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Optical and structural properties of nanostructured ZnO thin films deposited onto FTO/glass substrate by a solution-based technique

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Abstract

Nanostructured zinc oxide thin films were spin coated on conductive glass substrates via a sol–gel based technique using zinc acetate dihydrate as precursor. The pH of the alkalis used as catalytic agents in the hydrolysis step is shown to have a strong effect on the structural and morphological properties of the deposited ZnO. The size of the particles was observed by Transmission Electron Microscopy (TEM), while Focused Ion Beam-Scanning Electron Microscopy (FIB-SEM) and Atomic Force Microscopy (AFM), were used to analyze the morphology of the films. X-ray diffraction (XRD) and Raman spectra provided evidence of crystal growth together with an increase in the crystalline degree of the hexagonal wurtzite structure after annealing. The bandgap energy was estimated by Tauc's method and found to decrease after annealing, which is attributed to an increase in the crystallite size and to the presence of less defect sites. A good correlation between crystallite size and absorption edges was found. The photoluminescence spectra of as-deposited samples depend on the nature and pH values of catalytic agent used, and reveal the presence of a broad visible emission attributed to a variety of intrinsic defects.