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Structural and electronic properties of graphene grown by chemical vapor deposition (CVD)

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Graphene grown by chemical vapor deposition (CVD) has brought many exciting opportunities for both fundamental studies and practical applications. In this talk, I will present our studies of the structural and electronic properties of graphene synthesized by ambient CVD based growth on polycrystalline Ni and Cu foils. Our earlier work on graphene layers and large scale graphitic thin films grown on Ni and transferred to insulators [1,2] show that such films can have excellent electronic properties, despite their structural non-uniformity. We also characterized the wrinkles in such films, yielding insights on their growth and buckling processes [3]. On Cu foils, we have synthesized wafer-scale graphene films consisting of predominantly monolayer graphene [4]. We have studied the electronic transport properties [4], including field effect, "half-integer" quantum Hall effect (electronic hall-mark of graphene) and weak localization (probing carrier scattering) in such synthetic graphene transferred to SiO2/Si substrates and characterized its structural properties by Raman mapping, transmission electron microscopy (TEM) and scanning tunneling microscopy (STM). We have also studied thermal transport in CVD graphene using both electrical and Raman measurements [5]. Finally, one of the outstanding issues in large scale CVD graphene, which can be monolayer but generally polycrystalline, is the role of grain boundaries. I will present our recent studies of single crystal graphene grains (hexagonally-shaped with edges macroscopically aligned close to zigzag directions) grown on Cu, and how individual grain boundaries affect the electronic transport properties [6]. Work in collaboration with Q. Yu, H. Cao, L. Jauregui, J. Tian, N. Guisinger, R. Colby and E.A.Stach.

[1] Q. Yu et al., Appl. Phys. Lett. 93, 113103 (2008);
[2] H. Cao et al., J. Appl. Phys. 107, 044310 (2010);
[3] R. Colby et al., Diamond Relat. Mater. 19, 143 (2010)
[4] H. Cao et al. Appl. Phys. Lett. 96, 122106 (2010)
[5] L. Jauregui et al. ECS Trans. 28 (5), 73 (2010)
[6] Q.Yu and L.A. Jauregui et al., arXiv:1011 (2010)