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Photoluminescence and Structural Properties of Ti⁴⁺-doped ZnO Thin Films Deposited by Sol–Gel Dip Coating

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Abstract

Tin-doped ZnO (TZO) thin films with various tin concentrations (0, 1, 2, 3, 4, and 5 atomic percent [at. %]) are prepared by the sol-gel dip-coating method. The doping effects of tin on the structural and optical properties of the TZO thin films are investigated. All the samples have a granular structure consisting of small particles and exhibited a preferred *c*-axis orientation. The transmittance and optical band gap of the TZO thin films increase

at relatively low tin concentrations of 1 at. %, whereas they decrease at higher concentrations of 3–5 at. %. The ratio of near-band-edge emission intensity to deep-level emission intensity significantly increases with increasing tin concentrations from 0 to 4 at. %. In addition, low-temperature photoluminescence for undoped and 4 at. % TZO thin films are measured at 12 K to thoroughly analyze the effects of tin doping.

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