

Nitrogen doped graphene studied by STM/STS and Photoemission Spectroscopy

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Tuning the electronic properties of low dimensional carbon materials is a current challenge for the development of carbon based technology. Doping by insertion of foreign atoms in the atomic lattice is a promising strategy to reach the control of the electronic structure of carbon materials. Nitrogen atoms are good candidates for chemical doping due to their suitable atomic radius and the additional electron that they contain as compared to carbon. They can adopt different local environments (graphitic-like, pyridinic-like) which can have various effects on the electronic structure [1].

For the particular doping method we use (i.e. exposure of the epitaxially grown graphene to an atomic nitrogen flux), we combine STM imaging and tunnelling spectroscopy [2] with Angled-Resolved Photoemission Spectroscopy (performed at the Cassiopée beamline at the synchrotron Soleil), to correlate the configuration of the nitrogen atoms in the graphene lattice with their observed effect on the band structure and compare it with the result of DFT-based calculations. We also evaluate the number of charge carriers brought by each doping atom and its evolution as a function of the nitrogen concentration. We will point out difficulties in determining those quantities arising when one is dealing with heavily doped samples.

A direct comparison between STS measurements and ARPES measurements will reveal the importance of taking into account the gap in the STS spectra induced by the absence of the phonon-mediated channel, as put forward by Zhang *et al.* [3]

Finally, XPS results and in particular the puzzling evolution of the N1s peak relative intensity as a function of the photon energy, which is not what one expects for nitrogen present at the extreme surface, will be presented and discussed.

References

[1] B. Zheng, P. Hermet, L Henrard, ACS Nano, **7** (2010) 4165

[2] F. Joucken et al., Phys. Rev. B **85**, (2012) 161408(R)

[3] Y. Zhang et al., Nature Phys. **4**, (2008) 627