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Photovoltaic property of ZnO:Al/n-ZnO/p-Si structures fabricated by pulsed laser deposition

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ZnO material has been extensively utilized in semiconductor device technology due to the its unique electrical and optical properties. ZnO has wide direct band gap (3.37 eV), n-type conductivity, which are a promising as photodiode material. Also, Al-doped ZnO (AZO) thin film is particularly attractive for an electron transporting layer of solar cell because of its high optical transmittance, good thermal stability, high conductivity, and low cost of fabrication.[1] In this study, we fabricated ZnO/p-Si substrate with and without AZO as electron transporting layer by using pulsed laser deposition (PLD) [2,3], and the performance of these devices were analyzed by current density-voltage (J-V) characteristic and spectral responsivity. The ZnO thin films were deposited on p-Si substrates under different oxygen pressure from 40 mTorr to 70 mTorr by using pulsed laser deposition (PLD). In x-ray diffraction analysis, ZnO thin film grown under oxygen pressure of 60 mTorr showed the highest intensity of (002) diffraction peak and highly c-axis oriented. At room temperature, all ZnO thin films grown at different oxygen pressure showed near band edge emissions about 385 nm, and good rectifying behavior under dark condition. The n-ZnO/p-Si device grown at oxygen pressure of 60 mTorr showed better photovoltaic properties. When Al-doped ZnO (AZO) deposited on the surface of n-ZnO/p-Si structure, the power conversion efficiency of the device under Air Mass 1.5 Global solar simulator was much enhanced from 0.61% to 1.5%. By measurement of spectral responsivity, it appeared that the AZO layer as an electron transporting layer affects to the photocurrent enhancement in all solar spectral range.

References

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