MAR13-2012-020431
Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Probing electronic and vibrational interactions in few-layer graphene by optical spectroscopy

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Graphene possesses remarkable physical properties and great potential for novel applications. As more than one graphene layers are stacked on one another, the properties of the few-layer system can be strongly modified by the interactions between electrons and lattice vibrations in different graphene layers. We have investigated, by means of infrared and Raman spectroscopy, the electronic and vibrational properties of few-layer graphene with different layer thickness and stacking sequence. Our results reveal the critical roles of these degrees of freedom in defining the properties of few-layer graphene. We show how optical spectroscopy offers important routes to characterizing the thickness and stacking order of the graphene samples as well as probing the material's response to external perturbations. In particular, we will describe the use of Raman spectroscopy to identify the interlayer breathing modes in few-layer graphene of up to 20 layers in thickness, and the use of Infrared spectroscopy to probe the modulation of electronic structure and electron-phonon interactions in few-layer graphene with varying thickness, stacking order and doping level. This work was performed at Columbia University in collaboration with L. Brus, E. Cappelluti, G. L. Carr, Z.Y. Chen, Z.Q. Li, K.F. Mak, L.M. Malard and R. Saito.

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