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Fabrication of F-CNT/ PEDOT: PSS Composite Coated Flexible Counter Electrode for DSSCs

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Abstract : Flexible dye sensitized solar cells have emerged as the promising technology for wearable electronics and energy storage due to their flexibility, lightweight and facile fabrication. However, the expensive platinum (Pt) has limited the practical applications and roll to roll processing of dye sensitized solar cells (DSSCs). Printable carbon-based photovoltaics have attracted great attention due to their potential for large-scale applications for powering wearable electronic devices. It is challenging to incorporate various characteristics together such as mechanical stability, solution printability, conductivity, electrocatalytic activity, and heat-generating properties in the flexible fabric-based electrode system. Thus this research study is focused on the design and synthesis of a flexible and mechanically stable counter electrode based on printable carbon composite using functionalized multi walled carbon nanotubes and Poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS) conducting polymer. The composite exhibits superior electrocatalytic activity, excellent conductivity, high surface area and good durability thus surpassing the conventional Pt electrodes. The acid functionalized multiwalled carbon nanotubes (F-CNT) exhibited larger surface area thus promoting the greater absorption of electrolyte. Different compositions of carbon composites were synthesized by varying the concentration of conducting polymer. The uniform deposition of carbon composite onto cotton fabrics using an optimized doctor blade technique resulted in crack free and durable coating. Our proposed material printed on woven cotton fabric exhibited remarkable conductivity of 2–5 Ω and lower charge transfer resistance RCT = 2.69 Ω. These flexible and conductive electrodes are durable and can withstand repetitive bending and flexing cycles. The proposed research paves the way for solution printable high-conductivity, lightness, and flexibility high-electrocatalytic activity performance on woven fabric for wearable electronics.

Keywords : MWCNTS, DSSCs, wearable electronics, carbon composite, PEDOT:PSS
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