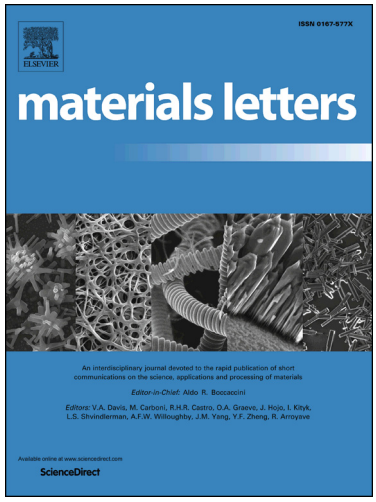

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An efficient and low-cost photoanode for backside illuminated dye-sensitized solar cell using 3D porous alumina

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Abstract:

This paper presents a new strategy for developing back-side illuminated dye-sensitized solar cells (DSSCs) using nanoporous alumina substrate containing Cu impurities. The presence of a traces of Cu in the aluminum leads to the formation of 3D nanoporous anodic aluminum oxide (AAO) structure which consisted of an array of cylindrical pores interconnected by horizontal holes. Under different anodizing conditions, four different AAO substrates were fabricated and applied for developing DSSCs. The current-voltage characteristics of the DSSCs were measured and compared. Results obtained indicated that the performance (photocurrent density, open-circuit photovoltage and efficiency) of DSSCs based on 3D AAO was significantly enhanced compared to those of FTO/TiO_2. The efficiencies of DSSCs based on alumina P90A, P90B and OX60 were improved by 172%, 51%, and 274%, respectively. The enhancement in photocurrent and efficiency is attributed to the reduction in the carrier recombination, uniform distribution of the dye molecules inside the vertical tubes, horizontal interconnections of pores as well as a reduction in pore size. This indicates that AAO based DSSCs can contribute significantly to energy harvesting from the sun.

Keywords: Dye-sensitized solar cells; Anodic aluminum oxide; Backside illuminated solar cells; Solar energy materials

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1. Introduction

Dye-sensitized solar cells (DSSCs) have attracted considerable attention in recent years due to their low-cost conversion of photovoltaic energy, high photon-to-conversion efficiency, ease of fabrication and the ability to improve the DSSCs efficiency by developing their components [1-4]. DSSCs have four basic components: *(a)* dye sensitizer to harvest solar energy and generate excitons, *(b)* nanostructure metal oxide material to transport electrons