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Efficient carbon nanotubes counter electrode for dye-sensitized solar cell

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Dye-sensitized solar cells (DSCs) have been vital on research due to their low-cost, easy fabrication methods and high performances. The DSCs consist of three main parts namely, working electrode (WE), triiodide redox shuttle and counter electrode (CE). Cost of dye-sensitized solar cells depends mainly on the CE material. The best catalyst for triiodide reduction at the CE is platinum (Pt), which is highly expensive as well as not totally resistive to the corrosion. Among various non-platinum counter electrode catalysts, carbon-based materials stand out to be the best alternative as far as cost is concerned. Carbon nanotubes (CNTs) have been considered as promising alternative material to Pt counter electrode due to their high electronic conductivity, good electrochemical activity and comparatively low cost. A simple procedure is used for preparing CNT-based CE by spray pyrolysis technique. The CNT CE was made using single-wall CNTs, poly(vinyl acetate) (PVA) as binder and Triton X-100 as a surfactant. Scanning electron microscope image was taken to surface morphology of the CNT CE. The prepared CNT CE-based DSC had good adherence between the catalytic material particles and CNT particles to the conducting glass surface which ensured a good Ohmic contact. We prepared TiO_2 WE by spray pyrolysis deposition using titanium tetraisopropoxide, acetic acid, ethanol and Triton X-100. The prepared WE was immersed in a N719 dye solution overnight. The space between the WE and CE was filled with a liquid electrolyte (I^-/I_3^-) and solar cell performance was measured. Electrochemical impedance spectroscopy (EIS) was used to evaluate the charge transfer resistance at the interfaces of solar cells. Under simulated sunlight (AM 1.5 at 100 mW cm^{-2}), CNT CE-based DSC showed power conversion efficiency of 7.1% which is comparable to 9.4% of Pt CE based solar cell.

Keywords: *carbon nanotubes, counter electrode, dye-sensitized solar cell, working electrode*