

Correspondence between STM and photoemission results on N-doped graphene

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Abstract

We present a combination of STM and ARPES results obtained on nitrogen-doped graphene. The pristine graphene samples were grown on 4H-SiC(000-1) using the confinement controlled sublimation method [1] and were subsequently doped by exposing them to a nitrogen radical flux produced by RF plasma source.

The electronic doping level was first measured by ARPES at the Cassiopée beamline of the Soleil synchrotron (cf. fig. 1). The same samples were then investigated by LT-STM to evaluate their nitrogen concentration (cf. fig. 1) as well as the electronic doping on a nanometer scale. Core-level photoemission experiments were also performed on the samples.

The combination of these data with tight-binding calculations allowed us to evidence several important effects. First, the number of charge carriers brought by each dopant does not appear to be constant, which, as tight binding results support, questions the reliability of the rigid band model for graphene. Second, the N 1s energy level corresponding to nitrogen in the ‘graphitic’ configuration depends on the level of nitrogen concentration. Connections between this dependence and the departure from the tight-binding model can be made. Third, the measure of the electronic doping by STS and another technique (ARPES) permits to demonstrate unambiguously the need for renormalization of the STS spectra and strongly supports the interpretation of the pseudogap observed in the tunneling spectra as the absence of an inelastic tunneling channel at low bias [2].

These results, as well as previous related results, are discussed in refs [3] & [4].

References

[1] W. de Heer *et al.*, PNAS **108**, 16900 (2011)

[2] Y. Zhang *et al.*, Nat. Phys. **4**, 627 (2008)

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

[4] F. Joucken *et al.*, Sci. Rep. **5**, 14564 (2015)

Figures

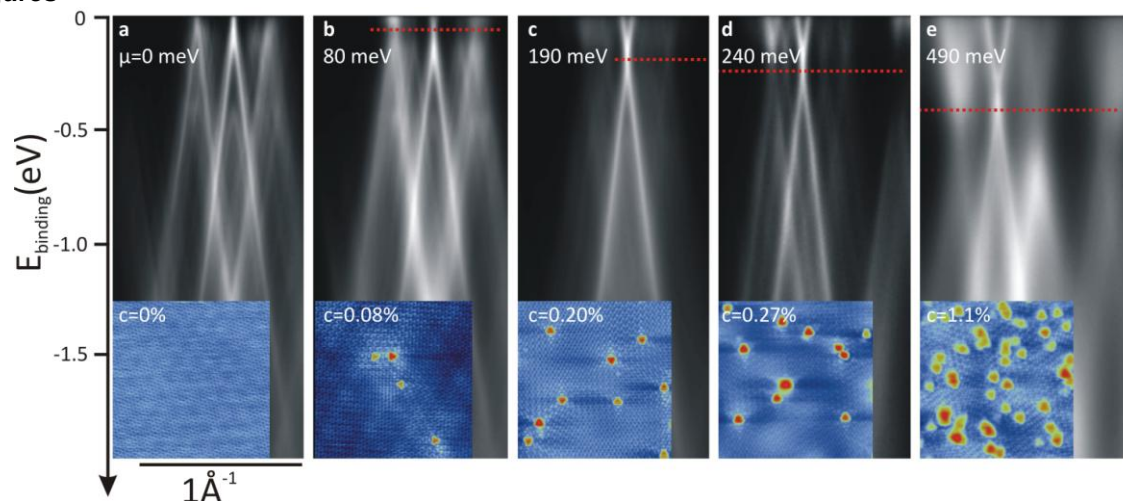


Figure 1: ARPES and typical STM images acquired on samples with different nitrogen concentration. The electronic doping levels (μ) as well as the nitrogen concentrations (c) are given on each image. N dopants appear as red protrusions on the STM images