Molecular Beam Deposition and Raman Characterization of Large Area Graphene Layers

J.M. García[1, 2, 3], M.P. Jiang[1], J. Yan[1], Y. Zuev[1], P. Kim[1], K. W. Baldwin[2], K.W. West[2], L. N. Pfeiffer[2], and A. Pinczuk[1]

[1]Departments of Physics and APAM, Columbia University; [2]Bell Labs, Alcatel-Lucent, Murray Hill, New Jersey, [3]MBE lab, Instituto de Microelectrónica de Madrid, IMM-CNM, CSIC, Spain

Large area graphene layers are key novel materials systems to be implemented for the exploitation of many of their exciting properties in future devices. Recently two groups have used the segregation to the surface of dissolved carbon into a metal matrix to produce large area graphene layers [1, 2]. These works used a Chemical Vapor Deposition (CVD) growth method to cover a Nickel buffer layer with graphene. In contrast, our approach is to use Molecular Beam Deposition in an Ultra High Vacuum system for the controlled deposition of Carbon atoms onto a suitable metal surface (the metal matrix). Our graphene samples consist of 3x3 mm^2 diamond and strip-shaped SiO2/Si (4x40mm^2) substrates covered with 300 nm of Ni deposited by e-beam evaporation. Pd layers have also been explored as a metal matrix. These elongated substrates are used for the growth of samples with a gradient in carbon thickness. After carbon deposition, the substrates are annealed at temperatures from 800º C to 1000º C for 30 min and cooled down to RT at cooling rates from -1.2ºC/s to -50ºC/s. Raman spectroscopy of the samples with Ni and Pd show clear G and D* resonances associated with few graphene layers. Also a D resonance, associated with local disorder, is observed, suggesting that the quality of the samples can be further improved. The relative peak intensities I_{D*}/I_G and I_D/I_G are used to examine the quality of the samples. We find that the best layers are obtained when thinner layers of carbon are deposited.

[1] K.S. Kim *et al.* Large-scale pattern growth of graphene films for stretchable transparent electrodes. *Nature* **457**, 706-710 (2009).

[2] A. Reina *et al*. Large Area, Few-Layer Graphene Films on Arbitrary Substrates by Chemical Vapor Deposition. *Nano Lett.*, **2009**. 9 (1), 30-35.

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