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Al-doped ZnO nanofilms: Synthesis and characterization

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Al-doped and un-doped ZnO nanofilms on quartz substrate were obtained by ultrasonic spray pyrolysis of salt solutions (mole concentration of Al within 0–10%). The films were characterized by Scanning electron microscopy (SEM), X-ray diffraction (XRD), Atomic force microscopy (AFM) and UV spectroscopy to study the morphology and optical properties. The optical studies showed that the increase in Al within ZnO thin layer increases its band gap energy. The obtained value of band gap energy is very close to the determined oscillation energy. However, the dispersion energy is nearly half of band gap energy value.

1 Introduction The versatility of doped and un-doped ZnO has prompted the extensive research of morphology-selective syntheses because its properties strongly depend on the microstructure [1]. ZnO-based heterostructures are of peculiar interest among the semiconducting oxides due to its superior optical and electronic properties and potential numerous applications in nanoscale transistors, sensors, and UV laser diodes [2, 3]. We present here the characteristics of ZnO nanofilms synthesized via a pyrolytic route.

2 Experimental details Synthesis of Al-ion doped ZnO nanofilms was performed on a quartz substrate (10 mm × 45 mm) using Ultrasonic Atomizer and Generator (Sonaer, USA). The reactants used were zinc acetate (Qualigens Fine Chemicals, Division of Glaxo India Ltd., 98.5% purity), aluminum acetate (Sigma, USA, 99.0% purity) and ethanol (Bengal Chemicals and Pharmaceuticals Ltd., India, pure). Spray pyrolysis of zinc acetate ethanol solution (mole concentration of Al-acetate within 0–10%) on heated (500 °C) yielded thin deposits. The substrate temperature was measured by IR thermometer (spectral response 6214 μm). A 5 ml solution was sprayed at constant flow rate of 1 ml per second, keeping the substrate 20 cm away from the atomizer nozzle tip (Fig. 1). The deposits were later characterized using XRD (Bruker D8, Cu K-alpha radiation with a 0.02° step), SEM (LeO 500 microscope), AFM (SPM Nanoscope III, Digital Instruments, Vecco Metrology Group Ltd.), and UV–Vis–NIR (Genesis-10 UV Spectrophotometer, Thermo Scientific, UK) techniques.

3 Results and discussion XRD spectra of deposits are shown in Fig. 2. Regardless the composition of the

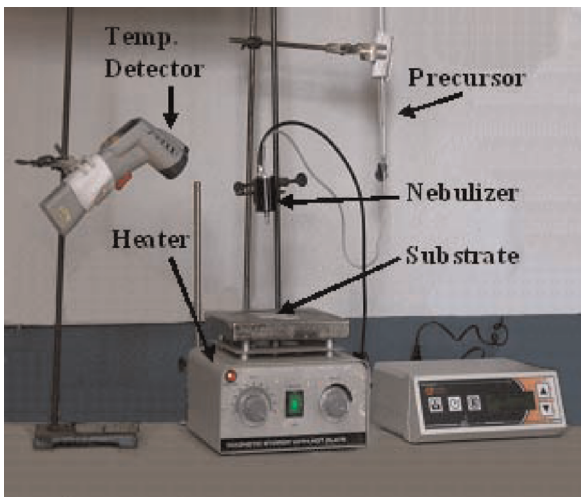

Figure 1 (online color at: www.pss-b.com) Experimental set-up for spray pyrolysis.