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Synthesis and characterization of textile compatible solid state secondary battery and connector

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Advancement in textile wearable technologies [1] requires textile integrated flexible energy storage [2] system to meet power requirements without affecting the comfort of its user. In this work, an attempt has been made to develop solid state rechargeable batteries for textile application. For this polymeric slurry of battery material has been synthesized. This slurry can be applied either by dipping, spraying or simply by painting by hand on textile fabrics or other substrates. Current collector layer consists of copper coated carbon fibers (Cu-CFs) as shown in figure 1, carbon black and poly-ethylene oxide (PEO) provide better conductivity and mechanical stability. Lithium iron phosphate ($LiFePO_4$) as cathode material and titanium dioxide (TiO_2) as anode material along with of PEO. Li salt and PEO were used for separator membrane, chopped glass fiber (GFs) were mixed to enhance the mechanical strength of layer. Parameter are adjusted and tuned to get best combination of flexibility and electrochemical characteristics for textile applications as shown in figure 2.

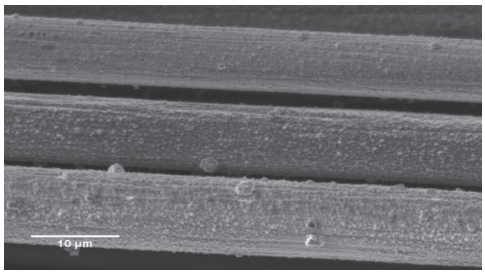

Figure 1: SEM image of copper coated carbon fibers

Secondly, Composite connectors was developed to connect two or more these batteries in various connection modes. These connectors should possess high mechanical strength for firm gripping or joining of batteries, superior chemical bonding characteristics for thermoplastic adhesion and electrical conductivity which forms the perquisites for these connectors to meet voltage and power requirements of e-textile. Carbon black (CB) and copper coated carbon fibers (Cu-CF); possessing electrical conductivity, along with mixture of polyethylene oxide (PEO) and a conducting polymer matrix are dispersed in methanol forming a fluid dispersion. Composites are fabricated by evaporating solvent from fluid dispersion. Carbon black content is varied from 10% to 50% and their effects on electrical and mechanical properties of composite were studied along with the I-V characteristics of the composite.

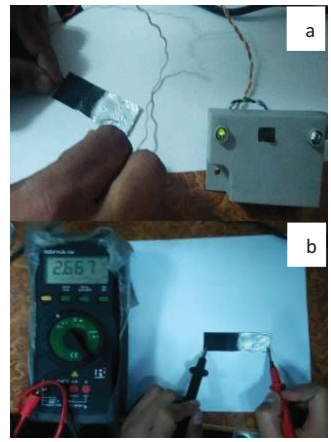

Figure 2: (a) Lighting a LED bulb (b) Battery showing 2.6V

Finally, the performance of this battery and connector is studied in term of voltage output, charge- discharge performance under mechanical loading conditions.

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