From growth to local electronic properties of topological quasi-one dimensional defects in twisted graphene layers.

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Abstract

Creating topological defects in graphene can induce unexpected electronic properties. We present scanning tunneling microscopy studies of defect formation catalyzed by gold on few-layer graphene on SiC(000-1) [1]. A very high density of quasi-one dimensional defects is obtained thanks to a two-steps process. Those defects, the so called flower defects [2], are promoted by gold atoms thanks to a drastic decrease of their formation energy, as evidenced by first-principles calculations. Scanning tunneling spectroscopy studies exhibit localized electronic states at high energy which depends on the twisted angle between the two upper graphene surface layers, very similar to electronic states observed on extended grain boundary loops [3]. Interestingly, we observe low energy states near the Fermi level which are localized asymmetrically on the defect, breaking their apparent 6-fold symmetry. Those unknown in-(pseudo)-gap states could deserve future experiments and theoretical developments [4].

References

[1] Q. Berrahal et al., Carbon 170 (2020) 174
[2] E. Cockayne et al., Phys. Rev. B 83 (2011) 195425
[3] E Y. Tison et al., Nano Lett. 14 (2014) 6382
[4] M. Mirzakhani et al., Phys. Rev. B 101 (2020) 075413

Figures

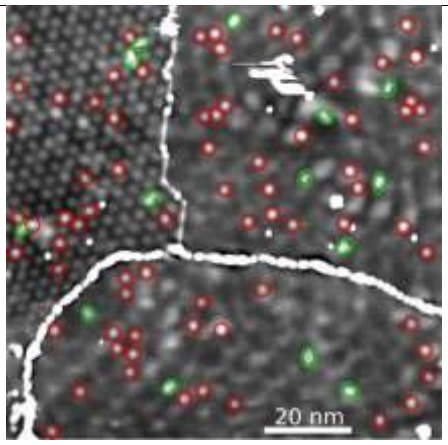

Figure 1: STM image of three domains of few layer graphene. Flower defects (resp. bigger loops) are circled in red (resp. green).

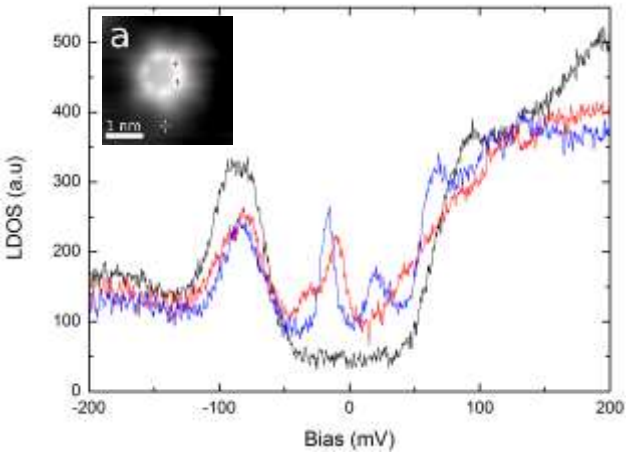

Figure 2: dI/dV spectra taken on (a). The black curve is taken on the graphene and shows the phonon gap. The red and blue curves are taken on two different lobes of the defect.