Contribution ID : **15** Type : **not specified**

NEXAFS characterisation of CVD graphene on copper

Thursday, 4 February 2016 09:30 (15)

Technology development and device-design based upon graphene materials require reliable techniques for mass production that are time-robust and reproducible. CVD-synthesis is expected to be the prime candidate for such up-scaling. Copper is a preferred substrate for CVD. Details of the graphene-copper substrate interactions in regard to mechanical stability and electronic band structure are therefore crucial input for future device engineering.

Such application will require that the electronic band-structure of different graphene materials is measured in detail and that graphene-substrate interactions are well understood. Both, the degree of sp2-hybridisation and the electronic band-structure can be directly probed with NEXAFS. The spectroscopy technique enables detailed studies of structural changes at the graphene surface and at its substrate interface. Our NEXAFS studies at the Australian Synchrotron have produced new evidence for a contentious state in graphene near 288 eV. This resonance has been intermittently observed before by others and it is often referred to as an 'interlayer state' due to a perceived analogy with graphite [1-5] .

Our results for CVD-graphene synthesized on copper show a pronounced anisotropy for this state. We derive an excitation energy of 288.3 eV and a partial overlap with an isotropic contaminating resonance. After annealing and keeping the graphene in ultra-high vacuum, the NEXAFS signature of the 288.3 eV state only gradually appears and builds-up over several hours. This signature can be removed again by renewed annealing. The reversible phenomenon may thus relate to residual lattice mismatch between the graphene and the copper substrate. Associated stress may gradually be relaxed through the rippling of the graphene layer [6]. Tilting angles of >20° appear possible. The rippling is evidenced in our data by a correlated, reversible non-linearity of the cos-square-theta-dependence of the 285 eV π^* resonance of graphene.

References

[1] Fischer et al., Phys. Rev. B, 44 (1991) 1427-1429

[2] Pacile et al., Phys. Rev. Lett., 101 (2008) 066806

[3] Jeong et al.; Phys. Rev. Lett., 102 (2009) 099701

[4] Lee et al.; J. of Phys. Chem. Lett. 1 (2010) 1247-1253

[5] Schultz et al.; Nature Communications, 2 (2011) 372

[6] Paronyan et al., ACS Nano, Vol. 5, 12, 2011, 9619

Primary author(s) : Mr WAHAB, Hud (UNSW Canberra)

Co-author(s) : Prof. MERTINS, Hans-Christoph (Muenster University of Applied Sciences, Muenster, Germany); Prof. CADOGAN, Sean (UNSW Canberra); Prof. CHOI, Suk-Ho (Kyung Hee University, Yongin, Korea); Mr KIM, Sung (Kyung Hee University, Yongin, Korea)

Presenter(s) : Mr WAHAB, Hud (UNSW Canberra)

Session Classification : Contributed talk