



THE EFFECT OF SOLUTION SPRAYING RATE ON THE ELECTRICAL PROPERTIES OF CHEMICALLY SPRAYED ZnO:IN THIN FILMS

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ABSTRACT

We have previously deposited nanostructured (ITO/ZnO_{rod}/In₂S₃/CuInS₂) solar cells [1] where ZnO_{rod}/In₂S₃/CuInS₂ is deposited by low cost chemical spray pyrolysis (CSP) on commercially available but rather expensive indium tin oxide (ITO) electrode. The current approach is to study the feasibility of CSP deposition of ZnO:In for use as a TCO for potential application in all-layers-sprayed solar cell. CSP has a lot of parameters which have effect on the resulting films structural, electrical and optical properties, e.g. growth temperature, precursor salt and its concentration and dopant concentration. In this work we study the effect of solution spraying rate on the electrical properties of ZnO:In films. The films were deposited at 400°C by CSP from zinc acetate solutions containing InCl₃ as dopant source with $[In^{3+}]/[Zn^{2+}] = 3$ at.%. Electrical resistivity, carrier concentration and mobility were determined at temperatures 100-400 K by van der Pauw-Hall measurements. With an increase in spraying rate from 0.5 up to 3 ml/min, the resistivity decreases rapidly (from 60 to 3 mΩcm). The low resistivity is achieved due to the increase in grain sizes and increase in the carrier concentration. Carrier mobility increases from 4.0 to 16 cm²/Vs and carrier concentration increases from 2.2×10^{19} to 1.4×10^{20} cm⁻³ with respect to the increase in spraying rate. We report metal-semiconductor transition (MST) for ZnO:In films. We conclude that solution spraying rate is an important parameter which impacts the electrical properties of ZnO films obtained by CSP.

Keywords: ZnO:In thin film, Spray pyrolysis, electrical properties, metal-semiconductor transition

[1] M. Krunks, E. Kärber, A. Katerski, K. Otto, I. Oja Acik, T. Dedova, A. Mere, (2010), Extremely thin absorber layer solar cells on zinc oxide nanorods by chemical spray, *Solar Energy Materials and Solar Cells* **94**, 1191-95