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Growth of high mobility, in-situ back-gated two-dimensional electron gases in GaAs/AlGaAs quantum wells JOHN WATSON, SUMIT MONDAL, Department of Physics and Birck Nanotechnology Center, Purdue University, MICHAEL MANFRA, Department of Physics, Birck Nanotechnology Center, Schools of Electrical and Computer and Materials Engineering, Purdue University — Investigations of the energy scales of many-body phenomena in high mobility two-dimensional electron gases (2DEGs) often require the ability to tune the electron density in a single device. Electrostatic gating is often the method of choice, but traditional device designs are less than ideal. The 2DEG density in top-gated devices is often hysteretic and/or unstable over time due to intervening doping layers, and traditional back-gates applied to mechanically thinned substrates typically require large gate voltages ($\sim$ 100 V) to achieve significant modulation of the electron density due to the large gate-channel separation ($\sim 150\ \mu$m). We report on the growth of a series of high mobility 2DEGs in 30 nm GaAs/AlGaAs quantum wells in which the density is modulated by an in-situ grown back-gate. Such in-situ gates can be grown close to the 2DEG ($\sim 1\ \mu$m) and without doping layers between the 2DEG and gate. We discuss heterostructure design parameters and device processing conditions leading to low gate leakage currents, low ohmic contact resistances, and high electron mobilities (10^7 cm^2/Vs) at low temperature (T = 300 mK).

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