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Smart' Textile Materials: A Paradigm Shift

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At the twirl of the 21st century, scientists have witnessed a remarkable march in the field of innovation and technology. One of such innovative strategy is the development of 'smart' fabrics which is a consequence of constant prospecting for methods of improving textile quality for specialized purposes like cosmetics, pharmaceutical, biomedical, sportswear, military and other protective uses. 'Smart' fabrics are the amalgamation of conventional textile materials and polymer hydrogels imparting advanced properties [1]. Such properties are conferred by 'smart' functional finishing technology that provides a wide spectrum of rich value-added product choices. This technology is based on grafting of a thin layer of Surface Modifying Systems (SMS) in the form of stimuli responsive gels/ Environment Responsive Polymers (ERP) onto the surface of conventional textile materials like cotton or cellulose.

The term 'smart' here refers to the textile materials or products that can discern and deduce changes in their surroundings, and respond appropriately. The functional activity of these materials is therefore, a significant facet. 'Smart' textiles act as both sensors and actuators and thus stand differently from the other existing multifunctional textiles that behave as mere "passive" materials with enhanced properties. As a result, novel improved fabrics can be created that not only possess the original fabric properties (e.g. mechanical strength, flexibility, etc.) but also advanced functionalities and/or environmental responsiveness implemented by manipulating the surface of the textile material.

Polymer hydrogels [2] possess unique property of volume transitions (i.e. swelling and shrinkage) which can be stimulated by external stimuli such as pH, temperature, solvent, electric field, light, stress, ionic strength, other external chemical stimuli, etc. Moreover, this phenomenon is reversible and has thus, provoked scientists to explore the potential of such gels as actuators and sensors in the textile industry. In designing 'smart' textile materials, the applications of biopolymer-based hydrogels have received special interest. In addition to biopolymers like chitosan [3], synthetic polymers are also used as components to produce effective 'smart' hydrogels. Moreover, copolymerization of two different polymers has also proven significantly successful tool for grafting of 'smart' textiles. The following is a glance at the major prospects of these 'smart' textiles.

- **Deodorant fabrics:** These fabrics are capable of releasing deodorant agents at specific temperatures. Thus they are used in aroma finishing of fabrics. The fragrance moieties are included in the β-Cyclodextrin and are capable of releasing it in a sustainable fashion by changing the external temperature or pH [4].
- **Drug/nutrient delivery fabrics:** These fabrics are applied for temperature dependent delivery of drugs/nutrients like vitamins, chinese herbs and other therapeutic medicines. The property of swelling and shrinkage of polymer hydrogels enables a drug or nutrient loaded in the hydrogels to be released in a controlled manner.
- **Shape memory fabrics:** These are fabrics coated with shape memory polymers like polyurethane that aid in the shape recovery process of the coated fabric. Water/solvent responsive shape memory fabrics harbor shape recovery of deformed fabrics by the plasticizing effect of water molecules.
- **Breathable fabrics:** These fabrics depict a glass transition at around human body temperature. When the body temperature is above the glass transition temperature, the free volume of the film increases and enables the transfer of heat and vapor through perspiration to the environment and thereby provides with a for a contented feeling to the person wearing such a fabric.
- **Thermochromic textiles:** These textiles display change in color with the change in the external temperature [5]. This is imparted by the use of thermochromic materials like cholesterins. Temperature change causes variations of the light selective reflection of the cholesterins and thereby the thermochromic effect.
- **Photochromic textiles:** Upon irradiation with light, the covalent bond between the carbon and oxygen of photochromic compound on the fabric breaks and gives rise to ionic pairs. The molecule thus produced, absorbs photons of visible light, and is colorful.
- **Skin care fabrics** are grafted from stimuli-responsive hydrogel treated textiles to impart moisturizing, whitening, brightening, and even anti-ageing effects on human skins [6,7].

With this modest information about 'smart' textiles, we should be pleased with the fact that these fabrics in near future will provide us with considerable convenience (help us stay warm during winters or cool during summers); support (protect us against infections) and gratification in our routine life style. This "smart" functional finishing technology should be therefore, greatly welcomed as it allows the producers to use their conventional textile materials and still achieve added-value for the same fabrics that will attract the potential consumer markets for sure.

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