can be integrated will play an important role in the treatment of wounds and skin. It is estimated that nanotechnology in textiles will be billion dollar business in the next few years. The fibrous nature of textile has enabled to support many different industries with their diverse functions [(2)]. Fashion clothing has an important applications in the medical technology, protective defense clothing, aerospace, automotive sector, construction, women protective clothing, sportswear industries and geo field.

II. POPULAR SECTORS

A. Application of biotech and microbiology in textiles:

Biotechnology for fashion includes working with living cells and their molecules for fashion application for betterment of production techniques and enhancement of living standard of mankind. Production of natural fibres with highly improved and modified properties involves the application of biotechnology. Fabrics that contain micro-fabricated bio-environments and biologically activated fibres will have genetically engineered bacteria incorporated into them that will enable them to generate and replenish chemical coatings and chemically active components. Enzyme based biotechnology application in the textile finishing sector can reduce water usage by about 17% to 18%. Bio Couture is focused on bringing living and bio-based materials to fashion, they are growing clothes from microorganisms like cellulose, fungi and algae to create amazingly innovative smart textiles and develop technology[(3)].

Fig-1 Bio fabrics developed from microorganisms [(3)]

B. Application of Nanotech in textiles:

Nanotechnology is the technology of the future and is a method of controlling and manipulating matter on an atomic or molecular scale. Nanotechnology is defined as the science and technology of building electronic circuits and devices from single atoms and molecules. In the field of textiles, nanotechnology has been employed in the synthesis of quantum dot and dye molecules which are used to cloud fibres. Today with the evolution of science smart textiles were developed with nanotechnology, in which dirt is unable to attach on the surface of the fabric due to complex micro and nanostructures.

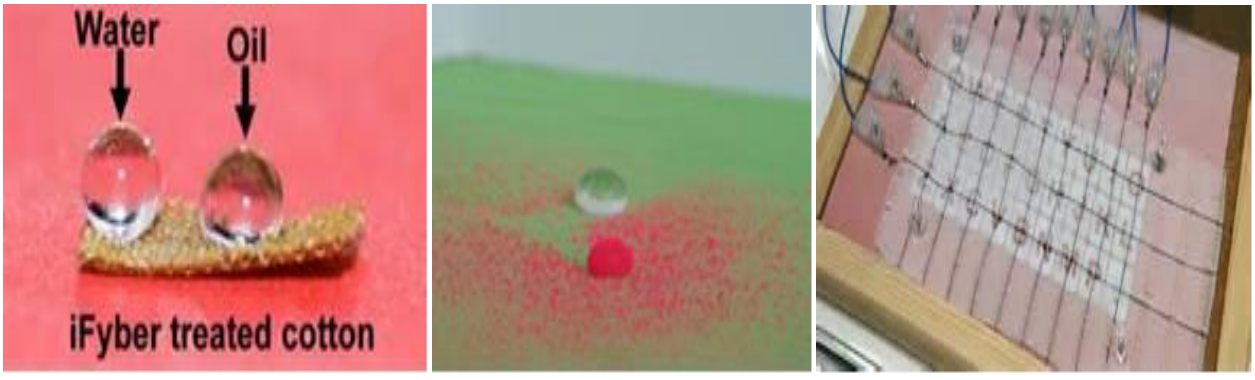

Fig-2 Nanotechnology application in textiles [(4)]

Nano technological developments as Nano-layer surface coating ,Sol-gel technology helps to prevent the formation of dangerous microorganisms on hospital and healthcare textiles, such as scrubs, uniforms, laboratory coats, curtains and gowns. Textile materials finished with Nano sphere repel liquids, dirt, and stains. Synthetic fibers can be made soft and comfortable like cotton. Nano- Touch TM fabric technology is known to permanently graft an outer layer of cotton- like properties around a synthetic fiber core. Polymers reinforced with 2-5 wt. % of Nano clays exhibit significant improvement in thermal- mechanical properties, flame retardancy, barrier properties, dimensional stability, and electrical conductivity. The spun, polymer-based Nano fibres can be 'loaded' with different additives as nanoparticles, enzymes, drugs or catalysts [(4)].

C. Future Smart clothing

As there is advances in Science and technology innovations are leading towards development of smart/ functional clothing. These clothing respond to the environmental changes and function as per the need. Smart developments in textiles includes deodorizing fabrics, breathable fabrics, insect killer clothing, hazard warning clothing, functional sportswear, medical and safety wear, anti-stress wear etc.[(5)]. Micro encapsulation of Stimuli sensitive materials in the fabrics helps the fabric to respond to physical / chemical / biological external stimuli e.g. temperature. Smart textiles technologies that can be incorporated into fashion includes color changing fabrics; shape memory textiles, sweat-free garments etc.

Scientists are working on Nano electronic devices that can be embedded into textiles to provide special support systems for individuals in dangerous professions or sports. Some garments can now provide life-signs monitoring, internal temperature monitoring, chemical sensing, power generation and storage to enable communication with the outside world. Research is ongoing into man-made Nano fibres where clay minerals, carbon nanotubes or Nano particulate metal oxides can be used to impart new properties. These properties provide halogen-free, flame retardancy for a fabric, increased strength and shock-absorbency, heat and UV radiation stability, and bright color. Chinese and U.S. researchers have developed a carbon nanotube-coated smart yarn which can conduct electricity and be woven into textiles to detect blood or to monitor health [(6)].

Nano technology has come up with an innovative way of combining the two fibres; one natural and the other Nano technology to build a new kind of smart textile which helps the soldier when he is in danger[(7)]. Cotton yarn with a thickness of 1.5 millimetres is dipped a few times in a solution of a special sticky polymer in ethanol and dried. This enables the yarn to conduct power from a battery to illuminate light emitting diode device. The antibody anti-albumin is added to the carbon nanotube solution. Anti-albumin reacts with albumin, a protein that is found in blood. When the anti-albumin infused yarns were exposed to albumin, the conductivity is increased considerably. This method is sensitive, simple and durable [(8)].

Smart clothing responds to the environmental changes and manifest their functions according to the change. These includes deodorizing fabrics, breathable fabrics, insect killer clothing, hazard warning clothing and functional sportswear. They are respond to the environmental changes and manifest their functions according to the change. These includes deodorizing fabrics, breathable fabrics, insect killer clothing, hazard warning clothing, functional sportswear, medical and safety wear[(9)]. Innovations in these sectors create significant demand for functional clothing which has a massive impact on today's fashion trends.

III. CONCLUSIONS

Nanotechnology is the technology of the future in the field of textiles. Finishing of textiles and fibre manufacturing are areas where bio and nanotechnology has great potential for application. Health monitoring of the wearer such as heart rate, respiration rate, temperature, activity and posture, Sports training data acquisition, monitoring personnel handling hazardous materials, tracking the position and status of soldiers in action, monitoring pilot or truck driver fatigue are the important sectors of future demand. The innovations are in these sectors to develop fabrics that contain micro-fabricated bio-environments and biologically activated fibres. The burgeoning interest in Nano technology opens a floodgate of opportunities for developing new and innovative products in the textile sector. To apply all the research in the multidisciplinary sector into a fashion needs a transforming methodology to make the innovation socially significant and meaningful.

Smart textiles are designed to integrate electronic components or monitors for taking physical measurements into fabric. Next generation of textiles will have the ability to monitor their environment and interact accordingly in order to accomplish a pre-programmed functionality. The vision is the development of novel technology for fabricating electronically active and sensor fibres, which will be the basic building blocks of the next generation of smart fibrous materials.

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