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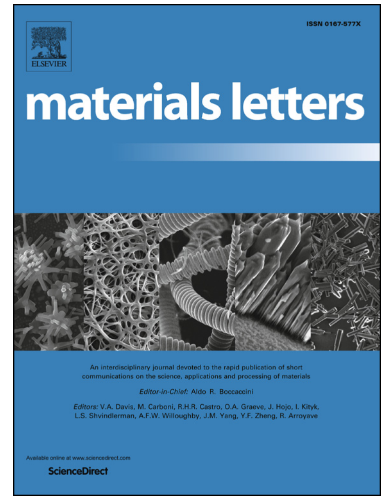

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Fabrication of planar heterojunction oxide solar cells by radio frequency magnetron sputtering

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Abstract:

In this study, planar heterojunction oxide solar cells (PHOSC) in both (p-i-n) and (n-i-p) configurations are fabricated using the radio frequency (RF) magnetron sputtered tin oxide (SnO_2), copper (II) oxide (CuO) and nickel oxide (NiO) as n-type, absorber and p-type layers, respectively. XRD analysis confirmed the formation of tetragonal SnO_2, monoclinic CuO, and cubic NiO phases. The cross-sectional SEM analysis showed the columnar growth for the sputtered metal oxide layers and XPS analysis revealed the valence states of metal oxides. Optical bandgap of n-type, absorber and p-type layers were found to be 3.7, 1.2 and 3.5 eV, respectively which leads to a staircase arrangement in the energy level alignment. The fabricated device with 600 nm thickness shows power conversion efficiency (PCE) (η) of 2.3 % with enhanced open-circuit voltage (V_{oc}) = 0.75 V, short-circuit current density (J_{sc}) = 5.73 mA/cm^2 and fill factor (FF) of about 54 % for (n-i-p) configuration. Similarly for (p-i-n) configuration, (η) of 0.4 % is achieved with decreased J_{sc}. This new strategy paves the way for easier, stable and large scale fabrication of planar oxide solar cells.

Key words: Oxide solar cells, magnetron sputtering, power conversion efficiency.

1. Introduction

Design and fabrication of photovoltaic devices based on semiconducting metal oxide thin films has a tremendous impact on harvesting energy from natural resources due to the enhanced stability, non-toxic and efficient charge transport properties[1]. TiO_2, ZnO, SnO_2 are being utilized as n-type layer whilst the metal oxides such as NiO, Cu_2O, CuO and p-Si are used as p-type layer in heterojunction devices[2,3]. Although the oxides of copper exist in different forms, Cu_2O is one of the first investigated