Nanohole-Structured, Iron Oxide-Decorated and N-doped Heteronanostructure as Lithium Ion Battery Anode

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Rechargeable lithium ion batteries (LIBs) are establishing their foremost position as universal power sources for portable energy storage systems due to their high capacity, high energy density, and long cycle life. [1] Generally, graphitic materials are commercially used as anode materials in LIB because of structural stability during cycling and flat potential profile versus lithium. However, graphite as an anode material in LIBs has a theoretical limit of the specific capacity (372 mAh g^{-1}) due to restacking effect, there are challenging issues remained for developing high energy density, long life cycle and cost-effective anode materials for the next-generation LIB electrodes.[2] Recently, it has been shown that the composite of 2D graphene sheets into 3D structures can provide with fast ion and electron transport kinetics for the combination of the 3D interconnected framework and the exciting properties of graphene [3]. Here, we report a nanohole-structured, iron oxide-decorated and gelatin-functionalized graphene aerogel (D-N-GGA) for high rate and high capacity lithium-ion anode. Initially, defective nanoholes by microwave irradiated (MWI) iron nanoparticles on the planar surface of exfoliated graphene layers were generated to offer effective path way of lithium ions. Concurrently, gelatin in GGA undergoes degradation under MWI to form nitrogen-doped graphene aerogel introducing more active sites for lithium ion storage. D-N-GGA synthesized by two-step MWIs using two different iron sources, shows 3D interconnected macroporous structure with uniform decoration of iron oxide nanoparticles and nanoholes, resulting in highly conductive networks and short diffusion lengths for effective lithium ion transport. Therefore, the obtained D-N-GGA nanostructure exhibited remarkably high specific capacity and rate capability.

References

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[3] L. Xiao, D. Wu, S. Han, Y. Huang, S. Li, M. He, F. Zhang, X. Feng., *ACS Appl. Mater. Interfaces*, 5, **2013**, 3764.

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Figures

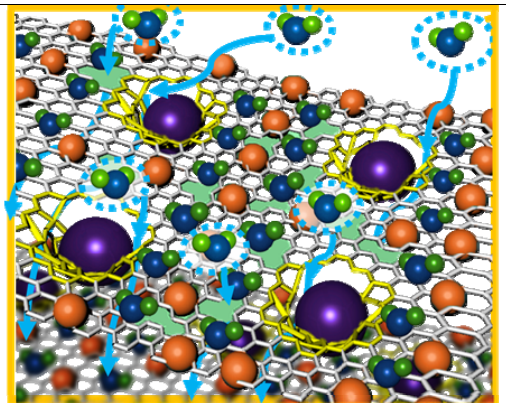

Figure 1: Schematic diagram for charge and discharge in D-N-GGA anode material.

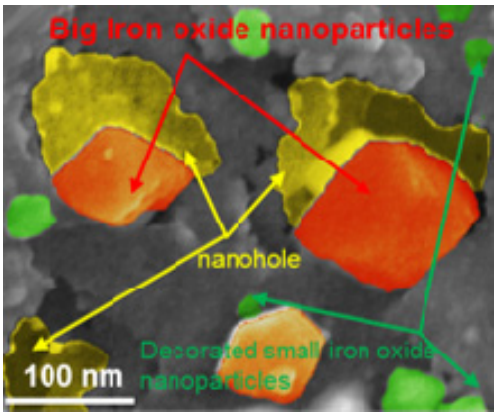

Figure 2: Scanning electron microscopy (SEM) image of D-N-GGA.