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Two dimensional epitaxial graphene - SiC/SiO_x field effect transistors JAN KUNC, YIKE HU, JAMES PALMER, ZELEI GUO, CLAIRE BERGER, WALTER DE HEER, Georgia Institute of Technology, GEORIA INSTITUTE OF TECHNOLOGY TEAM, INSTITUTE OF PHYSICS, CHARLES UNIVERSITY IN PRAGUE, CZECH REPUBLIC COLLABORATION, INSTITUTE NÉEL, CNRS, GRENOBLE, FRANCE COLLABORATION — We have produced and measured two dimensional (2D) field effect transistors composed of graphene source and drain and a 2D SiC/SiO_x channel supplied with a top gate. The devices have been measured in a wide range of gate voltages and temperatures. Careful attention was focused on the SiC/SiO_x channel formation and graphitization conditions. The channel was characterized by XPS, LEED, atomic and electrostatic force microscopy and Raman spectroscopy. On to off current ratios up to 10^6 have been achieved and sub-threshold swings up to 200 mV/decade have been attained with on-state currents in the sub-miliamp range. The channel formation as well as graphene/SiC junction including charge transfer in the graphene are modeled solving the coupled Poisson equation and Schrödinger equation in the effective mass approximation. The standard models of Metal Induced Gap States (MIGS) and Charge Neutrality Level concepts successfully reproduce the experimental data. The combined contributions of the space charge limited current in the channel and back-to-back Schottky diodes at the channel junctions are discussed. The thermionic and tunneling nature of the barriers is analyzed in these quasi two dimensional devices.

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