Sol-gel grown compound ZnO thin films for photovoltaic applications

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Zinc oxide (ZnO) and composite ZnO thin films were deposited on microscope glass by applying the sol–gel spin coating technique, with the purpose to be used as transparent front contacts in thin-film solar cells. Aluminium or indium was incorporated in the ZnO matrix, in order to improve the electrical resistivity of the films. The incorporation of gold or silver nanoparticles aimed at increasing the efficiency of the solar cell.

The resistivity of the films was measured by the four-point van der Pauw method. The film structure was studied by X-ray diffraction (XRD). It was observed that all undoped and doped films, regardless of the impurity element, have a hexagonal wurtzite structure, showing a high degree of orientation along the *c* axis (002 peak), indicating the preferred grain growth along this plane. In addition, topographical and morphological studies of the doped and undoped ZnO films were performed by Atomic Force Microscopy (AFM).

The optical properties of the pure and composite ZnO thin films were investigated. It was shown that the incorporation of aluminium or indium improves the average film transmission. Further, the presence of gold or silver nanoparticles was verified with the aid of their plasmonic resonance on the optical transmittance spectra around 600 and 430 nm, respectively. The band gap for all ZnO thin films was estimated from the optical spectra and the film thickness was obtained by profilometry. In general, all films were of high quality with an average optical transmission over 80%, which decreases sharply at approximately 380 nm due to the band gap absorption of ZnO. The effect of the concentration of the impurity elements on the film properties was investigated.

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