Synergetic Protection Hollow Silicon by Nitrogen-Doped Carbon/Reduced Graphene Oxide to Improve the Electrochemical Stability as Lithium-Ion Battery Anode

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Silicon is the most sought-after candidates for next-generation electrode materials for high energy density lithium ion battery because of its high theoretical capacity and appropriate working potential. However, it still suffers from dramatic volume expansion/shrinkage during repeat discharge/charge process, along with unstable solid electrolyte interface films, which largely degrade its practical application. To overcome these problems, we present an approach to synthesize hollow silicon@nitrogen-doped carbon/reduced graphene oxide (H-Si@N-C/rGO) composite via polymerization coating with dopamine on hollow Si and hydrothermal with graphene oxide followed by thermal reduction. The hollow structure of Si and intragranular voids between the Si nanoparticles significantly relief the volume change during lithiation/delithiation process. The synergetic protecting of nitrogen-doped carbon/reduced graphene oxide also improves the stability of surface of silicon. As a result, the H-Si@N-C/rGO composite delivers initial reversible capacity of 818 mAh g⁻¹ with retains 92% of initial capacity after 100 cycles at a current density of 0.2 A g⁻¹, and also displays stable cycling performance at a high current density of 1 A g⁻¹.

Keywords: Hollow silicon; Dopamine; Graphene; Lithium ion battery anode

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