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Simple-layered high mobility field effect heterostructured two-dimensional carrier devices. ROBERT WILLETT, LOREN PFEIFFER, KENNETH WEST, Bell Laboratories, Lucent Technologies — We present in this talk a two-dimensional electron heterostructure field effect device of simplistic design and ease of fabrication that displays high mobility electron transport. This is accomplished using a high efficacy contacting scheme and simple metallic overlapping gate, obviating dopant layers. The resultant devices demonstrate adjustable electron densities and mobilities larger than 8×10^6 cm²/V-sec at the highest densities of 2.4×10^{11} /cm². This device type provides a new experimental avenue for studying electron correlations and may answer demands for routine fabrication of practical HEMTs. In one extension of this work, using the same basic heterostructure design with appropriate contacts diffused to the AlGaAs/GaAs interface, a 2D high mobility hole channel can be populated through field effect, resulting in transport with clearly resolvable quantum Hall states at high magnetic fields. Finally, we also present a method for producing mesoscopic structures in these field effect 2D electron systems, which takes advantage of the extensive electron density control available when both the bulk and mesoscopically defined electronic densities can be tuned via overlapping gate arrays.

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