Statistical analysis of the reduction process of graphene oxide probed by Raman spectroscopy mapping

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Abstract

The oxidation level of GO or rGO strongly influences the electronic, optical and chemical properties, and it is crucial for their applications. To determine whether graphene oxide can be used in any of these applications the oxidation level or the effectiveness of the reduction process must be known, and thus the quality of the obtained material. We propose a systematic method for monitoring the large-scale homogeneity of the reduction process of graphene oxide. For this purpose, a Raman mapping technique is employed to probe the evolution of the phonon properties of two different graphene oxide (GO) thin films upon controllable thermal reduction. The reduction of GO is reflected by the upshift of the statistical distribution of the relative intensity ratio of the G and D peaks (ID/IG) of the Raman spectra and is consistent with the ratio obtained for chemically reduced GO. In addition, the shifts of the position distributions of the main Raman modes (D, G) and their cross-correlation with the ID/IG ratio provides evidence of a change of the doping level, demonstrating the influence of reduction processes on GO films. We also showed that for proper determination of the uniformity of the GO material, a statistical analysis of the *ID/IG* ratio should be used.

Figures

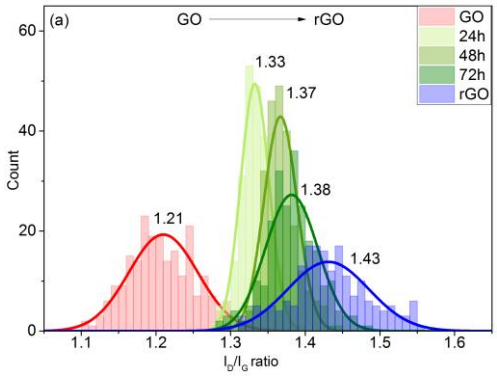

Figure 1: Evolution of the *ID/IG* ratio of GO upon thermal reduction. The solid lines in all histograms correspond to a Gaussian fit.

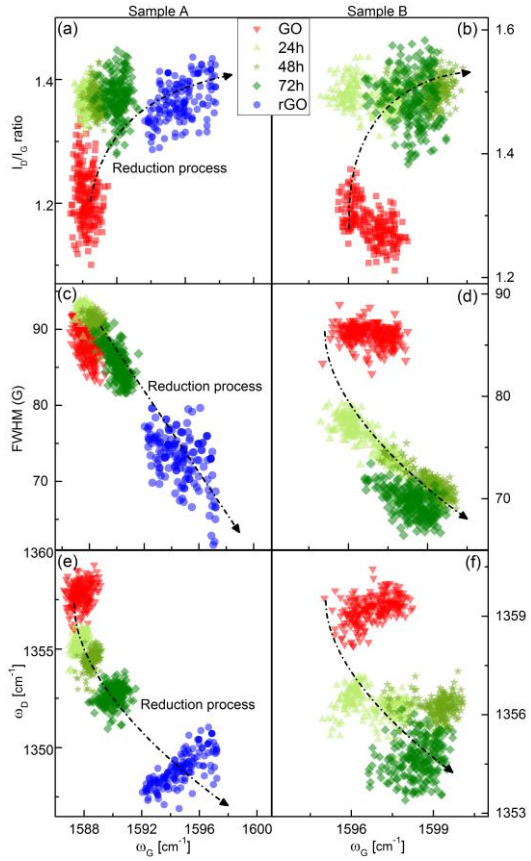

Figure 2: The *ID/IG* ratio versus (a) G peak position and (b) D peak position (provider A) upon thermal reduction. For provider B, the *ID/IG* ratio versus (c) G peak position and (d) D peak position. The dotted lines are a trend line.