High Sensitivity of Porous Si-Doped GaN MSM Photodetector using Thermally Untreated Platinum Contact

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In this work, we report the formation of porous Si-doped GaN films under a novel alternating current (sine-wave a.c. (50 Hz)) photo-assisted electrochemical (ACPEC) etching conditions. The ACPEC formed porous GaN with excellent structural and surface morphology. Field emission scanning electron microscope (FESEM), atomic force microscopy (AFM), photoluminescence (PL), Raman spectra and high resolution X-ray diffraction (HR-XRD) phi-scan and rocking curves measurements evidenced important features of the pore morphology, nanostructures and optical properties. According to the FESEM micrographs, the GaN thin films exhibit a homogeneous nanoporous structures with spatial nano-flakes arrangement. The AFM measurements revealed an increase in the surface roughness induced by porosification. The porous layer exhibited a substantial PL intensity enhancement with red-shifted band-edge PL peaks associated with the relaxation of compressive stress. The shift of E_2(high) to the lower frequency in Raman spectra of the porous GaN films further confirms such a stress relaxation. X-ray diffraction phi-scan showed that porous GaN sample maintained the epitaxial features. Thermally untreated platinum (Pt) finger contact was deposited on the porous GaN to form MSM photodetector. The current-voltage (I-V) measurements indicated that the devices were highly sensitive to ambient light. The photocurrent rise and decay times were investigated under 365 nm chopped light and at bias voltages of 1, 3 and 5 V.