Direct Fabrication of Nanoporous Graphene from Graphene Oxide by Adding a Gasification Agent to a Magnesiothermic Reaction

Zhenyu Xing,[a] Bao Wang,[a] Joshua Kane Halsted, [a] Raghu Subashchandrabose, [a] William F. Stickle [b] and Xiulei Ji [a] *

[a]Department of Chemistry, Oregon State University, Corvallis, Oregon 97331, United States

[b]Hewlett-Packard Co., 1000 NE Circle Blvd., Corvallis, Oregon 97330, United States

Experiment Section

In order to form $CaCO_3$/GO composite, we first mixed 600 mg CaO and 200 ml DI water by sonication for 8 h under CO_2 gas flow at a flow rate of 60 CCM. Then we added 100 ml GO aqueous suspension containing GO 60mg, prepared from modified Hummers method, into the $Ca(HCO_3)_2$ solution, and continued sonication for another 16 h under CO_2 gas flow. The mixture was dried in an oven at 50 °C for 48 h in order to convert $Ca(HCO_3)_2$ into $CaCO_3$. Then, we mixed the $CaCO_3$/GO composite with magnesium powder in mass ratio of 1 to 2 and conducted a reaction in the tube furnace at 650°C for 2.5 h under argon gas. Finally, the graphene product is collected after being washed with an aqueous solution of 1 M HCl, and oven dried at 60°C overnight.

Characterization methods:

The X-ray diffraction (XRD) patterns were collected using a Rigaku Ultima IV Diffractometer with Cu Kα irradiation (λ= 1.5406 Å). The morphology was examined by a field emission scanning electron microscopy (FESEM) using an FEI NOVA 230 high resolution SEM with an energy-dispersive X-ray (EDX) attachment. Transmission electron microscopy (TEM) images were recorded by a FEI Titan 80-200 TEM. High-angle annular dark field scanning TEM (HAADF-STEM) measurements were carried out on an FEI Titan 80-200 microscope coupled with a HAADF detector and an EDX spectrometer. Nitrogen sorption measurements were performed on Micromeritics TriStar II 3020 analyzer. X-ray Photoelectron Spectroscopy (XPS) measurements were performed in a Physical Electrons Quantera Scanning ESCA Microprobe with a focused monochromatic Al Kα X-ray (1486.6 eV) source for excitation. The X-ray beam used was a 25 W, 100 μm X-ray beam spot at the sample. The binding energy (BE) scale was calibrated using the Cu 2p3/2 feature at 932.62 ± 0.05 eV and Au 4f at 83.96 ± 0.05 eV. The ion gun used in this system was a standard Quantera ion gun, and the sputter depth profiles were acquired using a 1 KeV argon-ion beam

rastered over a 3 mm x 3 mm area. To minimize charging artifacts, the XPS data were collected with 1 eV, 20 μA electrons and low-energy Ar^+ ions.

List of Supporting Figures

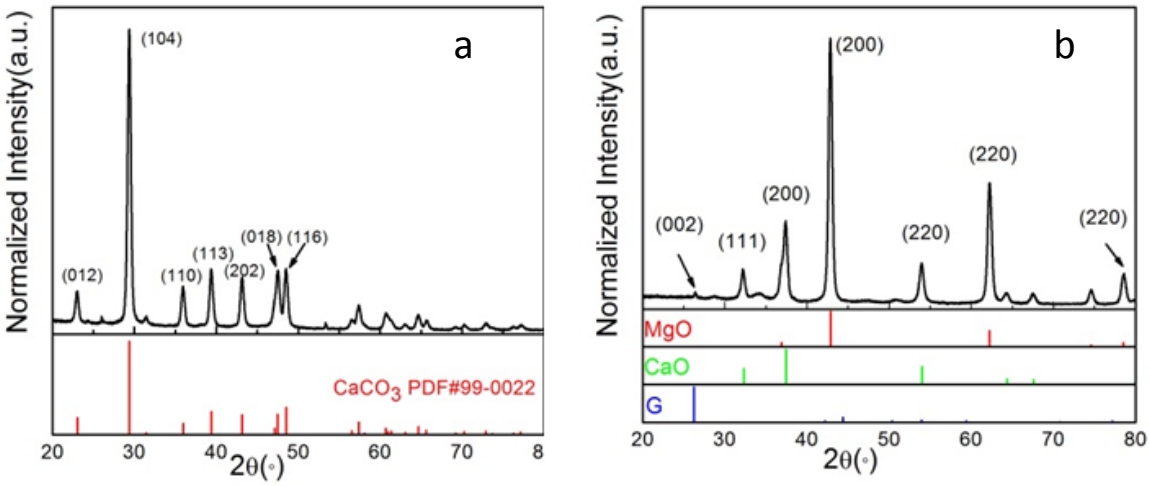

Fig. S1 XRD patterns of $CaCO_3$/GO **a** before and **b** after the magnesiothermic reaction.

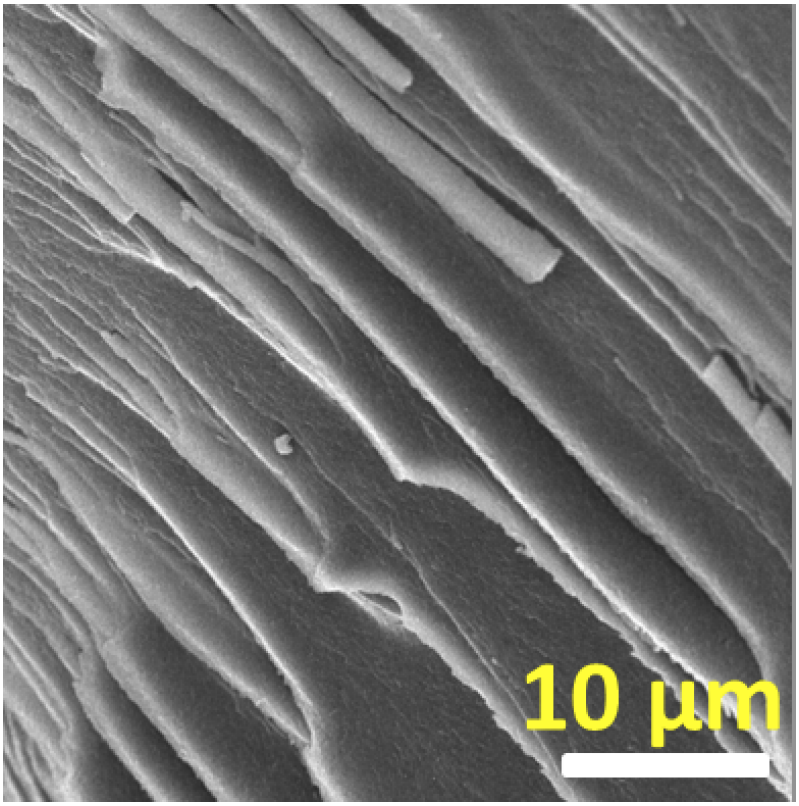

Fig. S2 SEM image of GC.

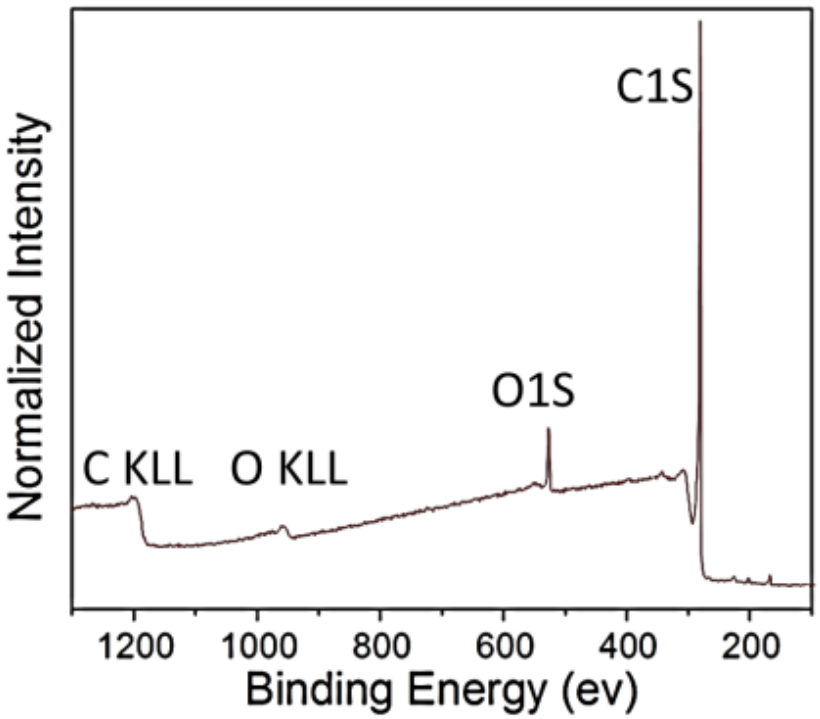

Fig. S3 XPS survey of GC-E.