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Development of Woven Fabric As E-textile Sensor From Organic Crystals

G. Lakshmi Jyothi
M.Tech I Year, Department of Textile Technology
Jaya Engineering College, Chennai

L.Nagarajan
Assistant Professor, Department of Textile Technology,
Jaya Engineering College, Chennai

S. Karthik
Assistant Professor, Department of Textile Technology
Jaya Engineering College, Chennai

***Abstract*—Textile materials are used widely as fabrics for clothing purpose due to their light weight and flexibility. Fabrics with digital components and electronics embedded in them are called e-Textiles. The e-textiles are simple computing systems which acts as sensors, actuators, data processing, storage and data communication. But there is a challenge in e-Textiles, accuracy of sensors performance in terms of sensitivity, repeatability and durability because of using embedded sensors with fabrics, often compromise for external factors such as structural deformation, temperature, humidity and sweat. The present study was that there is a chance to overcome the problem of sensitivity, structural deformation etc. of e-textiles may be overcome by using woven fabric patch manufactured with organic crystals. To investigate and explore the chances of manufacturing woven fabric with organic crystals, using as E-textile sensor and cope in many fields.**

***Keywords*—woven fabric, organic crystal, e-Textile sensor**

I. INTRODUCTION

Over the years, various types of materials have been developed to address the need of e- textiles which include metal fibers, conductive inks, plastic optical fibers, nano-particles, organic semiconductors, SM polymers, chromic materials and so on. E-textile are materials and structures that sense and react to environmental conditions. A textile that can think for themselves! The idea itself is very progressive and in reality, such textiles are a fact technically possible today and commercially viable tomorrow. E- Textiles can be used for numerous applications such as temperature sensitive fabrics, fashion and entertainment clothes, health monitoring fabrics, emergency fabrics, military, sportswear, transport and automotive etc. Electronic textiles involves the combination of electronics and textiles to form textile products.

II. THE FOLLOWING ARE THE ADVANTAGES AND DISADVANTAGES OF E-TEXTILES:

A. Advantages:

1. Like normal fabrics they provide comfort, durability and resistance to regular textile maintenance processes
2. They allow incorporation of latest technology elements to textiles
3. No wires are used
4. Thermal resistant and electrical resistant
5. Large surface area for sensing
6. Cheaper cost of making

B. Disadvantages:

1. The existing technology is not completely water proof, hence they cannot be worn continually under rainy environment.
2. Smart fabrics used in medical applications require calibration as per government requirements.
3. They are yet to be commercialized and yet to be developed for children.
4. Due to durability of the materials, they get implicated by harsh environmental conditions.
5. Not as flexible as normal textile clothing
6. Limited reliability compared to textile clothes
7. They have specific range of applications
8. They have limited processing and storage capability

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III. MANUFACTURING OF FABRIC WITH ORGANIC CRYSTALS

Production of textile sensor includes several steps which are lengthy and costly. Suitability and durability of sensors and other material need to be tested and there should be capability to reach the specification.

The process of weaving requires a yarn made of either natural or synthetic fibers that should possess elastic and can be bent without fracture while processing into two- dimensional fabric. With the projected shift from flexible devices, woven optoelectronic textiles have been identified as a prospective platform for wearable electronics, with increasing demand for e-textiles which are light in weight, flexible and comfortable to wear.

The feasibility of such elements has been demonstrated in applications that include wearable sensors, light emitting diodes and transistors. Although some of these applications require organic materials like powders or glasses, they have not use of crystal materials that lack of major structural defects. One of the major limitation of molecular crystal is can be pulled into fibers when soft, they can only be grown into small size and limited because they have relatively weak intermolecular binding.

Apart from that, organic crystals can be viewed as soft materials in which individual molecules assemble via noncovalent interactions into periodic ordered lattices. Because of this, the extraordinary elasticity of some organic crystals, they can be woven into fabric. There are chances of using variety of weaving methods to be applied to crystals, including plain, twill and satin weave having warp and weft yarns. Organic crystal formation involves amorphous spherical aggregates, initial densification, leading to nucleation, appearance of crystalline order within the precursor that retains round morphology and crystal growth occurs. Under UV spectroscopy can see the crystal growth stages.

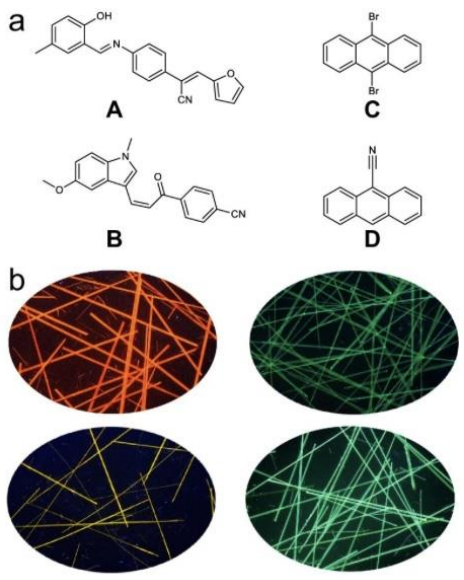

Fig. 1. a- some examples for organic crystals
b- Crystals under UV light

Organic crystals are inherently flexible and soft materials in which individual molecules assemble via non-covalent interactions into periodic ordered lattices. Organic crystals can be prepared by different methods. The solvents and all starting materials for the organic synthesis are prepared and filter the solution through a clean glass frit into a clean vessel and cover, but not tightly. Allow them to cool. The woven organic crystal patches are not only light in weight but also robust to mechanical impact. They are more than 15 times more resilient to failure than the individual crystals, reflecting the enhanced collective action in response to bending or other impacts on entangled structural elements. The researchers also report that the thermal stability of the crystalline fabric is another asset of the flexible crystals. The organic crystal fabric remains optically transmissive, providing the opportunity to construct networks of optical waveguide. When organic crystals used in appropriate aspect ratio, they can be mechanically compliant and either bent, curled od twisted. The crystals can hold large stress without fracture. The process of weaving is well known to increase the mechanical strength of the material as well as its energy absorption capacity. The new concept of using crystals as the basis for a woven fabric opens up new opportunities in e-Textiles.

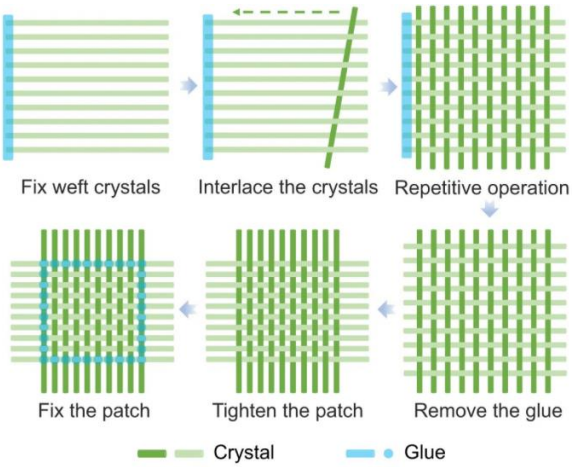

Fig 2.

A woven fabric consists of two sets of parallel yarns that are interlaced with each other, of one acts as a warp and the other as a weft. The crystals which are relatively uniform in size and have smooth surface are selected for weaving into fabric. To prepare support analogous to a weft, organic single crystals of similar length were aligned parallel to each other and affixed by gluing one of their ends to a base. Another set of crystals of same size were then interlaced similar to warp, producing an entangled structure to that of a plain weave. The glue was then removed from the weft of the porous structure by treatment with boiling water. The weave density was increased and the net was tightened by pushing the warp and weft crystals (which are insoluble in water) closer to each other. The interlaced structure was finally fixed by gluing the intersections of outermost warp and weft crystals to prevent unravelling. Fig 2 shows the woven fabric interlacement of crystals into plain weave.

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IV. BENEFITS OF ORGANIC CRYSTAL FABRIC

The development of woven fabric using organic crystal can brought many benefits in below fields and cope with unexpected

- Fabrics which can maintain body temperature
- Manufacture of spacesuits for astronauts
- Mining workers apron
- Fireman suits
- Medical applications etc…

V. CONCLUSION

In future, the woven fabrics manufactured by organic crystals can be used directly without embedding in textile sensors. In this article tried to give idea of a new concept, preparation of fabrics by weaving organic crystals into patches. Organic crystals can weave into basic weave structures. Given an idea about feasibility of organic crystals for future use. The new concept of using crystals as the basis for a woven fabric can result in exciting range of opportunities and untold number of technological applications.

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