Thermal reduction of thin graphene films on different substrates monitored by AFM

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Abstract

The morphology, size and height of graphene sheets are currently analysed by AFM without much difficulty. However, when dealing with graphenes obtained by thermal reduction of graphene oxides, the sheets cannot be easily visualized by this technique, mainly because of their shape, roughness and typical wrinkles, which difficult their AFM monitorization at the different temperatures.

The aim of this work is to evaluate the effect of the thermal treatment on the graphene oxide (GO) sheet morfology in different substrates by means of AFM. For that, a GO obtained by a modified Hummer's method [1] and subsequently sonicated (exfoliated) for 8h [2], was initially drop casted into silicon and HOPG substrates. After that, the whole systems were heated in a horizontal furnace, at different temperatures, under a N_2 atmosphere (rGO). All films were characterized by AFM and SEM microscopy.

The lateral size of parent GO sheets, as determined by AFM, is about 1-2 µm and the height is 1.75 nm in both substrates, showing a homogeneous distribution of the sheets on each one. After the thermal treatment of the films at 700 ºC, it is observed that their thickness on HOPG decreases to a value below 1nm due to the loose of oxygen functional groups (about 8 wt % O content at 700ºC as compared with the 35 wt % of parent GO) (Fig.1a-c). However, on Si substrate the thickness doesn't change significantly at these temperatures (Fig. 1d-f). This is explained from the different type of interactions of the rGO sheets with the substrates during reduction (reconstruction of the sp2 carbon structure).

Acknowledgements: This work has been supported by the Spanish MICINN (TECNIGRAF (IPT-2011-0951-390000) and Ramon y Cajal program of P. Alvarez). A. Perez-Mas acknowledges a fellowship from FICYT.

References

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[2] C. Botas et al. Carbon **63** (2013) 576

Figures

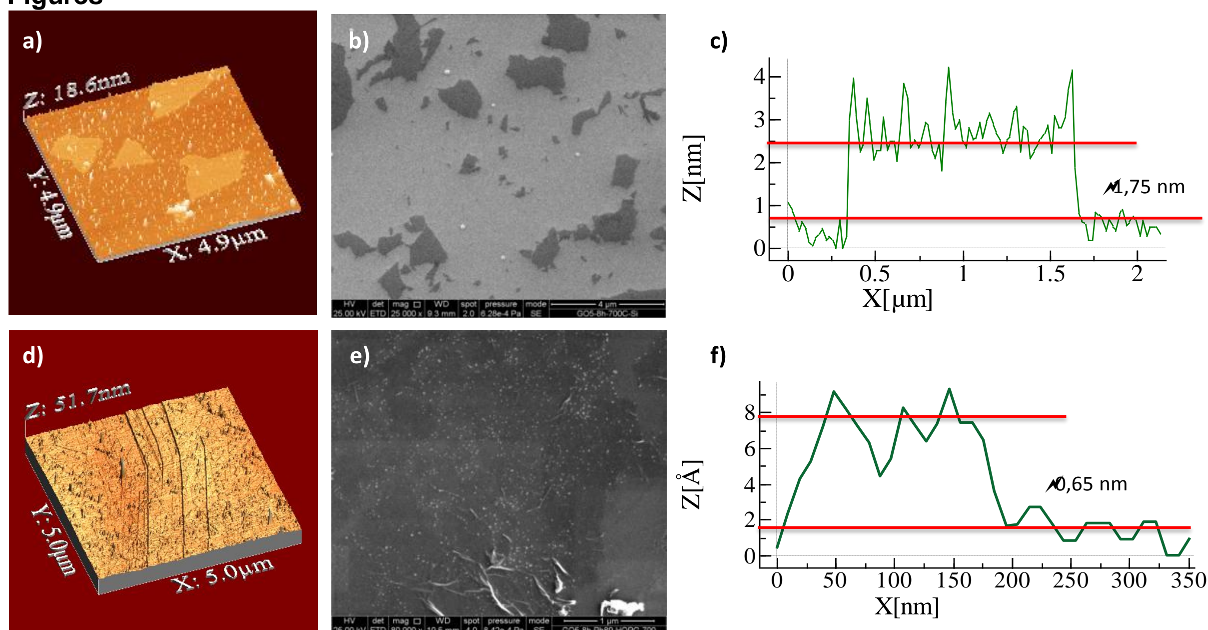

Figure 1. (a, d) AFM 3D topography, (b,e) SEM image, and heigh profile average (c, f) of graphene oxide reduced at 700ºC on a silicon substrate (a, b, c) and HOPG (d,e,f).