A robust, modular approach to produce graphene-MO_x multilayer foams as electrodes for Li-ion batteries

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Major breakthroughs in batteries would require development of new composite electrode materials, with a precisely controlled nanoscale architecture. Though, composites used for energy storage are typically a disordered bulk mixture of different materials, or simple coatings of one material onto another. We demonstrate here a new technique to create complex hierarchical electrodes made of multilayers of vertically aligned nanowalls of hematite (Fe_2O_3) alternated to horizontal spacers of reduced graphene oxide (RGO), all deposited on a 3D, conductive graphene foam. The RGO nanosheets act as porous spacers, current collectors and protection against delamination of the hematite. The multilayer composite, formed by up to 7 different layers, can be used with no further processing as an anode in Li-ion batteries, with a specific capacity up to 1175 µAh cm^{-2} and a capacity retention of 84 % after 1000 cycles. Our coating strategy gives improved cyclability and rate capacity compared to conventional bulk materials. Our production method is ideally suited to assemble an arbitrary number of organic-inorganic materials in an arbitrary number of layers.

References

[1] Xia, Z. et al., Nanoscale, accepted (2019)
[2] Xia, Z.Y. et al., Carbon, 84 (2015) 254
[3] Xia, Z.Y. et al., ChemPlusChem, 3 (2014) 439
[4] Xia, Z.Y. et al., Advanced Functional Materials, 37 (2013) 4684

Figures

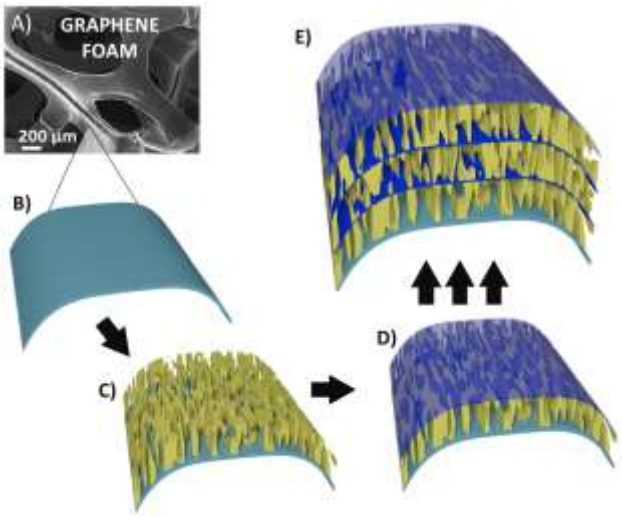

Figure 1: *Schematic illustration of the production of multilayer RGO-Fe_2O_3 graphitic foam architectures.*

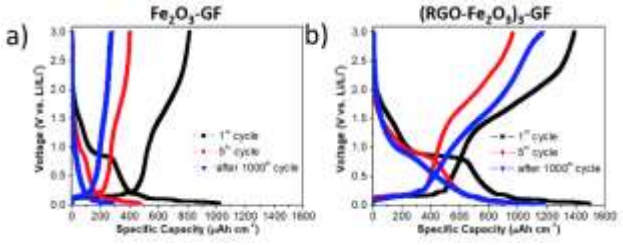

Figure 2: *Charge-discharge profiles of a) single and b) triple (RGO-Fe_2O_3)$_3$ electrodes at 0.2 C.*