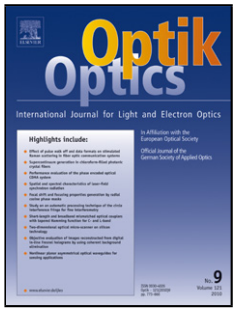

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Improving the Photovoltaic Performance of DSSCs Using a Combination of Mixed-phase TiO_2 Nanostructure Photoanode and Agglomerated Free Reduced Graphene Oxide Counter Electrode Assisted with Hyperbranched Surfactant

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Abstract

The role of hyperbranched surfactant, namely, sodium 1,4-bis (neopentyloxy)-3-(neopentyloxycarbonyl)-1,4-dioxobutane-2-sulphonate (TC14), in the synthesis and stabilisation of reduced graphene oxide (rGO) as counter electrode (CE) thin film was investigated for dye-sensitised solar cell (DSSCs) application. The energy conversion efficiency (η) of CE-based rGO from TC14 (TC14-rGO) was 0.0266%, with a short current density, open circuit voltage and fill factor of 0.222 mA/cm^2, 0.697 V and 14.15, respectively. The efficiency of the surfactant was two times higher than that of CE-based rGO from single-tail sodium dodecyl sulphate surfactant. Graphene oxide (GO) was initially synthesised by electrochemical exfoliation method. Hydrazine hydrate was subsequently used in the production of rGO through chemical reduction process. Spraying deposition method was used to transfer GO and rGO solutions and fabricate GO and rGO CE thin films. A novel combination of hydrothermal growth and squeegee method in the synthesis and production of mixed-phase titanium dioxide (TiO_2) nanostructures as photoanode was selected due to its simple and low-cost method. Rutile TiO_2 nanorods and anatase TiO_2 nanoparticles are essential in electron transfer process and dye adsorption, respectively. Therefore, these combinations resulted in improved photocatalytic activity and η of dye-sensitised solar cells when TC14-rGO was used.

Keywords: Reduced graphene oxide; Hyperbranched surfactant; Mixed-phase TiO_2 nanostructures; Efficiency; DSSCs

Introduction

The dependency on coal, oil and gas for electricity can be reduced by utilising solar energy, including the fabrication of dye-sensitised solar cells (DSSCs). DSSCs become a remarkable and promising subject