Magnetron Sputtering and Characterization of Doped Zinc Oxide Nanofibrous Films and Their Applications

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Abstract

We report on the role played by different types of dopants, namely, Tin and Aluminum on the properties of zinc oxide nanofibrous films prepared by RF magnetron sputtering on substrates in pure Argon atmosphere. The influence of dopant-type on the properties of nanofibrous films was studied by SEM, EDX, AFM, XRD, micro-Raman, electrical, photocatalytic, ultraviolet photo-detection and hydrogen sensing characterizations. The micro-structural evolution and electrical conductivity of films investigated by the SEM and electrical measurements showed a highly nanofibrous layer type morphology of the film with high resistivity, respectively. Depending on the deposition conditions and type of dopant (Sn or Al), highly fibrous and porous films were achieved at relatively low substrate temperature of ~110 °C. X-ray diffraction and Micro-Raman studies of the ZnO film revealed its hexagonal Wurtzite crystal structure and good crystal quality of the nanomaterial. Possible growth mechanism which ultimately determines the physical properties of nanofibrous layers will be discussed. The doped films deposited by magnetron sputtering yielded ultraviolet photodetection and gas sensing capabilities. Photocatalytic measurements of ZnO nanofibrous films have shown strong degradation of methylene blue proving that these deposited nanofibrous and layered films are of great interest for photocatalysis applications. This doping procedure paves the way for the realization of higher performance devices.