Effect of nitrogen doping of graphene on the electronic interaction with organic molecules

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Tailoring the properties of graphene is of fundamental interest to uncover new functionalities and open new opportunities for graphene based applications. In this context, substitutional doping and molecular functionalization have focused tremendous efforts. Nitrogen doping obtained by replacing some carbon atoms by nitrogen atoms appears to be particularly interesting as it allows to perform n-doping with minor structural perturbations. This chemical doping can also modify the interaction of graphene with organic molecules that can be exploited for sensing or catalysis. To probe this effect at the molecular level, scanning tunneling microscopy and spectroscopy experiments have been performed on molecules adsorbed on multilayer pristine and doped graphene on SiC(000-1). Local spectroscopy allows to reveal the electronic coupling between molecules and graphene. On doped graphene, a local modification of the charge transfer between molecules and graphene occurs at the doping sites [1, 2] (Fig. 1). This effect can be used to tune the electronic properties of molecules on graphene but can also tune the dynamical behavior of molecules excited through resonant process. This effect has been shown in the case of porphyrin molecules that undergo a tautomerization reaction excited by the tunneling current in a STM junction [3]. The effect of nitrogen doping was used to tune the molecular orbitals and test the link between the yield of the tautomerization reaction of porphyrin and the energy position of molecular orbitals. That study allowed to identify the excitation mechanism of hydrogen transfer in a molecule on graphene that turns out to be different from the reported mechanisms on metals. This brings an evidence of the difference of behavior of a molecule on graphene with respect to a metallic substrate. These findings shine more light on the role of doping on the properties of graphene and its implications in graphene-molecule interface.

References

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Figures

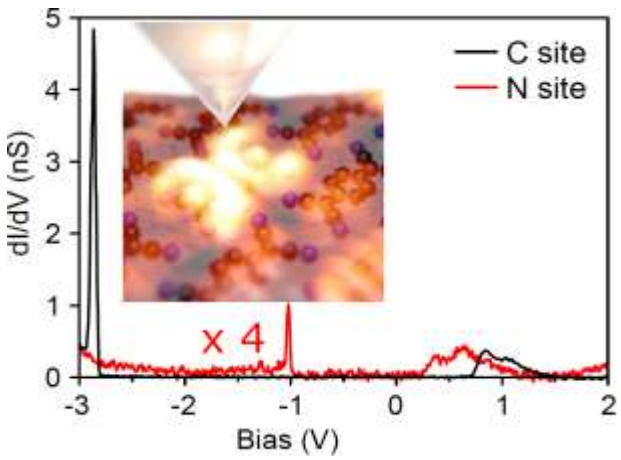

Figure 1: Spectroscopy of TCNQ molecules on nitrogen doped graphene.