In-situ electrochemically deposited polypyrrole nanoparticles incorporated reduced graphene oxide as an efficient counter electrode for platinum-free dye-sensitized solar cells

ABSTRACT

This paper reports a rapid and in-situ electrochemical polymerization method for the fabrication of polypyrrole nanoparticles incorporated reduced graphene oxide (rGO@PPy) nanocomposites on a ITO conducting glass and its application as a counter electrode for platinum-free dye-sensitized solar cell (DSSC). The scanning electron microscopic images show the uniform distribution of PPy nanoparticles with diameter ranges between 20 and 30 nm on the rGO sheets. The electrochemical studies reveal that the rGO@PPy has smaller charge transfer resistance and similar electrocatalytic activity as that of the standard Pt counter electrode for the I_3^-/I^- redox reaction. The overall solar to electrical energy conversion efficiency of the DSSC with the rGO@PPy counter electrode is 2.21%, which is merely equal to the efficiency of DSSC with sputtered Pt counter electrode (2.19%). The excellent photovoltaic performance, rapid and simple fabrication method and low-cost of the rGO@PPy can be potentially exploited as a alternative counter electrode to the expensive Pt in DSSCs.

Keyword: In-situ electrochemical polymerization method; Polypyrrole nanoparticles incorporated; Platinum-free dye-sensitized solar cells