STM and STS measurements of GO single layers

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Abstract

Graphene oxide (GO) raised substantial interest in the last two decades thanks to its unique properties beyond those of pristine graphene, including electronic energy band-gap, hydrophilic behavior and numerous anchoring sites required for functionalization[1]. In addition, GO was found to be a cheap mass-production source for the formation of the pristine graphene. However, the presence of numerous clusters containing oxygen functional groups (called oxygen debris[2]) on the GO surface hinders the GO integration in electronic devices.
Here, we present a simple method aimed to reduce the density of oxygen debris weakly bonded to the surface. The method consists of minimal treatments, like sonication and/or water rinsing processes. Whereas this simple method removed epoxy and hydroxyl oxygen groups weakly attached to the graphene matrix, the double C=O bonds are almost not affected by the applied treatment, as demonstrated by X-ray photoelectron spectroscopy and Fourier transform infrared spectroscopy. Scanning tunnelling microscopy and high-resolution transmission electron microscopy measures designated non-uniform distribution of the oxidation sites, appearing as clusters concentrated preferentially on GO defected regions, albeit separated by pristine graphene areas. The results should have an impact in the implementation of GO in electronic devices deposited on different substrates.

References

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Figures

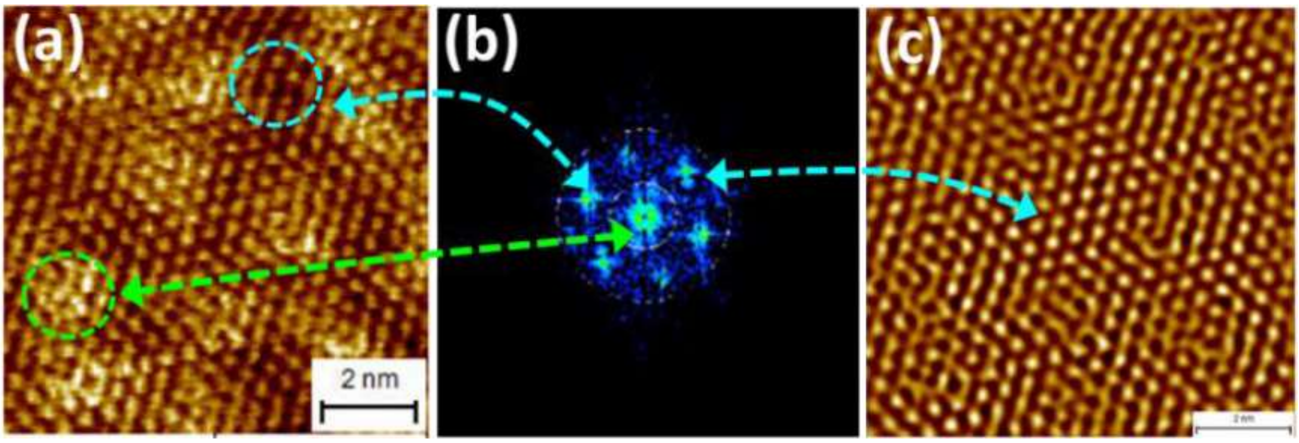

Figure 1: Characterization of the as-purchased GO multilayer samples: (a) A STM image; (b) Fourier transform of image in (a), showing two distinct regions: An inner part at low frequency, corresponding to a distorted region as framed by a green line in (b); An outer-ring at a higher frequency, related to the "graphenic" region marked by blue-line in (a). (c) Inverse Fourier transform image considering only the higher frequencies in (b)

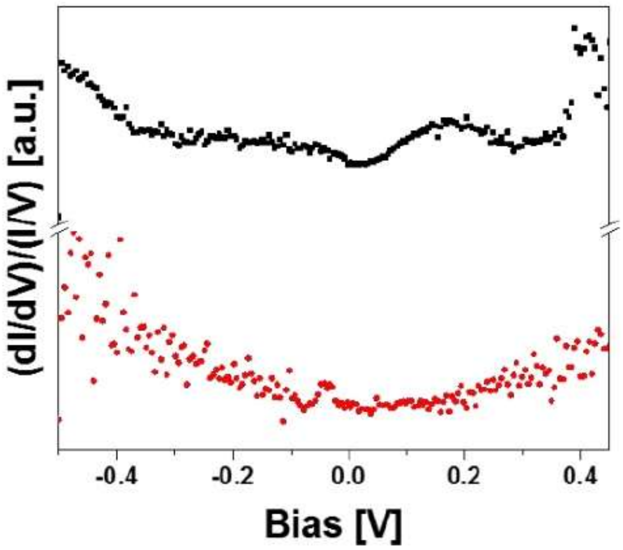

Figure 2: Characterization of the as-purchased GO multilayer samples. STS typical curves shows parabolic behavior (red) and shoulder at 0.2eV (black).