Comparative Study on Structural, Optical, and Electrical Properties of ZnO Thin Films Prepared by PLD and Sputtering Techniques

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ZnO thin films were formed on *c*-plane sapphire and *p*-GaN substrates by pulsed laser deposition (PLD) and RF magnetron sputtering techniques. XRD analysis including omega scan depicted the formation of highly textured wurtzite ZnO with *c*-axis. The texture was primarily introduced by the substrate effects as the planes lying at oblique angles also exhibited six-fold symmetry during phi scan. Atomic force microscopy exhibited the surface roughness of 4.33 nm and 12.99 nm for PLD and sputtered ZnO films, respectively. In photoluminescence (PL) measurements, a strong UV emission was observed at 3.30 eV for both ZnO films. However, deep-level emission was observed at around 2.61 eV in PLD film, but it had a wide range from 2.61 to 2.29 eV in case of sputter-deposited film. From the transmission spectra, the optical band gap values were found to be 3.29 and 3.28 eV for PLD and sputtered ZnO films, respectively. Hall measurement revealed the resistivity values of 0.0792 and $0.4832\,\Omega\cdot$cm and carrier concentrations of $2.28\cdot10^{18}$ and $1.73\cdot10^{18}\,\mathrm{cm}^{-3}$ for respective PLD and sputtered films. $I(V)$ current–voltage curves clearly demonstrated the *n*-ZnO/*p*-GaN hetero-junction with turn-on voltage of 3.8 and 5.2 V for PLD and sputtered samples, respectively.

Keywords: zinc oxide, RF magnetron sputtering, pulsed laser deposition, photoluminescence, hetero-junction.

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