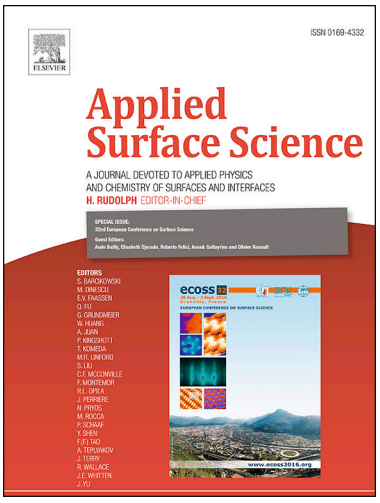

Full Length Article

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Cr-doped TiO_2 nanotubes with a double-layer model: An effective way to improve the efficiency of dye-sensitized solar cells

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Abstract

Dye-sensitized solar cells (DSSCs) have been emerging as a potential alternative to photovoltaic devices, which convert incident light into electric energy. However, the power conversion efficiency of DSSCs is currently too low for them to be used in commercial applications. Hence, further improvements in efficiency are necessary. Here, we have designed a DSSC with a double-layer structure, in which the top layer consists of a mixture of TiO_2-P25 and Cr-doped TiO_2 nanotubes (Cr-TNTs). Based on analyses using photoluminescence spectroscopy, X-ray photoelectron spectroscopy, and electrochemical impedance spectroscopy, we have demonstrated the effect of Cr-TNTs on the separation of photogenerated electron-hole pairs. A photoconversion efficiency (η) of 11.05% was obtained by using the Cr-doped TiO_2 material as compared to 9.05% for the un-doped TiO_2 nanotubes.

Key words: Microwave hydrothermal, Cr-doped TiO_2 nanotube, Dye-sensitized solar cell (DSSC), double layer, efficiency

1. Introduction

The dye-sensitized solar cell (DSSC), which converts the energy of photons from sunlight into electrical energy, has attracted major interest in the field of renewable energy [1]. The structure of a DSSC is shown in Figure 1, and its working principle is based on the photoelectric effect [2,3]. A typical TiO_2-based DSSC is composed of a