The effect of defects produced by electron irradiation on the electrical properties of graphene and MoS2

Adrian Balan*+, J. A. Rodriguez- Manzo*, M. Puster*, P. Masih Das*, C. Nayor*, A.T.C. Johnson*, M. Drndic*,

University of Pennsylvania, 209S 33rd St, Philadelphia PA, USA
Iramis, CEA Saclay, Gif-sur-Yvette, France

adrian.balan@gmail.com

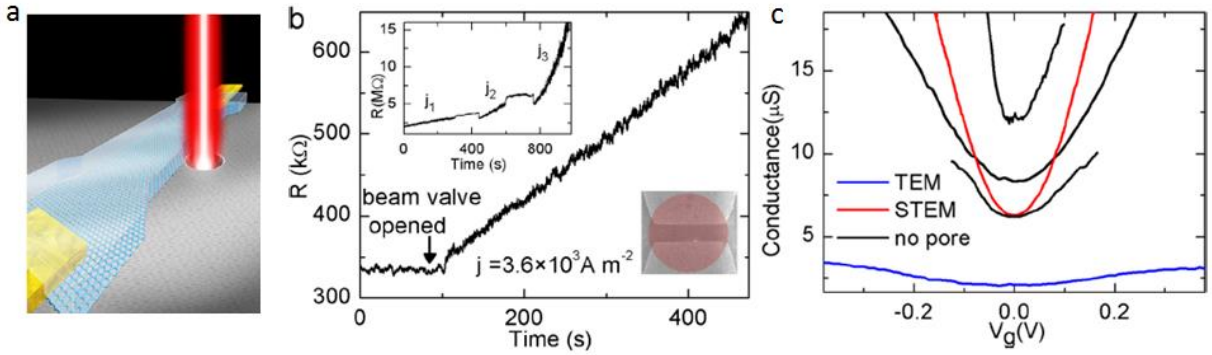
Abstract

We present a study of the effects of the defects produced by electron irradiation on the electrical and crystalline properties of graphene and MoS2 monolayers. We realized back or side gated electrical devices from monolayer MoS2 or graphene crystals (triangles respectively hexagons) suspended on a 50nm SiNx m. The devices are exposed to electron irradiation inside a 200kV transmission electron microscope (TEM) and we perform in situ conductance measurements [1]. The number of defects and the quality of the crystalline lattice obtained by diffraction are correlated with the observed decrease in mobility and conductivity of the devices. We observe a different behavior between MoS2 and graphene, and try to associate this with different models for conduction with defects. Finally, we use the TEM electron beam to tailor the macroscopic layers into ribbons to be used as the sensing element in MoS2 nanoribbon - nanopore devices for DNA detection and sequencing .

References

[1] Towards sensitive graphene nanoribbon-nanopore devices by preventing electron beam induced damage. M. Puster, J. A. Rodriguez- Manzo, A. Balan, M. Drndic. ACS Nano,10.1021/nn405112m.

Figures



a) Schematic representation of the monolayers exposed to the electron beam. b) Increase of resistance of graphene with dose c) Conductance vs gate voltage for pristine and irradiated devices.