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Mechanism of Interaction between Hydrogen and the Two-dimensional Electron Gas in AlGaN/GaN High Electron Mobility Transistors JASON GU, MAHAK KHANDELWAL, JACOB MELBY, Carnegie Mellon University, MICHAEL STEEVES, University of Maine, YUH-RENN WU, ROBERT LAD, University of Maine, ROBERT F. DAVIS, Carnegie Mellon University — The large polarization difference between AlGaN and GaN causes a two-dimensional electron gas (2DEG) to form at the interface between the two semiconductors. Capacitance-voltage (CV) measurements revealed a charge density of 4.71×10^{12} electrons/cm^2 in our 60 nm Al0.2Ga0.8N on 1.5 microns of GaN heterostructure. Exposure to hydrogen in the presence of a catalyst (Pt) resulted in a marked increase in the conductivity through the 2DEG. An interface state passivation mechanism is proposed as the most probable cause of this phenomenon. This mechanism was modeled using a self-consistent Schrödinger-Poisson solver, which showed that the passivation of interface states causes the shift of the Fermi level towards the conduction band, thereby increasing the carrier density of the 2DEG by 9%. In-situ CV measurements showed a 16% increase in the carrier density and a non-parallel shift in the CV curve when hydrogen was introduced, indicating in a change in the number of available states. This supports interface state passivation as a cause of the increase in the conductivity through the 2DEG.

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