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Hydrothermally reduced graphene oxide for the effective wrapping of sulfur particles showing long term stability as electrodes for Li-S batteries

J.L. Gómez-Urbano [a], J.L. Gómez-Cámer [a], C. Botas [a], N. Díez [a], J.M. López del Amo [a], L.M. Rodríguez-Martinez [a], D. Carriazo [a, b] ✉, T. Rojo [a, c]

[a] CIC EnergiGUNE, Parque Tecnológico de Álava, 01510, Miñano, Álava, Spain

[b] IKERBASQUE, Basque Foundation for Science, 48013, Bilbao, Spain

[c] Departamento de Química Inorgánica, Universidad Del País Vasco UPV/EHU, 48080, Bilbao, Spain

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Abstract

Lithium-sulfur batteries (Li-S) are identified as one of the most promising rechargeable energy systems due to their high theoretical capacity, high gravimetric energy density, low cost and low environmental impact. However, the insulating nature of sulfur and the migration of soluble polysulfides during discharge limit their practical application. In an attempt to mitigate these drawbacks here we report the preparation of a novel composite formed by hydrothermally reduced graphene oxide (HrGO) and submicrometer-sized sulfur particles. The role of HrGO is not restricted to enhance the electronic conductivity of the composite, but also sulfur wrapping in order to prevent polysulfides migration. Besides, the addition of polyvinylpyrrolidone (PVP) during the synthesis of the sulfur particles allows a greater control of their size and improves its homogeneous distribution within the composite. The material is tested as cathode for Li-S batteries showing reversible capacities over 900 mAh g^{-1} at a rate of 0.2 C and more than 650 mAh g^{-1} after 100 charge-discharge cycles. Moreover, this simplistic and environmentally friendly approach allow obtaining composites with sulfur loadings as high as 92 wt%, and large areal capacities up to 1.5 mAh cm^{-2}.

Graphical abstract