Opto-capacitive study of n-ZnO/p-Si heterojunctions elaborated by reactive sputtering method: Solar cell applications

L. Chabane, N. Zebbar, M. Trari, M. Kechouane

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Opto-capacitive study of n-ZnO/p-Si heterojunctions elaborated by reactive sputteringmethod : solar cell applications

L. Chabane[a1], N. Zebbar[a2], M. Trari[b] ,M. Kechouane[a]

(a) Department of Materials & Compounds, Faculty of Physics, USTHB, BP 32, 16111 Algiers, Algeria

(b) Laboratory of Storage and Valorization of Renewable Energies, Faculty of Chemistry, (USTHB), BP 32 16111 Algiers, Algeria

Abstract

Thin films of ZnO were deposited on glass and p-Si substrates by DC reactive sputtering, at different deposition times. The physical properties of the films were investigated by X-ray diffraction, UV-visible transmittance and four-probe measurements. The results show the improvement of the crystallinity, the transparency and the conductivity of films with increasing the thickness. The dark current-voltage, the capacitance-voltage and the spectral response characteristics of n-ZnO/p-Si heterojunctions revealed that the potential barrier profile and the interface state change strongly with the film thickness, which leads to an important difference in the carriers transport phenomena. The good rectifyingbehaviors were obtained for the thinner ZnO films (16 -50 nm). Under illumination, the hetero-junctions with thinner films show a good photosensitivity in the visible range wavelength (~ 425 nm). While, the heterojunctions with thick ZnO films exhibit a good photosensitivity in the visible and NIR regions (~ 1100 nm). The least thick ZnO film (16 nm) shows a photovoltaic behaviour with a short circuit current density (Jsc) of ~ 1 mA/cm^2 and an open voltage (V_{oc}) of ~ 0.4 V.

Highlights

- ZnO thin films and ZnO/Si hetero-junctions were deposited.
- The hetero-junctions with thinner films showed a good rectifying behaviour.
- The carriers transport mechanism is controlled by both the interface and volume defects.
- The hetero-junction with the smallest ZnO film thickness exhibit a photovoltaic behaviour.

Keywords: ZnO thin film, heterojunction, reactive DC sputtering, spectral response, solar cell.

1. Introduction

ZnO is one of the most important n-type semiconductor materials, with a wide direct band gap (3.37 eV) and a

Corresponding author : [1]lamia007ch@hotmail.com (L. Chabane)
[2]nacbar2003@yahoo.fr (Dr. N. Zebbar)
Tel. +213 21 24 79 55 ; Fax. +213 21 24 80 08