Electronic Supplementary Information

Reduction of RGO by BH_3: Facile Route to Partially Hydrogenated RGO Preparation

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1. Raman spectra of RGO and HG

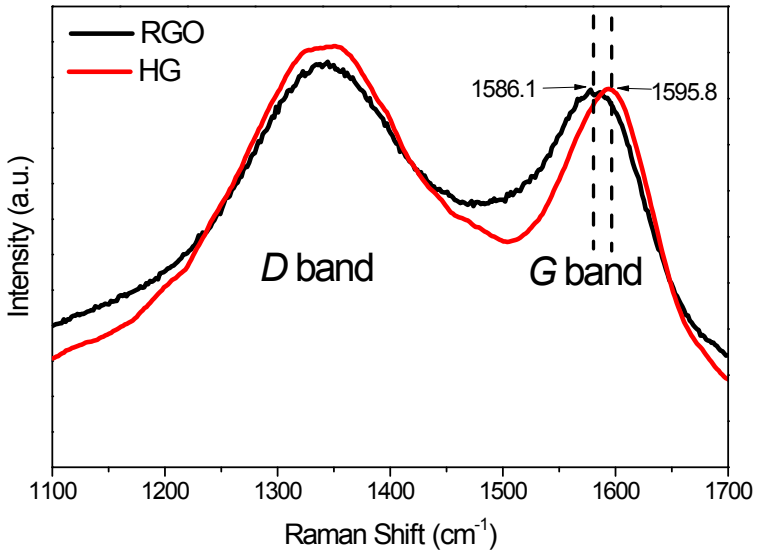

Fig.S1 Raman spectra of RGO and HG

Raman spectroscopy can be a valuable aid in the reduction of RGO. The intensity of the *D* band (at ~1350 cm^{-1}) that concerned with the breathing-like mode slightly increased. Whereas the *G* band (at ~1580 cm^{-1}) related to the in-plane vibrational (E_{2g}) mode showed an obvious blue shift (~9.7 cm^{-1}) after the hydrogenation, which should be assigned to the destruction of the π conjugated system on the carbon basal plane[1] and the transformation of many planar carbon atoms from sp^2 to sp^3.

2. EELS analysis: double windows method

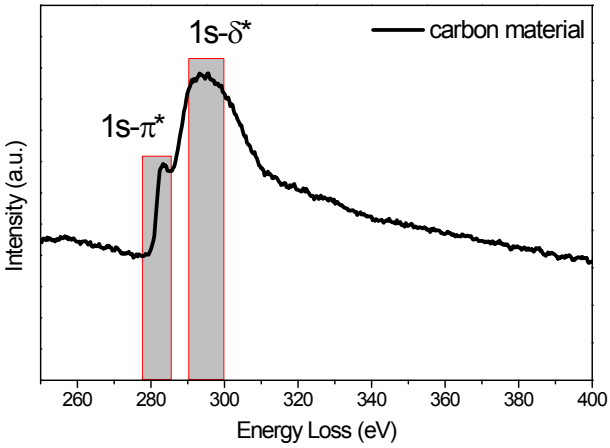

Fig.S2 EELS spectra of carbon material

The percentage of sp^2 carbon atoms can be given in this formula:

$\%\ sp^2 = [(I_{\pi*}/I_{(\pi*+\sigma*)})/(I_{\pi*}/I_{(\pi*+\sigma*)})_{gr}] \times 100\%$

In the formula, $I_{\pi*}$ represents the integral area of intensity with $\pi*$ peak as the center, and its energy window is about 5 eV. $I_{(\pi*+\sigma*)}$ represents the integral area of intensity including $\pi*$ and $\sigma*$ peaks with $\sigma*$ peak as the center, and its energy window is about 20 eV. When calculating, we can adjust the width of energy window slightly to make the results more accurate. The index of *gr* represents a kind of material with 100–percent sp^2 hybridized atoms, for example ideal monocrystal graphite. The grey rectangle represents the tunable energy window.

3. The theoretical calculation of the surface density

On average, there are two carbon atoms in every hexagonal ring, whose weight is $m=24/N_A$

Area of hexagon: $S=3\sqrt{3}a^2/2=2.6 \times (142 \times 10^{-12})^2\ m^2=5.24 \times 10^{-20}\ m^2$

So the carbon weight in per square meter is: $24/(5.24 \times 10^{-20} N_A)\ g\ m^{-2}=0.76\ mg\ m^{-2}$

The same procedure applied to HG gives a value of 0.66 mg m^{-2}. The detailed calculations were as follows:

Two carbon atoms in every hexagon on average, whose weight is $m=24/N_A$

Area of hexagon: $S=3\sqrt{3}a^2/2=2.6 \times (152 \times 10^{-12})^2\ m^2=5.24 \times 10^{-20}\ m^2$

So the carbon weight in per square meter is: $24/(5.24 \times 10^{-20} N_A)\ g\ m^{-2}=0.66\ mg\ m^{-2}$

In theory, we can conclude the decrease in the density of graphene after hydrogenation. And this result is consistent with the EELS spectra.

4. The X-ray Photoelectron Spectroscopy of hydrogenated graphene

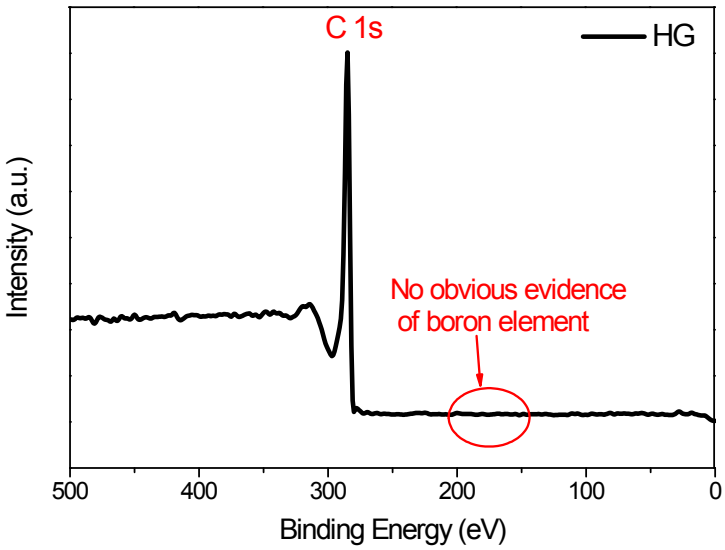

Fig.S3 XPS spectra of hydrogenated graphene

The element of boron shows peaks among 185–200 eV in X-ray Photoelectron Spectroscopy. Shown as Fig.S3, there is no obvious evidence of element boron after hydrolysis and this indicates the boron has been removed.

Reference

1. Y. Li, H. Y. Chen, L. Y. Voo, J. Y. Ji, G. H. Zhang, G. L. Zhang, F. B. Zhang and X. B. Fan, *J. Mater. Chem.*, 2012, **22**, 15021-15024.