Hierarchically Porous Graphene as a Lithium-Air Battery Electrode

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Supporting Information

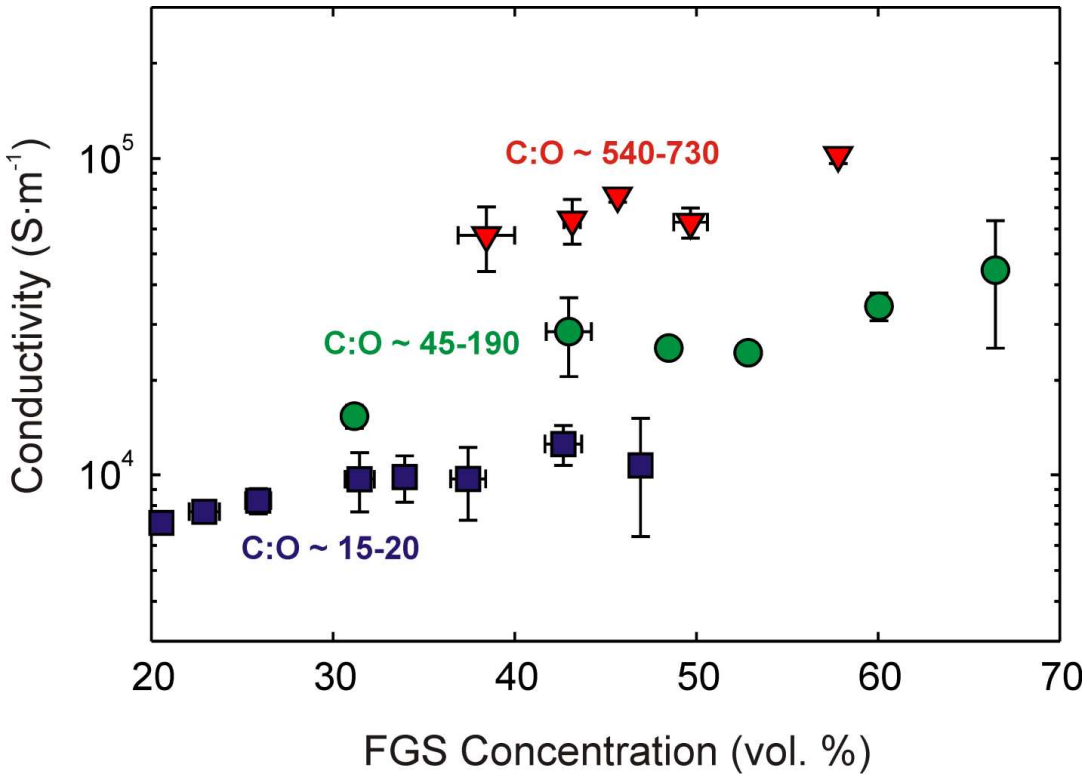


Figure S1. Electrical conductivity of the compressed FGS pellets as a function of C/O ratio and the FGS concentration of the pellets. Conductivity measurements were done on pellets prepared after annealing the FGS powder at 1100 ° and 2000 °C in argon atmosphere as detailed in Korkut, S.; Ozbas, B.; Milius, D.L.; Liu, J.; Aksay, I.A. "Effect of Annealing on the Structure and Electrical Conductivity of Functionalized Graphene Sheets" Chem. Materials (in review) (2011). The C/O ratios ranged from 45-190 and 540-730 for the annealing temperatures of 1100 ° and 2000 °C, respectively against a C/O ratio of 15-20 for the as-produced FGS. Due to certain degree of restacking of FGS during annealing, achievable FGS volume fractions through compression varied with the type of FGS. The upper and lower limits for the FGS concentrations were set by the packing efficiency of the powder and the mechanical integrity of the pellet respectively.

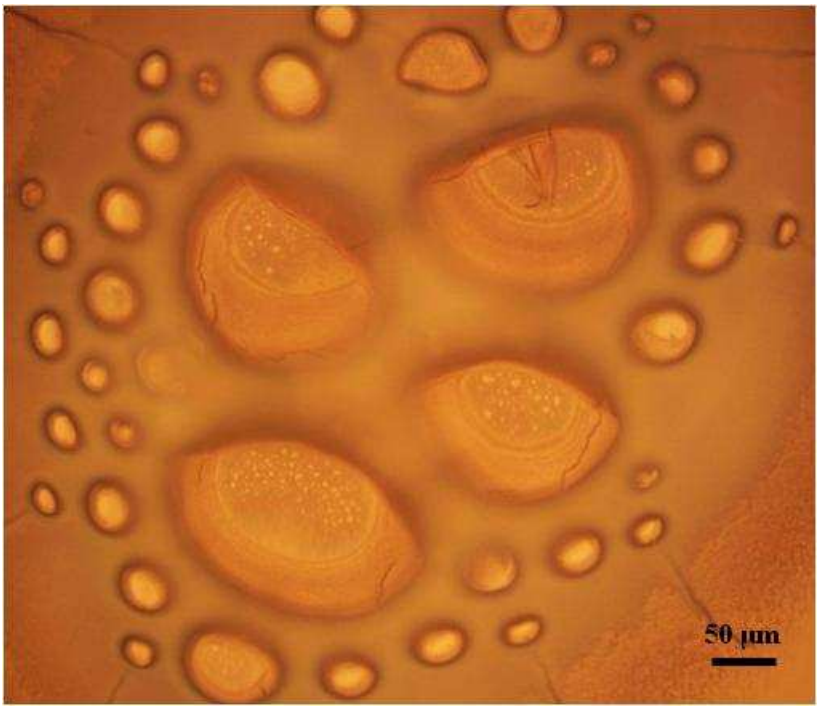
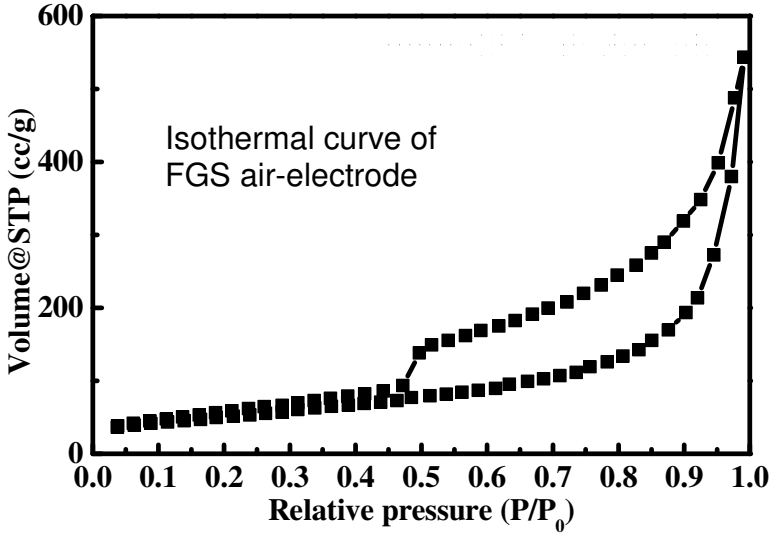
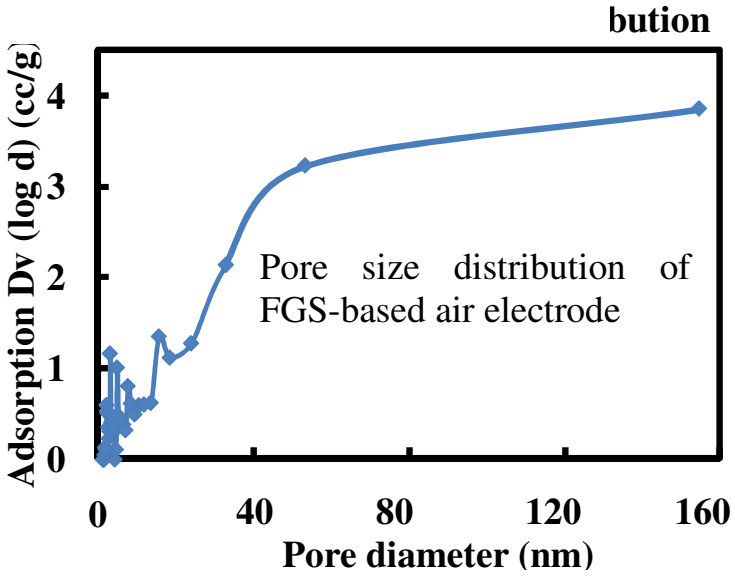


Figure S2. Optical microscopy image of the PTFE3859 emulsion dried on a glass slide. Because of the surfactant in the dispersion, bubbles easily formed during stirring. The bubble shapes are retained after drying, which matches the morphology of the graphene air electrode. The optical microscopy image was taken in a static state in which the bubbles are larger than those during the stirring process.



(a)



(b)

Figure S3. (a) The N_2 adsorption isotherm and (a) the BJH pore size distribution of the FGS-based air electrode. The average "pore" size is about 18.1 nm.

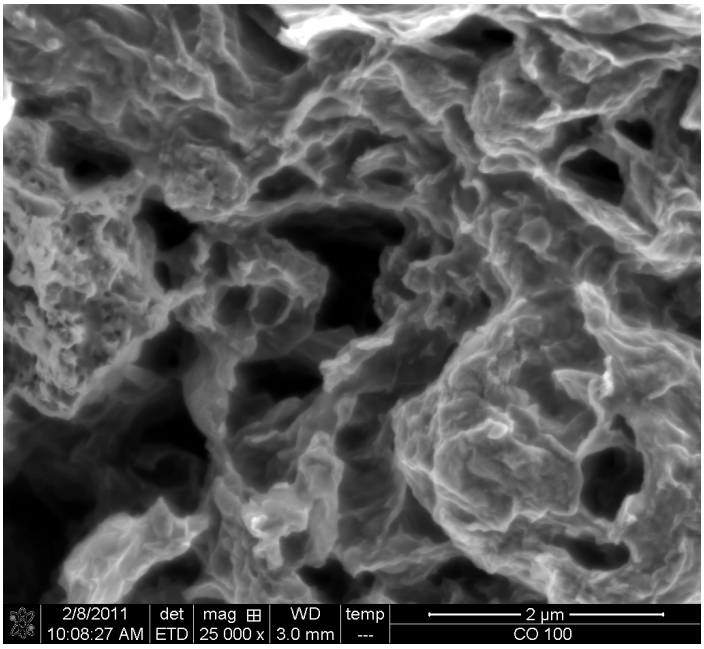


Figure S4. SEM image of the air electrode consisting of FGS with C/O = 100. It has similar "broken egg" shapes with big tunnels deep into the interior of the carbon electrode that promote the oxygen diffusion during discharge and thus the utilization rate of the whole carbon electrode.

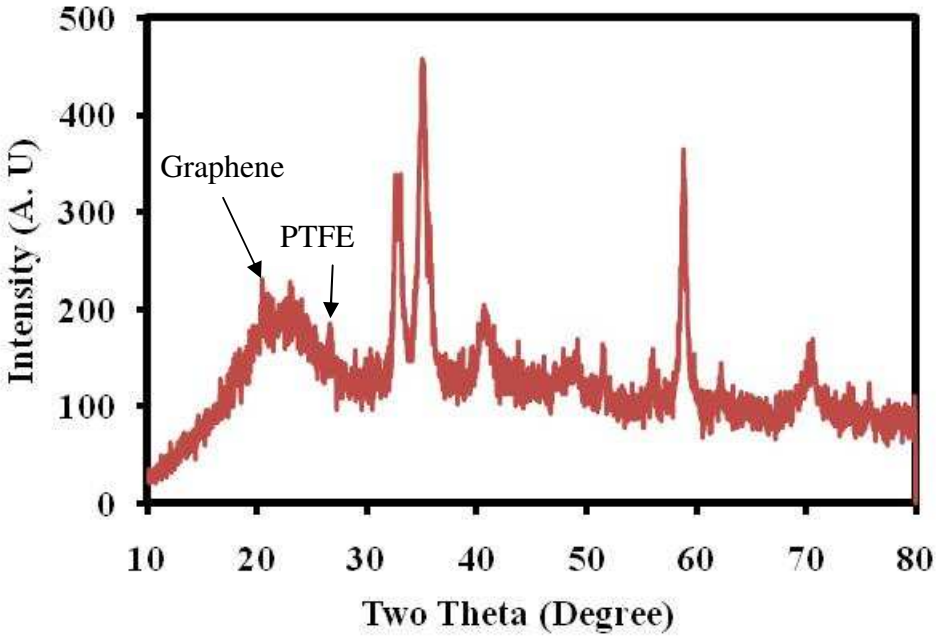


Figure S5. XRD pattern of discharged graphene-air electrode. The peaks associated with graphene and PTFE binder are labeled while all the other peaks can be indexed to Li_2O_2. No Li_2O was detected in the discharge product.

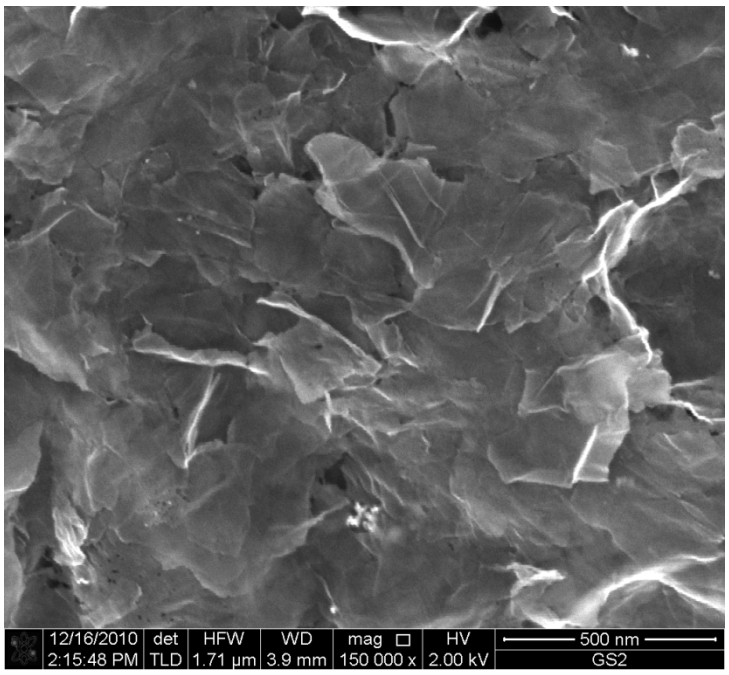


Figure S6. SEM image of graphene "paper" made by a traditional filtration method. The as-prepared electrode contains densely-packed graphene layers which impede gas flow when used as an air electrode. Electrolyte penetration into this dense graphene paper electrode is also difficult.