Abstract Submitted
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Efficient electrolyte gating of high mobility graphene X. HONG, K. ZOU, J. ZHU, Penn State University — We report the effect of highly efficient electrolyte top gating (PEO:$LiClO_4$) on the transport properties of graphene. Single layer graphene sheets are mechanical exfoliated on SiO_2/doped Si substrates and fabricated into field effect transistor (FET) devices using standard e-beam lithography. Pristine devices exhibit field effect mobility (μ_{FE}) of 6,000 to 13,000 cm^2/Vs. An electrolyte droplet is then applied to such devices and functions as a top gate. It exhibits gating efficiency of 1x10^{13}/cm^2V at low gate voltage (V_t <1), which is 140 times higher than the 300 nm SiO_2/Si back gate and corresponds to a Debye length of <3 nm. At larger V_t, the gating efficiency rises sharply. The top gate can induce high carrier densities up to 1x10^{14}/cm^2 with less than 2 V. At low carrier densities (n<1x10^{13}/cm^2), μ_{FE} of electrolyte gated graphene is comparable to that of the pristine device. At higher densities, the conductivity σ shows very weak density dependence, leading to $\mu \sim 1/n$. In this regime, Li^+ and ClO_4^- ions in the close vicinity of graphene become the main scattering source. We explore the interplay between the high geometric capacitance of the electrolyte top gate and the quantum capacitance of the graphene 2D electron gas.

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