Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Schrodinger-Poisson Modeling of $Al_xGa_{1-x}N$/GaN Heterostructures Employing Tailored Depth-Dependent Aluminum Concentration for Polarization Grading[1] JEFFREY CALAME, IGOR CHERNYAVSKIY, MARIO ANCONA, DAVID MEYER, Naval Research Laboratory — Polarization-gradient profiling of $Al_xGa_{1-x}N$/GaN heterostructures in the vertical (depth) direction, achieved by deliberate spatial tailoring of the aluminum concentration profile, can be used to control the spatial structure of the conducting electron gas in high electron mobility transistors. In particular, the typical two-dimensional electron gas of abrupt heterostructures can exhibit a more three-dimensional distribution in graded structures. This offers the possibility of improved device linearity through deliberate vertical heterostructure engineering, which can minimize or compensate for various scattering mechanisms that contribute to nonlinearity. Schrodinger-Poisson modeling (i.e., the Hartree approximation) is used to study the electron density profiles that result from such deliberate grading, and how those profiles evolve with the application of biasing vertical electric fields across the heterostructure. Implications of the results on device linearity will be discussed. Comparisons between the electron density profiles predicted by the Schrodinger-Poisson modeling and those obtained by density-gradient theory will be made in selected examples.

[1]Work supported by the U.S. Office of Naval Research

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Date submitted: 01 Nov 2016 Electronic form version 1.4