Sonicated Sol–Gel Preparation Of Nanoparticulate Zno Thin Films With Various Deposition Speeds: The Highly Preferred *C*-Axis (0 0 2) Orientation Enhances The Final Properties

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ABSTRACT

Zinc oxide (ZnO) thin films have been deposited onto glass substrates at various deposition speeds by a sonicated sol–gel dip-coating technique. This work studies the effects of deposition speed on the crystallisation behaviour and optical and electrical properties of the resulting films. X-ray diffraction (XRD) analysis showed that thin films were preferentially oriented along the (0 0 2) *c*-axis direction of the crystal. The transformation sequence of strain and stress effects in ZnO thin films has also been studied. The films deposited at a low deposition speed exhibited a large compressive stress of 0.78 GPa, which decreased to 0.43 GPa as the deposition speed increased to 40 mm/min. Interestingly, the enhancement in the crystallinity of these films led to a significant reduction in compressive stress. All films exhibited an average transmittance of greater than 90% in the visible region, with absorption edges at ~380 nm. The photoluminescence (PL) measurements indicated that the intensity of the emission peaks varied significantly with deposition speed. The optical band gap energy (E_g) was evaluated as 3.276–3.289 eV, which increased with decreasing compressive stress along the *c*-axis. The energy band gap of the resulting ZnO films was found to be strongly influenced by the preferred *c*-axis (0 0 2) orientation.

KEYWORDS: ZnO; Thin films; Sol–gel processes; X-ray diffraction; Strain

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