Direct growth of carbon nanotubes on BaTiO₃ thin films for ferroelectric field effect devices

PATRYCJA PARUCH, LASSP, Cornell University, AGHAM-BAYAM POSADAS, CHARLES H. AHN, Yale University, PAUL L. MCEUEN, LASSP, Cornell University — Carbon nanotube field effect transistors have been extensively investigated using a variety of gate dielectrics. We propose instead to use ferroelectric (FE) field effect, replacing the dielectric by a thin FE film on a conducting substrate. The remanent FE polarization can provide reversible, locally-controlled, and non-volatile electronic doping of up to $5 \times 10^{14}$ charges/cm², over 10 times greater than that available with SiO₂ at breakdown fields. However, many FE materials cannot withstand the high temperatures and reducing atmosphere required for CNT growth. We subjected different perovskite FEs to CNT growth conditions, and from subsequent local and macroscopic measurements of their polarization we have identified BaTiO₃ as a good device material. Single walled CNTs grown on BaTiO₃ were characterized using the Nb:SrTiO₃ substrate as a gate electrode. The effects of FE polarization on the CNT electronic properties are currently being studied.