Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Surface functionalization on graphene through chlorination XU ZHANG, YI SONG, ALLEN HSU, KI KANG KIM, JING KONG, MIT EECS, MILDRED DRESSELHAUS, MIT EECS & MIT Physics, TOMAS PALACIOS, MIT EECS — Since graphene is an all-surface material, surface functionalization provides effective methods to engineer its electronic properties. Here, we demonstrate that exposure of graphene devices to chlorine plasma in an electron cyclotron resonance (ECR) plasma etcher is an effective way to decrease its sheet resistance, engineer its C/Cl ratio and control the interaction between chlorine and carbon atoms.. First, conductivity of chlorinated graphene increases, due to the hole doping induced by the chlorine plasma. This is further confirmed by the Hall-effect measurements: the hole concentration increased from about 5×10^{12} cm^{-2} to around 1.3×10^{13} cm^{-2}. Meanwhile, mobility decreases from about 2500 cm^2/Vs to 1000 cm^2/Vs, which is still very attractive compared to strained silicon films. The sheet resistance of graphene also decreases, which is an overall result of the competition between the decreased mobility and the increased carrier concentration. Raman spectrum analysis on chlorinated graphene samples treated under different RF bias indicated that the interaction between graphene and chlorine underwent three different scenarios under different RF bias conditions: van der Waals bonding, covalent bonding and defects creation. Finally, by tuning the RF bias and treatment time, we can control the C/Cl ratio effectively.

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Date submitted: 23 Nov 2012 Electronic form version 1.4