Graphene-molecule interactions and the potential for selective chemical sensing by graphene FET's

Nikolai Dontschuk and Jiri Cervenka
School of Physics, The University of Melbourne

Graphene's two dimensional nature, highly sensitive unique electrical properties and low intrinsic noise characteristics make it a prime candidate for the creation of a new generation of molecular sensors. Sensors that could provide single molecule sensitivity and selective determination of the sensed molecules. DNA sequencing technology is an area that stands to benefit greatly from such advances in sensing technology. As such we have seen a number of theoretical models for DNA relying on graphenes ability to sense and distinguish between DNA bases (or base pairs) as that pass near the graphene surface[1, 3].

Despite the promise of such models the underlying assumption, that graphene is sensitive enough to the physical absorption of molecules for single molecule selective sensing, has not been shown experimentally. Current theory uses Boltzmann transport theory to describe changes in graphene's conductivity due to the presence of charge scattering sites [4]. Whilst strong agreement with experiment has been shown for molecules which undergo interger charge transfer with the graphene for many molecules physically absorbing to graphenes surface only partial charge transfer is observed, making such theories inadequate.

In order to start addressing the validity of this assumption about graphene's sensitivity we have undertaken experiments observing the changes in single layer CVD graphene on 90 nm SiO_2 field effect transistors (FETs) when nucleobase molecules are absorbed on the graphene surface. To avoid potential environmental contamination our experiments were carried out in the ultra high vacuum systems of the soft X-ray beamline at the Australian synchrotron. This also allowed for the use of XPS techniques to monitor the quantity of molecules absorbed on our devices.

Here we report on the results of these measurements, in particular on the potential of graphene to be used as a selective molecular sensor for genome sequencing applications.

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