Assessing the electronic and magnetic properties of functionalized of hexagonal boron nitride

Karthik Sridhara[12]
Evgeniya Lock[2], Luke O. Nyakiti[1], Boris Feigelson[2]

[1] *Department of Materials Science and Engineering, Texas A&M University, College Station, TX, 77843, USA*
[2] *US Naval Research Laboratory, Washington DC, 20375, USA*
karthik.sridhara@tamu.edu

In recent years there has been an interest in altering the electronic properties of 2D materials, mainly graphene and graphene oxide, through functionalization to induce new behaviour for novel electronic and sensing applications. Of the 2D materials, hexagonal boron nitride (h-BN) is gaining prominence as a substrate, and also as a tunnel dielectric due to its wide bandgap and insulating properties [1, 2]. There have been reports of induced magnetization of h-BN through functionalization leading to ferromagnetism and also bandgap engineering [3, 4].

While most of the h-BN functionalization studies have been done on h-BN flakes, we use chemical vapor deposited (CVD) h-BN on polycrystalline Cu foils. In our work, we functionalize CVD h-BN with TFPA-NH_2 and TFPA-SH molecules. We perform x-ray photoelectron spectroscopy (XPS) and Fourier transform infrared reflection absorption spectroscopy (FT-IRRAS) before and after functionalization to assess the impact of functionalization on h-BN films. We observe that the functional groups bind with BN molecule as observed using XPS. Additional peaks, notably at ~1667 cm^{-1} and 1555 cm^{-1}, are also observed on FT-IRRAS, as shown in figure 1, indicating functionalization of h-BN film. We will use other electron microscopy and scanning probe microscopy techniques to assess the electronic and magnetic properties of functionalization of h-BN films.

References

[1] Dean, Young, Meric, Lee, Wang, Sorgenfrei, Watanabe, Taniguchi, Kim, Shepard, and Hone, "Boron nitride substrates for high-quality graphene electronics," Nature Nanotechnology, vol. 5, no. 10, pp. 722–6, 2010.
[2] L. Britnell, R. V. Gorbachev, R. Jalil, B. D. Belle, F. Schedin, M. I. Katsnelson, L. Eaves, S. V. Morozov, A. S. Mayorov, N. M. Peres, A. H. Neto, J. Leist, A. K. Geim, L. A. Ponomarenko, and K. S. Novoselov, "Electron tunneling through ultrathin boron nitride crystalline barriers.," Nano Lett., vol. 12, no. 3, pp. 1707–10, Mar. 2012.
[3] Y. Guo and W. Guo, "Magnetism in Oxygen-Functionalized Hexagonal Boron Nitride Nanosheet on Copper Substrate," The Journal of Physical Chemistry C, vol. 119, no. 1, pp. 873–878.
[4] S. Tang, J. Yu, and L. Liu, "Tunable doping and band gap of graphene on functionalized hexagonal boron nitride with hydrogen and fluorine," Phys Chem Chem Phys, vol. 15, no. 14, pp. 5067–5077, 2013.

Figures

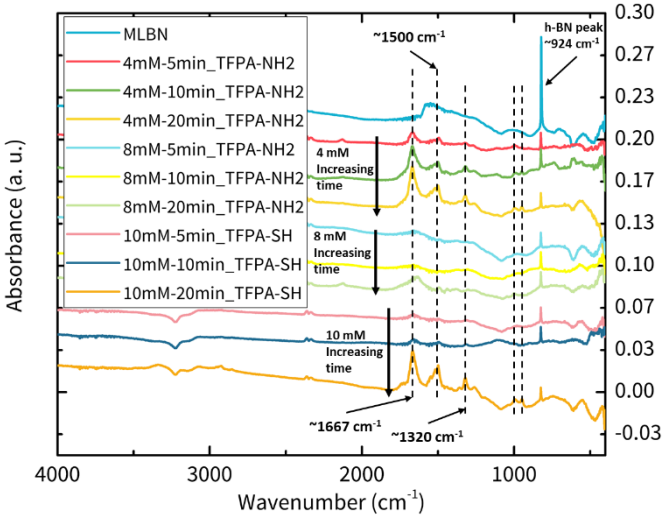

Figure 1: FT-IRRAS showing the primary peaks of h-BN before and after functionalization