

Improved Optoelectronic Characteristics of Post-Annealed Ti/Al/ITO Transparent Conducting Electrodes Deposited on n-GaN

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We report on the improved structural, electrical and optical properties of the Ti/Al/ITO transparent conducting electrodes (TCEs) deposited on n-GaN. The TCEs were deposited by RF/DC magnetron sputtering under Ar ambient at room temperature. The as-deposited TCEs were annealed at 600 °C in N₂ ambient for 15 min. The structural, electrical and optical properties of the TCEs were characterized by 2-Theta X-ray diffraction (XRD), atomic force microscope (AFM), Hall effects, I-V and UV-visible measurement system. From XRD measurement, significant ITO (222) and (411) peaks were observed after the sample was post-annealed at 600 °C. Morphological analysis by AFM shows that surface roughness R_q of the post-annealed sample is smoother as compared to the as-deposited sample. The electrical resistivity of the TCEs layer decreases to $8.607 \times 10^{-5} \Omega\text{-cm}$ after the post-annealing process. Further analysis on the I-V characteristics reveals that the post-annealed samples have better Ohmic behavior than the as-deposited sample. The post-annealed sample shows high optical transmittance characteristics in visible spectrum of ~95%. The figure of merit (FOM) of the as deposited and post-annealed samples are $2.39 \times 10^{-4} \Omega^{-1}$ and $5.91 \times 10^{-2} \Omega^{-1}$, respectively. Therefore, the post-annealed TCEs show the best electrical and optical quality due to the improved structural and morphological characteristics.