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Field-effect-induced two-dimensional electron gas utilizing modulation doping for improved ohmic contacts SUMIT MONDAL, Department of Physics and Birck Nanotechnology Center, Purdue University, GEOFF GARDNER, Birck Nanotechnology Center and School of Materials Engineering, Purdue university, JOHN WATSON, Department of Physics and Birck Nanotechnology Center, Purdue University, MICHEAL J. MANFRA, Department of Physics, Birck Nanotechnology Center and Schools of Materials Engineering and Electrical and Computer Engineering, Purdue University — Recently there has been a significant interest in the use of GaAs-based quantum dots for spin qubits. Progress is hindered by the presence of charge noise in modulation doped heterostructures where fluctuations occurring in the remote ionized dopant layer couple to the qubit. In this work we demonstrate the experimental realization of a new field effect transistor (FET) device where the active channel region is locally devoid of the silicon doping layer and hence precludes the possibility of charge fluctuations on ionized dopants causing instability. The underlying heterostructure was grown by molecular beam epitaxy and is designed with an etch-stop between the silicon delta-doping layer and single interface GaAs/AlGaAs heterojunction that facilitates removal of the modulation doping at precise locations defined by lithography. The resulting 2DEG is induced by a field-effect and the density is tunable in a wide range of $6X10^{10}$ cm^{-2} to $2.7X10^{11}$ cm^{-2}. The design, fabrication, and operation of these devices along with low temperature (T = 0.3K) transport data is presented.

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