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UV Photodetector based on Mg-doped GaN Thin Films Prepared by Sol-gel Spin Coating

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In this work, sol-gel spin coated 2 % of magnesium (Mg) doped gallium nitride (GaN) thin films grown on AlN sapphire substrate was reported. The structural, lattice vibrational, and electrical properties of the deposited films were investigated and compared. X-ray diffraction results show that the hexagonal wurtzite structure with preferred orientation of GaN(002). The Raman active phonon modes of the wurtzite GaN correspond to the E_2(high) and A_1(LO) at 568 cm^{-1} and 733 cm^{-1} phonon modes of the hexagonal GaN were observed, while a broad peak attributed to the Mg-related lattice vibrational mode was detected at 669 cm^{-1}. Hall effects results show that the resistivity of 0.1397 Ω cm for the Mg-doped GaN. The carrier concentration and hall mobility of 1.77 × 10^{18} cm^3 and 6.04 cm^2/Vs were obtained. Besides, the characteristics of dark and photocurrent of the ultraviolet (UV) detector and the UV photoresponse of the detector were investigated. The measurements were conducted under dark and UV illuminations. The current-voltage (I-V) characteristics of the Mg doped GaN-based UV photodetector exhibits the Schottky behaviour. Lastly, the ideality factor and Schottky barrier heights were calculated using thermionic emission theory.

Keywords: Gallium nitride, magnesium, sapphire, silicon, spin coating.