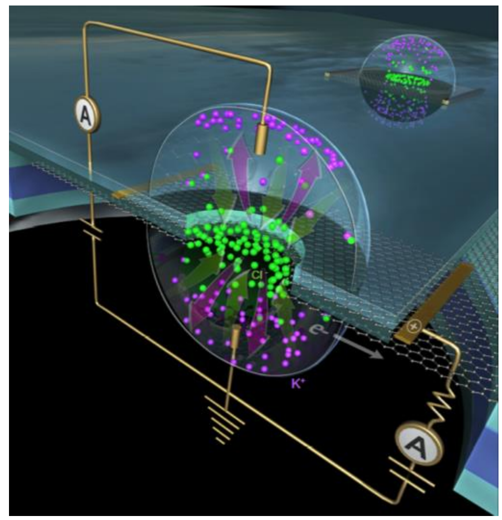
NANOHOUR

Thursday, March 28, 2013 at 3:00 pm
Beckman Institute - Room 3269

Nano-Electrochemistry for DNA Detection in Graphene-Based Nanopores

Shouvik Banerjee, Materials Science and Engineering
Graduate Student with Professor Rashid Bashir

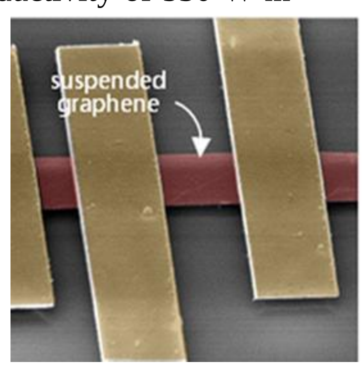


We demonstrate a stacked graphene-Al_2O_3 dielectric nanopore architecture to investigate electrochemical activity at graphene edges. It has proven to be difficult to isolate electrochemical activity at the graphene edges from those at the basal planes. We use 24 nm of Al_2O_3 to isolate the graphene basal planes from an ionic fluid environment. Nanopores ranging from 5 to 20 nm are formed by an electron beam sculpting process to expose graphene edges. Electrochemical measurements at isolated graphene edges show current densities as high as 1.2 x 10^4 A/cm^2, 300 times greater than those reported for carbon nanotubes. Additionally, we modulate nanopore conductance by tuning the graphene edge electrochemical current as a function of the applied bias on the embedded graphene electrode. Our results indicate that electrochemical devices based on graphene nanopores have promising applications as sensitive chemical and biological sensors, energy storage devices, and DNA sequencing.

High-Field Electrical and Thermal Transport in Suspended Graphene

Vincent Dorgan, Electrical and Computer Engineering
Graduate Student with Professor Eric Pop

We study the intrinsic transport properties of suspended graphene devices at high fields (≥1 V/μm) and high temperatures (≥1000 K). Across 15 samples, we find peak (average) saturation velocity of 3.6×10^7 cm/s (1.7×10^7 cm/s) and peak (average) thermal conductivity of 530 W m^{-1} K^{-1} (310 W m^{-1} K^{-1}) at 1000 K. The saturation velocity is 2−4 times and the thermal conductivity 10−17 times greater than in silicon at such elevated temperatures. However, the thermal conductivity shows a steeper decrease at high temperature than in graphite, consistent with stronger effects of second order three-phonon scattering. Our analysis of sample-to-sample variation suggests the behavior of “cleaner” devices most closely approaches the intrinsic high-field properties of graphene. This study reveals key features of charge and heat flow in graphene up to device breakdown at ~2230 K in vacuum, highlighting remaining unknowns under extreme operating conditions.



Coffee and cookies will be served
http://nanohour.beckman.illinois.edu