Thermal electron capture rate by Fe acceptor in GaN

J. DASHDORJ, M.E. ZVANUT, University of Alabama at Birmingham, T. PASKOVA, K. UDWARY, Kyma Technologies, Inc. — Doping GaN with Fe compensates the main residual impurities such as O and Si to produce semi-insulating substrates. Electron paramagnetic resonance measurements were made on GaN grown by hydride vapor phase epitaxy and doped with $1.5 \times 10^{17}$ to $1.6 \times 10^{18} \text{ cm}^{-3}$ Fe. The Fe$^{3+}$ spectra, angular dependence, and concentrations are consistent with literature and secondary ion mass spectroscopy data. During illumination with photon energies greater than 1.2 eV, the Fe$^{3+}$ signal increased in the lowest doped sample, but decreased in the more highly doped samples. One possible interpretation of the results is that the Fe$^{2+}$/$^{3+}$ and Fe$^{3+}$/$^{4+}$ levels are about 1.2 eV below the conduction band. Due to our measurement resolution, the spectral separation between the levels cannot be determined. The time-dependence of the Fe$^{3+}$ signal recovery after removal of 2.64 eV was recorded at temperatures between 3.5 and 297 K. Analysis show that capture rate of electrons by Fe$^{3+}$ decreases from $6 \times 10^{-16}$ to $5 \times 10^{-17} \text{ cm}^3/\text{s}$ with an inverse-square-root temperature dependence. The work is supported by the NSF.

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