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Developing a conductive textile rayon fiber

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Electrically conductive textile fibers are the key component of electronic textiles, and is used in a wide range of fields such as military, sports, medical and entertainment fields. However, the conventional textile fibers are intrinsically insulators. Hence, conventional textile fibers should be integrated with conductive substances to make them conductive. In this research, the regenerated cellulose fibers (RF) were synthesized, and prepared typical RFs were transformed into conductive RF by dip coating with poly (3,4-ethylenedioxythiophene): poly (styrene sulfonate) (PEDOT: PSS) polymer. The electrical conductivity of PEDOT: PSS coated RFs were enhanced by multiple coating with PEDOT: PSS and post treatment with polar solvents such as ethylene glycol (EG), glycerol and 1M H_2SO_4. The electrical resistance of treated RFs was measured using two-point probe method along the fiber maintaining a distance of 1 cm between the probes. Furthermore, chemical and physical characteristic of the resultant RFs were investigated. The electrical resistance of the bare fibers was reduced from mega-ohm range (23.5 ± 0.71 MΩ) to kilo-ohm range (30.5 ± 0.54 kΩ) after treating with PEDOT: PSS polymer. The resistance of coated RF was reduced with increased density of polymer layers, where the five-time PEDOT: PSS coated fiber [PEDOT (5×)] showed an average resistance of 1.73 ± 0.07 kΩ. The one-time PEDOT: PSS coated fiber [PEDOT (1×)] after EG treatment showed very low resistance (1.38 ± 0.10 kΩ) compared to other post treatment solvents because EG causes conformational changes of the PEDOT: PSS structure. According to the SEM analysis, the PEDOT (5×) fiber has a dense network of polymer on the fiber surface while [PEDOT (1×)] EG post treated fiber has smooth dispersion of polymer on fiber surface. [PEDOT (1×)] EG post treated RF has high breaking load (0.2 N) than PEDOT (5×) RF (0.02 N). Both the RFs have a similar washing stability with tetrachloroethelene solvent. Furthermore, [PEDOT (1×)] EG post treated RF exhibited reasonably good stability when washed with aqueous detergent. It was observed that the [PEDOT (1×)] EG post treated fiber has better conductance, mechanical strength, and washing stability than other studied fibers. Hence, it can be investigated further in the development of conductive textiles.

Keywords: Electronic textile, rayon fiber (RF), PEDOT: PSS, ethylene glycol (EG), resistance

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