Current-Induced Heating and Reduction of Graphene Oxide

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Abstract

Flakes (or nanosheets) of graphene oxide (GO) can be produced by chemical exfoliation of graphite and show different morphologies, dimensions, texture and surface chemistry.[1-4] GO nanosheets, in particular, may find application in energy storage, sensors, catalysis and water treatment. Whilst the thermal and chemical reduction methods of GO have been largely investigated, there is little information available on electrically-driven approaches. Here, flat GO nanosheets were synthesized by modified Hummers' method and loaded onto custom-made electrical devices for in-situ transmission electron microscopy (TEM). The increasing current density passing through the isolated GO particles resulted in heating and, after a while, the reduction of these to graphene. Structural and electrical data were acquired in- and out-side the TEM, permitting a "true" correlated analysis of localised changes in individual GO sheets subjected to resistive heating.

References

[1] Songfeng Pei, Hui-Ming Cheng, Carbon, 50 (2012) 3210
[2] Rajesh Kumar Singh, Rajesh Kumar, Dinesh Pratap Singh, RSC Advances, 6 (2016) 64993
[3] Dinesh K. Mahalingam, Shaofei Wang, and Suzana P. Nunes, ACS Appl. Nano Mater., 1 (2018) 4661
[4] Amira Alazmi, Omar El Tall, Shahid Rasul, Mohamed N. Hedhili, Shashikant P. Patole, Pedro M. F. J. Costa, Nanoscale, 41 (2016) 17782

Figures

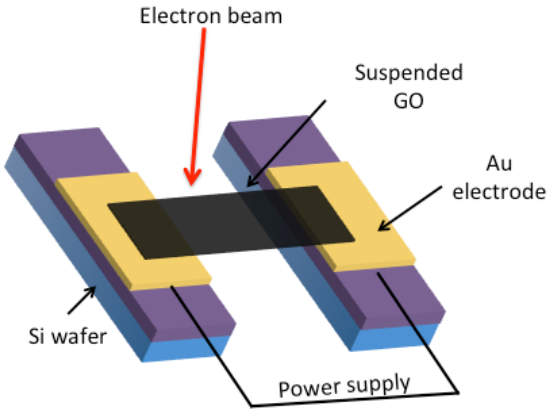

Figure 1: Schematic of an in-situ TEM electrical device loaded with a GO nanosheet.

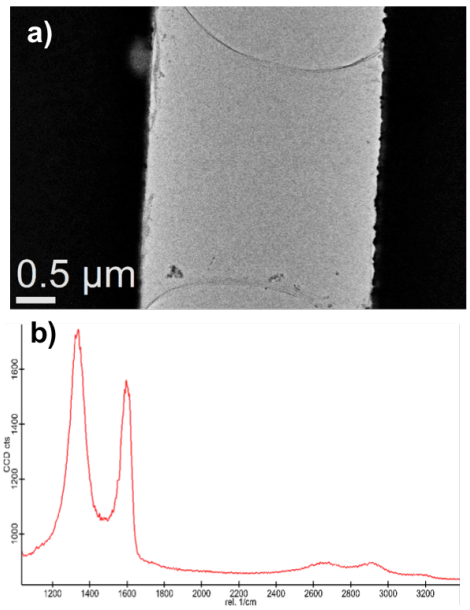

Figure 2: a) TEM image of a suspended GO nanosheet, b) Raman spectrum of the particle in a).