Length-Dependent DNA Conductivity Study using CNTFETs

Daniel Chenet[1], Xian Zhang[1], Bumjung Kim[2], Arend van der Zande[1], Colin Nuckolls[2], James Hone[1]
[1]Deparment of Mechanical Engineering, Columbia University, New York, NY 10027
[2]Department of Chemistry, Columbia University, New York, NY 10027
dac2158@columbia.edu

Field effect transistors have classically been used in biosensing applications by relating the change in channel conductance to the presence of a targeted analyte. Due to their superior electronic properties and extreme sensitivity to their environment, single-walled carbon nanotubes have lent themselves quite well as the channel material in FETs. Additionally, with diameters on the scale of 1-2 nm, SWNTs also have the ability to form single-molecule covalent bonds at their ends with other molecules of interest. Here, we report the development of a CNTFET with a single DNA molecule serving as a bridge. We achieve this by, first, growing a single nanotube several millimeters in length and contacting it with electrodes. Then, by electron beam lithography, we open small windows in PMMA and selectively etch gaps in the nanotube using oxygen plasma, leaving carboxylic acid functional groups at the ends. We use amine-terminated DNA molecules to covalently reconnect our devices. The novelty of our platform is that we are able to create several hundred devices using a single, low-resistance carbon nanotube allowing us to eliminate sources of statistical scatter in our data and perform a more precise study of the intrinsic electronic properties of our molecule of interest. We demonstrate the efficacy of our device by performing a study of length-dependent conductivity of double-stranded DNA.