Materials Science and Engineering Department

Spring Seminar Series

How stiff are 2D materials? Imaging 2D materials to understand how they bend, stretch and twist

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Because they are atomically thin, 2D materials offer a uniquely powerful platform for electron microscopy to extract the structure and properties of materials with single-atom or even picometer precision. In this talk, I will discuss how we use aberration-corrected scanning transmission electron microscopy (STEM) to measure the strain and bending of materials just a few atoms thick. Understanding the bending of two-dimensional materials and heterostructures is crucial for the development of next-generation electronics including deformable electronics, biosensors, and nanoelectromechanical systems. We use aberration-corrected STEM to image bent and kinked 2D layers and produce insight into their bending stiffness and bending mechanisms. Our results indicate that the bending stiffness of few-layer graphene can be orders of magnitude smaller than previously thought and provide a new lower limit for the fabrication of ultra-soft, high mobility electronic nanodevices based on 2D materials. This unusual behavior results from the atomic-scale bending mechanism in 2D multilayers, which is dominated by interlayer shear and slip. Our findings have profound implications on 2D heterostructures, where we demonstrate that the bending stiffness can be controlled by tailoring the interfacial interactions between individual atomic layers of 2D materials.

Pinshane Y. Huang is an Associate Professor in the Department of Materials Science and Engineering at the University of Illinois, Urbana-Champaign. Pinshane holds a Ph.D. and an M.S. in Applied and Engineering Physics from Cornell University, and B.A in Physics from Carleton College. Her research is focused around transmission electron microscopy and spectroscopy of two-dimensional materials and nanoelectronic systems. Her awards include a Presidential Early Career Award for Scientists and Engineers (PECASE), a Packard Fellowship, a Sloan Fellowship, as well as Air Force Young Investigator and NSF CAREER awards. Her research has been featured in Nova, National Geographic, BusinessWeek, CBS News, Discover Magazine, and the Guinness Book of World Records

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