

Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

n-Type Behavior of Graphene Supported on Si/SiO₂ Substrates¹

HUMBERTO GUTIERREZ, HUGO ROMERO, NING SHENG, JORGE SOFO, PETER EKLUND, Physics Department, Penn State University, PARSOON JOSHI, SRINIVAS TADIGADAPA, Electrical Engineering Department, Penn State University — Results are presented from an experimental and theoretical study of electronic properties of back-gated graphene field effect transistors (FETs) on Si/SiO₂ substrates. The excess charge on the graphene was observed by sweeping the gate voltage to determine the charge neutrality point in the graphene. Devices exposed to laboratory environment for several days were always found to be initially p-type. After ~ 20 h at 200 °C in $\sim 5 \times 10^{-7}$ Torr vacuum, the FET slowly evolved to n-type behavior with a final excess electron density on the graphene of 4×10^{12} electrons/cm². This value is in excellent agreement with our theoretical calculations on SiO₂, where we have used molecular dynamics to build the SiO₂ structure and then density functional theory to compute the electronic structure. The essential theoretical result is that SiO₂ has a significant surface state density just below the conduction band edge that donates electrons to the graphene to balance the chemical potential at the interface. An electrostatic model for the FET is also presented that produces an expression for the gate bias dependence of the carrier density.

¹This work is supported by NSF NIRT ECS 06-09243.

Humberto Gutierrez
Physics Department, Penn State University

Date submitted: 29 Nov 2008

Electronic form version 1.4