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SEMINAIRE IPCMS

DIRECT GRAPHENE CHEMICAL VAPOR DEPOSITION ON DIELECTRIC SUBSTRATES: DOPING, BAND GAPS, AND PRACTICAL DEVICES[1]

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Salle 70

We have recently demonstrated the direct chemical vapor deposition (CVD) of graphene monolayers on BN monolayers formed by atomic layer deposition (ALD) on Ru(0001) [1]. We have also recently demonstrated the formation of graphene monolayers by free radical-assisted chemical vapor deposition (FRA-CVD) on MgO(111)(1x1) [2]. These are the first reports of direct formation of macroscopic graphene layers on well-defined dielectric substrates—a critical step toward the formation of industrially practical graphene devices compatible with Si CMOS. XPS, STM, LEED, Raman and Auger studies, carried out in collaboration with Inverse Photoelectron Spectroscopy (IPES) studies by the Dowben group at the University of Nebraska-Lincoln, and theoretical studies by Prof. Mei's group at the University of Nebraska-Omaha, show that:

a) in both cases, the electronic structures of the surface films are indicative of true graphene monolayers
(b)graphene/BN/Ru(0001) exhibits strong BN-to-graphene charge transfer (~ 0.1 e-/C atom), filling the π^* band—extrinsically doped graphene
(c) graphene formation on MgO(111) results in a graphene layer with an oxidized carbon (graphene oxide?) interface and a ~ 1 eV band gap

The graphene/BN/Ru indicates a new pathway towards intrinsic doping of graphene for high mobility and spintronic applications, while the formation of a 1 eV band gap is essential for the formation of true FET-type devices exploiting high graphene mobility at 300 K. Prospects for spintronic, logic and combined applications based on these results will be discussed.

References

[1] Cameron Bjelkevig, Zhou Mi, Jie Xiao, P. A. Dowben, Lu Wang, Wai-Ning Mei and Jeffry A. Kelber, J. Physics Condensed Matter (Fast Track Communication) **22**, 302002 (2010)
[2] Lingmei Kong, Cameron Bjelkevig, Sneha Gaddam, Zhou Mi, Young Hee Lee, Gang Hee, Gang Hee Han, Jay-Kyung Jeong, Ning Wu, Zehngsheng Zhang, Jie Xiao, P. A. Dowben and Jeffry A. Kelber (in preparation)

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