Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics

Supporting Information

Graphene Ultracapacitor: Structure Impacts

Weixin Song[a], Xiaobo Ji[a,], Wentao Deng[a], Qiyuan Chen[a], Chen Shen[a] and Craig E Banks[b,]**

[a] Key Laboratory of Resources Chemistry of Nonferrous Metals, Ministry of Education, College of Chemistry and Chemical Engineering, Central South University, Changsha, 410083, China. Fax: (+86)73188879616; E-mail:xji@csu.edu.cn

[b] Faculty of Science and Engineering, School of Science and the Environment, Division of Chemistry and Environmental Science, Manchester Metropolitan University, Chester Street, Manchester M1 5GD, Lancs, UK. Fax: +44(0)1612476831;E-mail: c.banks@mmu.ac.uk

1. Experimental Section

GO was prepared by typical Hummers' method (purchased from XFnano, China). The suspension of GO (100 mg) dispersed in 3 mL distilled water was added to 5 mL 7M KOH aqueous solution, ultrasonic for 2 h. Then the mixture solution was dried within the lab environment at 60 ^{o}C for 20 h and the GO/KOH mixture was heated at 180 ^{o}C for 1 h in vacuum oven. After cooling down in vacuum, the sample was repeatedly dissolved in distilled water and neutralized with HCl until a PH value of 7 was reached. Then the solution was washed and filtered with distilled water for three times and dried at 60 ^{o}C in vacuum overnight to obtain AGO. 100 mg GO and AGO were dispersed into 100 mL distilled water, followed by dropping 2 mL hydrazine monohydrate (80%, w/v) into the suspension at 98 ^{o}C, respectively. The reduction process was finished after stirring and refluxing for 24 h, and the suspensions were filtered and washed by distilled water, dried at 50 ^{o}C in vacuum for 10 h to obtain RGO and ARGO.

All chemicals (analytical grade or higher) were used as received from Hengxing Co. ltd, Tianjin. All solutions were prepared with distilled water at a concentration of 0.3 mg/mL. Electrochemical characterization was carried out on Modulab (Solartron Analytical). For measuring the cyclic votlammetric responses, the modified electrodes were fabricated by pipetting 15 μL onto a GC electrode and drying at room temperature. For capacitance measurements, the working electrode was fabricated by mixing directly prepared GO, (or RGO, AGO, ARGO) with polytetrafluoroethylene (PTFE) at a weight ratio of 100:1, and the mixture was dropped and pressed onto the nickel foam under a pressure of 10 MPa. A three electrode system composed of the fabricated working electrode, platinum counter electrode and saturated calomel reference electrode was employed in 1 M Na_2SO_4 aqueous solution. SEM was carried out using FEI Quanta 200 scanning electron microscope, TEM was carried out on JEOL 2010F, and XPS was performed on VG-Microtech Multilab electron spectrometer. BET SSA of the slight GO, AGO and RGO could be obtained

accurately from the nitrogen adsorption isotherms by a freeze drying method carried on Quantachrome Nova 2000. The as-prepared powders were sonicated into deionized water to form the dispersed solutions with a concentration of 0.5 mg/mL, and the solutions were transferred to the fridge to freeze about 10 hrs. Then the refrigerant products were dried for 48 h by outgassing to form the vacuum conditions prior to the typical BET measurement carried out.

2. Scanning Electron Microscopy (SEM) of GO and AGO

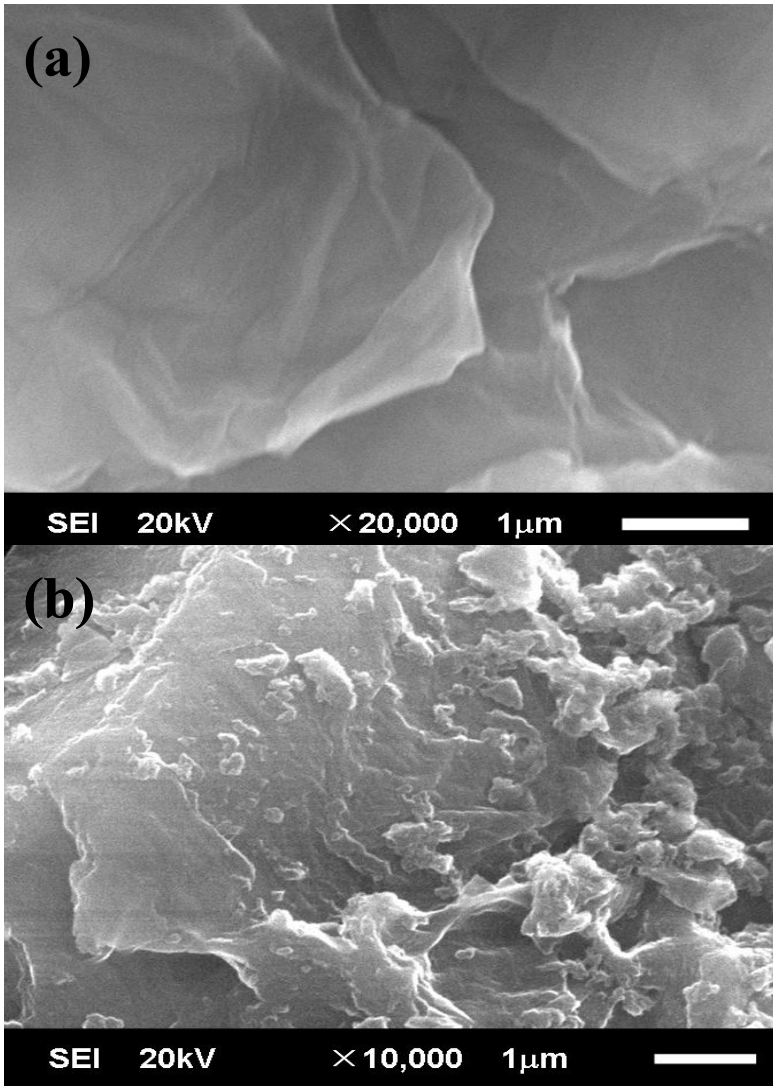

Figure S1. SEM images of (a) GO and (b) AGO

3. Diffraction rings from TEM

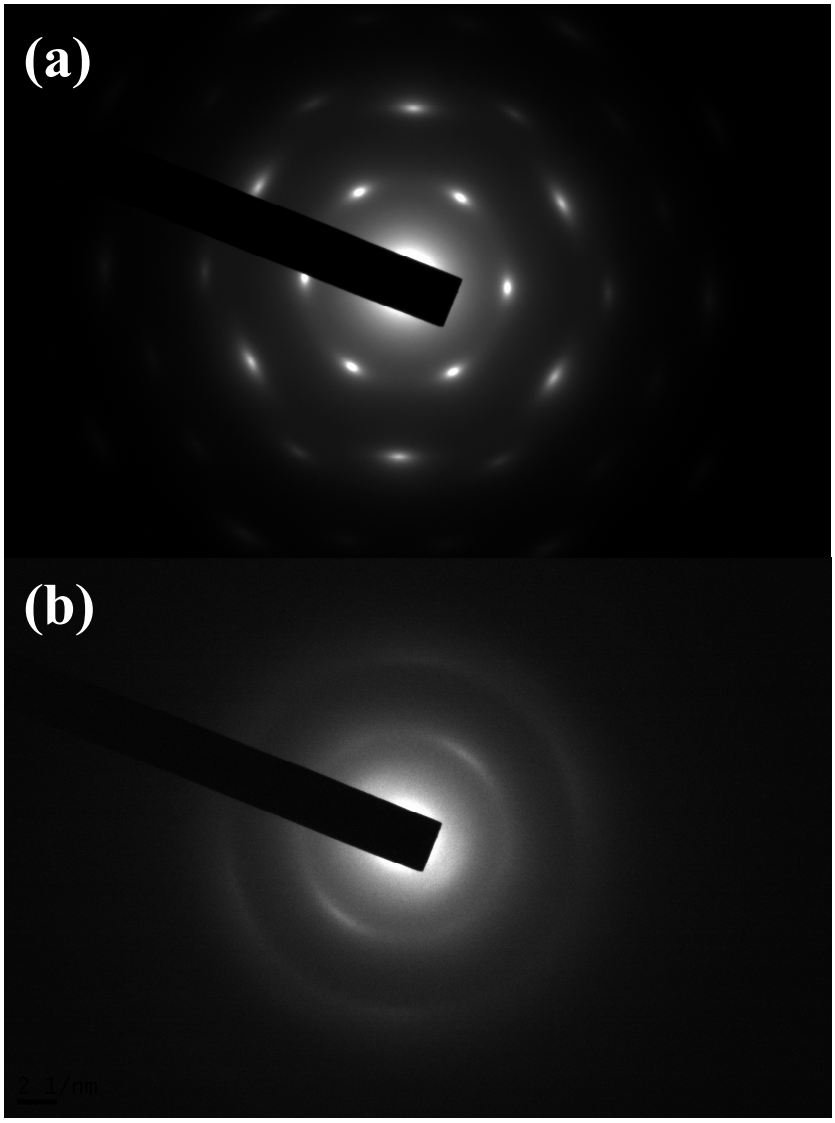

Figure S2. The diffraction images of (a) GO and (b) AGO

4. Nitrogen adsorption/desorption isotherms of GO, AGO and RGO

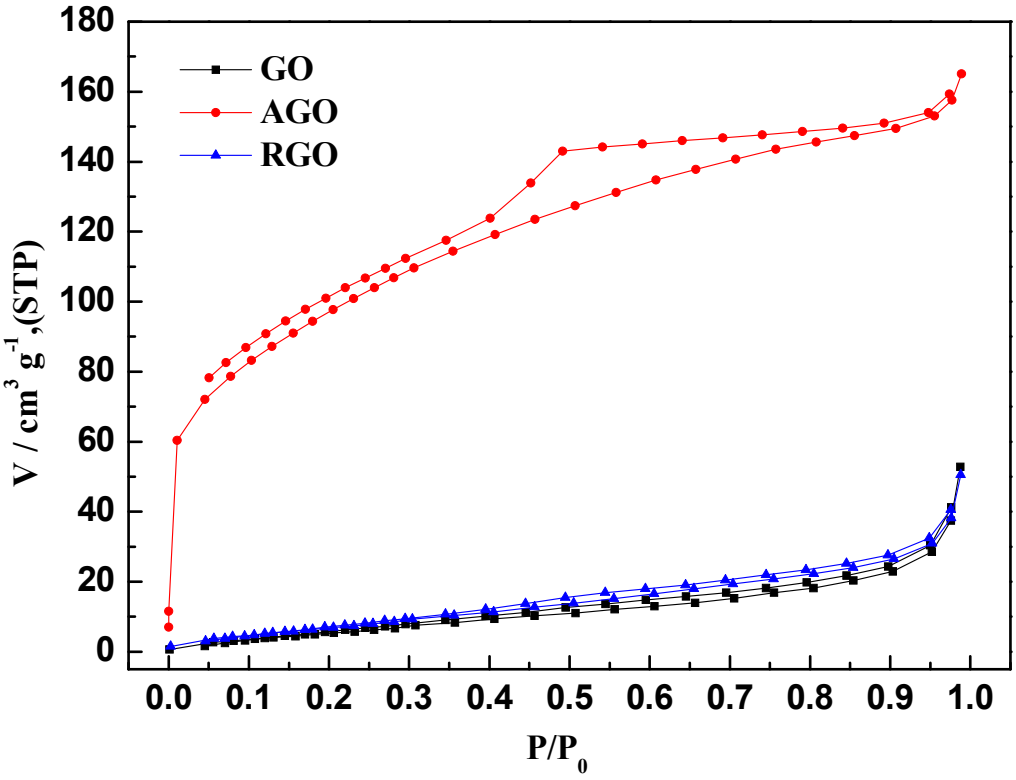

Figure S3. Nitrogen adsorption/desorption isotherms of GO, AGO and RGO

5. Cyclic voltammetric profiles of GO, RGO, AGO and RAGO modified GC electrodes

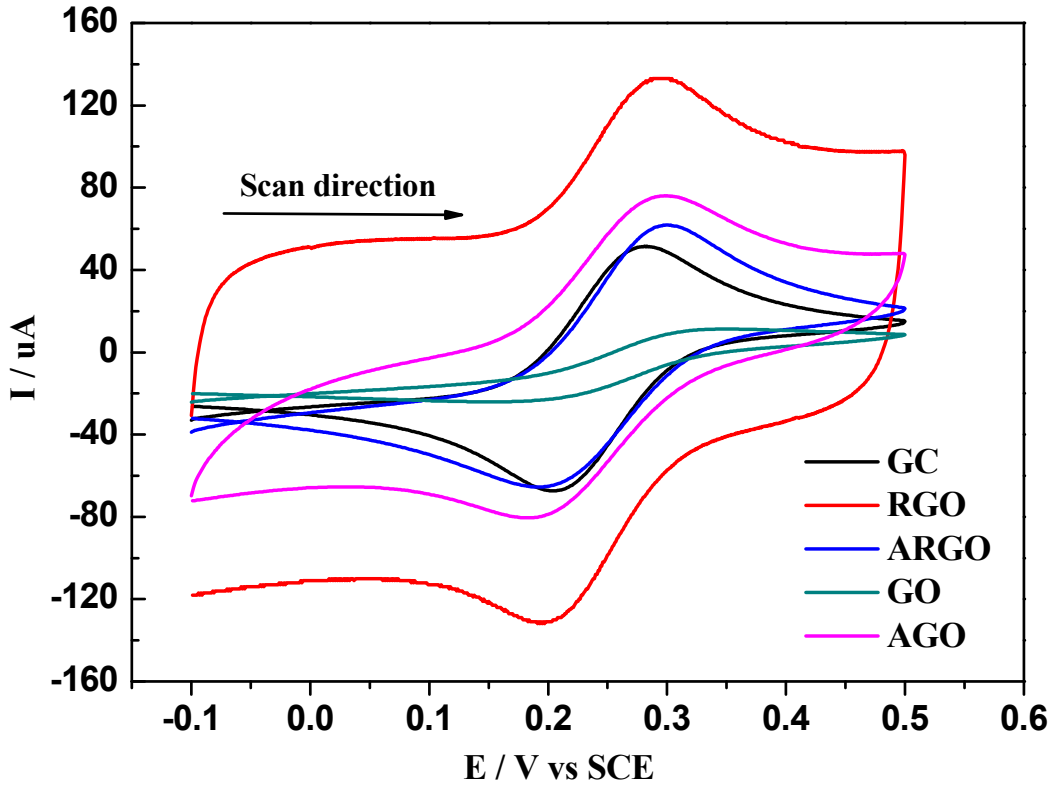

Figure S4. Cyclic voltammetric profiles recorded in 5 mM potassium ferrocyanide in 0.1 M potassium chloride for GO, RGO, AGO and RAGO modified GC electrodes. Scan rate: 100 mV/s, Counter electrode: Platinum, Reference electrode: SCE