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Optical and electrical characterization of defects in zinc oxide thin films grown by atomic layer deposition

Tomasz A. Krajewski, Grzegorz Luka, Lukasz Wachnicki, Rafal Jakiela, Bartłomiej Witkowski, Elzbieta Guzewicz, Marek Godlewski, Nolwenn Huby, Grazia Tallarida

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Keywords

zinc oxide, atomic layer deposition (ALD), electrical properties, photoluminescence

Abstract

In the present paper, we discuss the influence of point defects on electrical and optical characteristics of ZnO thin films grown by the atomic layer deposition (ALD) method. The films were grown on glass substrates at low temperature (100–200 °C). We used diethylzinc (DEZn) and deionized water as precursors. Room temperature photoluminescence (RT PL) spectra, secondary ion mass spectroscopy (SIMS), electron dispersive X-ray (EDX) analysis and Hall effect measurements were made for as-grown ZnO layers and for the annealed ones (in air at 300 and 400 °C as well as in N₂ atmosphere at 400 °C). The air-annealed ZnO films reveal a substantial reduction of a carrier concentration (up to 4 orders of magnitude - from 10¹⁹ to 10¹⁵ cm⁻³) combined with changes in intensity of the defect-related luminescence bands. PL related to deep defects is shifted towards the lower energy range (red light emission) after annealing (in air and nitrogen-rich conditions).



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