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Graphene oxide-carbon nanotubes aerogels with high sulfur loadings suitable as binder-free cathodes for high performance lithium–sulfur batteries

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Abstract

Herein we report a simple approach for the preparation of graphene oxide-carbon nanotube-sulfur composites. The self-standing composites can be easily prepared by freeze drying a frozen graphene oxide-carbon nanotube suspension, and then impregnated with sulfur by melt diffusion. Composites obtained in this way are physicochemically characterized by elemental analysis, X-ray diffractometry (XRD), electron microscopy and gas adsorption, showing a three dimensional macroporous graphene-based architecture in which sulfur is homogeneously distributed. The performance of self-standing composites with sulfur loadings over 4.0 mg cm^{-2} is evaluated as binder-free positive electrodes for Lithium-Sulfur (Li-S) batteries. Results show that the incorporation of just 2 wt.% of CNTs significantly improves both the specific capacity and capacity retention compared to the results shown by the CNT-free samples, and slightly improves the performance of thermally reduced samples. More importantly, reversible specific capacity values over 500 mAh g^{-1} at a rate of 0.1C after 100 charge/discharge cycles are obtained for either thermally reduced and CNT containing samples, which in terms of areal capacity correspond to values over 2.0 mAh cm^{-2}.