Popular Article

e-ISSN: 2583-0147

Volume 3 Issue 1
Page: 0327 - 0329

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Heat Generating Textile Products for Human Clothing

Electronic textiles (e-textiles) are textile products that have electronics and interconnections embedded into them. Components and connections are a part of the fabric and thus are much less visible and, flexible with the material and comfort to the wearer. ICAR-Central Institute for Research on Cotton Technology CIRCOT, Mumbai is a pioneer organization working on the post-harvest processing and value addition of cotton along with the application of recent technological advancement for fibre manufacturing. The institute is engaged in conducting research and development to manufacture many smart textile products.

INTRODUCTION

Conductive textiles are the next generation textiles having diversified applications in several clothing products, furnishing and technical textiles. Smart textiles consist of electronic components that can sense and react to different stimuli with respect to the environment. A smart textile includes new type of textile fibers and structure, miniaturization of electronics and wireless wearable technologies embedded on it. India's technical textiles market size reaches around 4% share in the global market. Indian market includes increasing consumer profiles and income levels that contribute through automobiles, healthcare, sports etc. Overall technical textiles and smart textile market has its own future in India.

CONDUCTIVE THREADS AND INK

A thread can be made conductive either by coating it with metals particles (copper, silver etc.) or carbon materials like graphene, polymers etc. On the other hand, some natural fibres or synthetic fibres can be wrapped over the conductive metal wires or conductive filaments like carbon to use it as electrical or thermal conductive yarn.

According to the application requirement, the conductive yarn properties can be optimized.

The conductive ink that conducts electricity and find path for printing or drawing circuits. A special ink that can be applied to textile and other substrates for connecting the circuits or to change one form of energy into another. Conductive inks contain powdered carbon, oxides of copper or silver mixed with traditional inks. Various forms of conductive inks are available in the market with different particle size and physical properties. The SEM image of the grapheme conductive ink is shown below as Figure 1. with the particle size is in few microns.

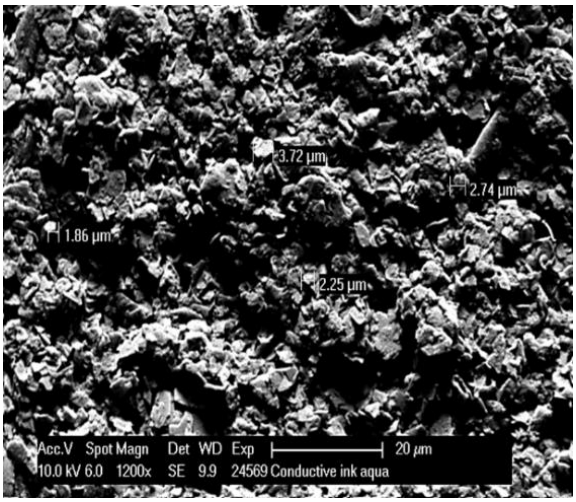

Figure 1. SEM image of the conductive ink based on grapheme

The electrically conductive inks are already used in various application fields for developing conductive textile materials and smart textile products. The electrically conductive textiles yarns are used as interconnection between the components and developing heat generating textile products using low voltage power supply.

SMART TEXTILE PRODUCTS

ICAR-CIRCOT, Mumbai is working on smart textiles and developed a laboratory for making smart textile materials. Flexible conductive yarn was developed which can be stitched over any fabric as shown in the Figure 2. The conductive yarn produced using cotton fibre and carbon filament by Core-yarn spinning in which cotton as sheath material and carbon act as core material.

Figure 2. Cotton based conductive yarn and fabric

The developed yarn was optimized to generate heat using low voltage DC power supply. The heating pads were optimized to generate the temperature of 40-60°C which can withstand for 7-8h from 20Ah rechargeable battery. This smart textile heating pads can be used for multi-purpose in developing textile products. The major advantage of this product is to produce maximum temperature up to 80°C from low voltage battery say 5V, 2A power supply at an ambient temperature of 32°C. Any mobile rechargeable power bank can be used to achieve the required temperature.

Figure 3. Heat generating textile products prepared using conductive yarn

Products developed using conductive yarn includes thermal garments, heating seat cover, heating gloves, heating muscle pad, heating shoe pad, warming mouse pad as shown in the Figure 3.

The products were developed by optimizing the conductive yarn to generate heat to the required level. Electronic control (push button) circuits were also used to adjust the temperature to different levels. This technology fits to various applications and has significant commercial potential.

CONCLUSION

Fabric sector has already been impacted by smart textiles. The progress in the functions of conductive textiles has been significantly swift in the last few years, primarily in smart fabrics using electronic components. An investigation concerning e-textiles to enhance functioning or to establish unparalleled operations of textile fabrics is booming. There is a high possibility that in the upcoming years, smart textile will invade into all spaces of fabrics. ICAR-CIRCOT, Mumbai working on the research and developments of smart textile products. Stepping into new technologies like combining textile with electronics, artificial intelligence, IoT etc. will print the road map for new innovative ideas.

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