NEBRASKA CENTER FOR MATERIALS AND NANOSCIENCE SEMINAR SERIES PRESENTS

NCMN

PROF. JEFFRY A. KELBER

Department of Chemistry
University of North Texas

SUBSTRATE-MEDIATED ASSEMBLY OF GRAPHENE ON h-BN(0001): A NEW APPROACH TOWARD GRAPHENE/DIELECTRIC HETERO-JUNCTIONS

Single layer graphene has been grown by chemical vapor deposition (CVD) at < 1000 K on h-BN(0001) monolayer and multilayer substrate grown by atomic layer deposition (ALD) on Ru(0001). This approach differs from the conventional approaches of either high temperature growth on SiC(0001) or single sheet transfer to various substrates, and has significant implications for practical device fabrication. Two ALD cycles of BCl_3/NH_3 on Ru(0001) yield a R30($\sqrt{3}$x$\sqrt{3}$) LEED pattern, with a ~ 2 eV band gap as observed by STM/STS. Subsequent CVD of ethylene at 1000 K yields a (1x1) LEED pattern with multiple scattering, indicating a hexagonal C(111) monolayer in registry with the BN substrate. STM/STS indicate a graphene-like local density of states with a 0 eV band gap. Raman spectra indicate "G" and "2D" features with relative intensities characteristic of single layer graphene, but with a sharp redshift of the 2D feature relative to HOPG consistent with BN→ graphene charge transfer. This is confirmed by photoemission and inverse photoemission data acquired by Prof. Peter Dowben's group, indicating that electron transfer from BN→ graphene fills the graphene π^* band. An effective mass value of 0.5 m_e is derived from the inverse photoemission dispersion data, consistent with values obtained by transport measurements on transferred single layer graphene sheets. The double layer of BN is produced by 4 ALD BCl_3/NH_3 cycles on Ru(0001) and yields a LEED Moiré pattern and an Auger-derived average thickness of ~ 3 Å, similar to that of the well-known "nanomesh" formed from borazine CVD on Ru(0001). The BN double layer has a 4 eV band gap. Ongoing studies of graphene growth on this surface, and differences between BN films formed by ALD and borazine CVD will be discussed with respect to potential nanoelectronic and spintronic applications.

Acknowledgements: Work at UNT was supported by the Global Research Consortium of the Semiconductor Research Corporation through Task ID 1770.001, and through ONR under award no. N00014-08-1-1107 through a subcontract with Texas State University at San Marcos. The work at UNL was funded by Defense Threat Reduction Agency (Grant No. HDTRA1-07-1-0008), the NSF "QSPINS" MRSEC (DMR-0820521) at UNL.

Host:
Prof. Peter Dowben
Physics & Astronomy

Friday, April 9, 2010
201 Brace Lab
1:30 p.m.

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