ANALYSIS OF GaN/$Al_xGa_{1-x}N$ HETEROJUNCTION DUAL-BAND PHOTODETECTORS USING CAPACITANCE PROFILING TECHNIQUES

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ABSTRACT

Capacitance-voltage-frequency measurements on n^+-GaN/$Al_xGa_{1-x}N$ UV/IR dual-band detectors are reported. The presence of shallow Si-donor, deep Si-donor, and C-donor/N-vacancy defect states were found to significantly alter the electrical characteristics of the detectors. The barrier Al fraction was found to change the position of the interface defect states relative to the Fermi level. The sample with an Al fraction of 0.1 shows a distinct capacitance-step and capacitance hysteresis, which is attributed to C-donor/N-vacancy electron trap states located above the Fermi level (200 meV) at the heterointerface; whereas, the sample with an Al fraction of 0.026 shows negative capacitance and dispersion, indicating C-donor/N-vacancy and deep Si-donor defect states located below the Fermi level (88 meV). When an i-GaN buffer layer was added to the structure, an anomalous high-frequency capacitance peak was observed and attributed to resonance scattering due to the hybridization of localized Si-donor states in the band gap with conduction band states at the i-GaN/n^+-GaN interface.

INDEX WORDS: Infrared detectors, Dual-band, Ultraviolet detectors, III-V material, GaN, AlGaN, Heterojunction, Workfunction, Photoemission, Impurity states, Capacitance, Negative capacitance, Capacitance hysteresis