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**Atomistic Modeling of Degradation Mechanisms in Nanoscale HEMT Devices** VAMSI GADDIPATI, SASI SUNDARESAN, KRISHNA YALAVARTHI, SHAIKH AHMED, Southern Illinois University — In this work, through atomistic numerical simulations, we investigate how performance degradation of state-of-the-art AlGa<sub>N</sub> HEMTs is governed by an intricate coupling of the underlying thermo-electro-mechanical processes while operating at high power and/or high-temperature. The polarization induced charge density is shown to be strongly dependent on the thickness of the AlN barrier layer. This further demonstrates that the degradation in these HEMT devices is related to the reduction of the effective thickness of the AlN barrier layer, which, during operation at high device temperature, could arise from the diffusion of gate metal into the barrier material matrix. This finding has been validated using the massively parallel LAMMPS molecular dynamics tool and available experimental data. We have also demonstrated that the polarization fields alone can induce channel carriers at zero external bias and lead to a significant increase in the ON current.

Krishna Yalavarthi  
Southern Illinois University

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