Synthesis and characterization of Ag-doped ZnO thin films

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Abstract

Zinc oxide (ZnO) is an important material with a wide bandgap of 3.4 eV and a relatively large exciton binding energy of 60 meV. It is also characterized by having excellent chemical stability, nontoxicity, and good electrical, optical, and piezoelectric properties. It is used in many practical applications including optoelectronic devices, for example, solar cells, UV sensors, biosensors, and light emitting diodes. For these applications, it is essential to have a thorough understanding of the growth mechanism to achieve the desired morphology of the ZnO nanostructures (NSs) needed. Since the properties of ZnO

NSs strongly depend on its morphology and shape, it is also essential to precisely control their size and surface architecture to utilize its properties in different practical fields. So it is important to find a simple for the synthesis of ZnO NSs and a way to control the growth parameters. In our work, the ZnO NSs were grown by using the sol-gel method. This method showed some advantages such as the use of a simple setup, a low temperature, large area of film deposition, and low cost also it is environment friendly. The synthesis of studied ZnO thin films was carried out using a solution of 0.75 g of Zinc acetate, 30 ml of 2-métoxy ethanol and 0.6 ml of ethanol-amine. The solution was heated at 60°C and stirred for 2 hours. After, the solution was aged for 24 hours. The deposition of ZnO thin films on cleaned glass substrates was carried out using the dip-coating technique. The films were dried at 100°C and annealed at 500°C.

The obtained thin films were characterized by X-ray diffraction, Raman and FT-IR spectroscopy, UV- Visible absorption. The results show good crystallinity and a preferential orientation crystallites along [002] axis of ZnO with wurtzite structure. The Raman and FT-IR confirm the formation ZnO structure. The as prepared thin films show good transparency (over 90%) in the UV-Visible range. when the thin films were doped by the chemical element Ag the transparency decreases and the band edge of absorption was shifted to higher wavelength. The doping with Ag can reduce considerably the transparency of ZnO thin films.

Keywords : Synthesis; thin films; Sol-gel method; XRD; Raman and FT-IR spectroscopy, UV-Visible absorption.