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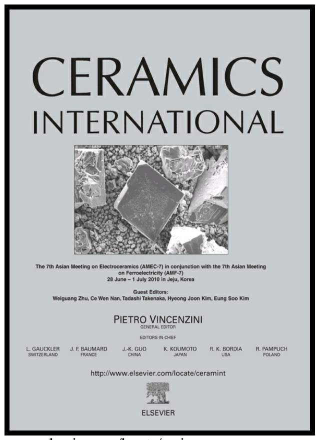

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Abstract

Titanium (Ti) ion implantation approach was used in the present study to modify the reduced graphene oxide nanosheet (rGO NS) by incorporating the Ti^{4+} ion (at various applied powers ranging from 50 to 250W) onto the rGO NS to prepare photoanodes for Dye-Sensitized Solar Cell (DSSC). The surface morphologies, functional groups, optical properties and surface chemical states of the modified rGO based photoanode (rGO-TiO_2 nanocomposite (NC)) were studied. Fourier transform infrared (FTIR) spectra coupled with the elemental/chemical states in X-ray photoelectron spectroscopy (XPS) analysis revealed the presence of Ti-O-C functional groups after the modification process. Besides, the average size of Ti ion was found to be 70-80 nm as incorporated with rGO NS. The spacing of anatase TiO_2 onto rGO NS were reported as 0.35 nm and 0.34 nm under HRTEM analysis, respectively. Experimental result implied that 150W was the optimum applied power for the surface modification to take place ascribed to the lowest possibility for the recombination to occur and the smallest energy band gap. On top of that, at 150W, the electron transfer rate was also found to be the highest due to the highest availability of the carbon-atom vacancy holes for Ti^{4+} replacement. It was also discovered that the optimized power conversion efficiency (PCE) of 8.51% could be achieved in DSSC by implanting the Ti ion onto rGO NS-based photoanode using 150W. Further increase of the applied power to 200W or 250W led to the undesirable recombination of the Ti ions and rGO NS due to the exceptional photocatalytic activity among N719 dye/rGO/TiO_2 interfaces which interfered the charge transportation at the KI electrolyte/N719 dye/rGO/TiO_2 interfaces.

Keywords: Ti Ion Implantation, rGO nanosheet, rGO-TiO_2 nanocomposite, Dye-sensitized solar cell

1. Introduction

Recently, strong interest has been aroused in the third generation of photovoltaic solar cell technology, particularly the DSSC devices, attributed to their rational energy conversion efficiency, flexibility, low production cost and ease fabrication process as compared to that of the silicon-based solar cells [1, 2]. Accordingly, DSSC attained the highest power conversion efficiency of 13% via the molecular engineering of porphyrin sensitizers in the year of 2014 [3]. Specifically, DSSC has a sandwich configuration consisting of three main elements, i.e.,