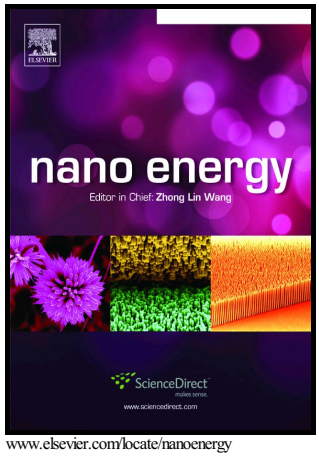

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Impacts of surface or interface chemistry of ZnSe passivation layer on the performance of CdS/CdSe quantum dot sensitized solar cells

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Abstract

ZnSe deposited via successive ionic layer adsorption and reaction (SILAR) method onto TiO_2/CdS/CdSe photoanode has been proven as an effective passivation layer to suppressing charge recombination and enhancing power conversion efficiency in quantum dot-sensitized solar cells (QDSCs). However, the device performance varies appreciably with the deposition process as the chemical identity and the interfacial structure between the passivation layer and the quantum dots and electrolytes have retained quite some unanswered questions. The present paper reports the significant impacts of ZnSe passivation layer with different surface or interface chemistry on the performance of CdS/CdSe QDSCs. The photovoltaic properties show that the performance of assembled cells has a strong dependence on the SILAR immersion sequences started with Zn^{2+} or Se^{2-}. When Zn^{2+} was initially deposited, the unintentionally formed QDs/ZnSe/Se/SeO_2 structure with a large amount of ZnSe leads to a significant increase in the photovoltaic properties. When Se^{2-} was first deposited, most of the Se^{2-} absorbed on the surface of the photoanode would be oxidized to form Se^0 and SeO_2, with a small fraction of ZnSe formed. The resulted QDs/Se/SeO_2/ZnSe structure leads to a drastic decrease of the solar cell performance.

Keywords: Quantum dot sensitized solar cell; ZnSe passivation layer; SILAR immersion sequence; Surface or interface chemistry; Charge recombination

Introduction

Excitonic solar cells have gained much attention, due to low materials cost, simple solution fabrication process with low energy consumption, and relatively high solar energy to electricity conversion efficiency.[1-3] Among various excitonic solar cells, dye sensitized solar cells (DSCs)