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The donor-acceptor relationship in Fe:GaN USTUN SUNAY, JAMIYANAA DASHDORJ, MARY ZVANUT, JOSEPH HARRISON, University of Alabama at Birmingham, JACOB LEACH, KEVIN UDWARY, Kyma Technologies — Due to its electronic properties, semi-insulating gallium nitride (GaN) is a promising candidate for high power and high frequency devices. One of the biggest plagues in GaN growth is residual donors, which results in a more conductive material. Fe replaces Ga in the wurtzite crystal structure as Fe^{3+}. The energy level of $Fe^{2+/3+}$ is significantly lower than shallow donors. As a result, a Fe atom is able to accept a shallow donor electron. This process changes the charge state of Fe^{3+} to Fe^{2+} and the neutral donor to have a net positive charge. This charge exchange should continue until the amount of either Fe^{3+} or the neutral donor is depleted. The samples in this study were hydride vapor phase epitaxy bulk grown GaN doped with Si, controlling the donor concentration, and Fe. The [Si]/[Fe] ratios ranged from 0.01 to 1.55. Electron paramagnetic resonance (EPR) spectroscopy is able to identify the Fe^{3+} acceptor and neutral donor. Fe^{2+} and positive charged donors are EPR inactive. The principal finding of this study was the simultaneous existence of both the neutral donor and Fe^{3+} acceptor state when Si to Fe concentration ratios are in the range of 0.13 to 0.42. Current interpretations involve donor and acceptor states induced by Fe. This UAB work is funded by NSF.

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