Graphene Nanoelectromechanical Systems

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We fabricate nanoelectromechanical systems (NEMS) from single and multilayer graphene sheets by mechanically exfoliating thin sheets from graphite over trenches in SiO$_2$. Vibrations with fundamental resonant frequencies in the MHz range are actuated either optically or electrically and detected optically by laser interferometry. The thinnest resonator consists of a single suspended layer of atoms and represents the ultimate limit of two dimensional nanoelectromechanical systems. The high Young's modulus ($E = 1$ TPa), extremely low mass (single layer of atoms), and large surface area make these resonators ideally suited for use as mass, force, and charge sensors.

In addition to work on doubly clamped beams and cantilevers, we also investigate the properties of resonating drumheads, which consist of graphene sealed microchambers containing a small volume of trapped gas. These experiments allow us to probe the membrane properties of single atomic layers. These membranes act as barriers for all standard gases including helium and represent the thinnest membrane possible (one layer of atoms) with the smallest potential pore sizes attainable (single atomic vacancies), and unprecedented mechanical stability.

References:

Scott Bunch is currently an Assistant Professor of Mechanical Engineering at the University of Colorado at Boulder. He received his Ph.D. in Physics in 2008 from Cornell University where he studied the electrical and mechanical properties of graphene under the guidance of Paul McEuen. After finishing his Ph.D, he spent 3 months as a postdoctoral researcher in the Laboratory of Atomic and Solid State Physics at Cornell University studying nanoelectromechanical systems with Professor Harold Craighead and Professor Jeevak Parpia. His awards include a Ph.D. fellowship from Lucent Technologies, Bell Laboratories (2000-2004) and the DARPA MTO Young Faculty Award (2008).