Protective carbon-covered silicon nanoparticles with graphene buffer layers for Li-ion battery anodes

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Silicon is a promising anode material for use in lithium-ion batteries (LIBs). However, its volume expansion problem can cause critical issues that deteriorate efficiency, cycle life, and result in sudden breakage of battery cells. Herein, polyethylene glycol derived thin carbon-coated Si nanoparticles (Si/c-PEG) and graphene wrapping were used to block electrolyte contact and buffer volume changes, respectively. The hierarchical graphene wrapped Si/c-PEG (Si/c-PEG/G) exhibited excellent performance. Moreover, the full-cell configuration using Si/c-PEG/G anodes with commercial lithium cobalt oxides ($LiCoO_2$, LCO) exhibit fully function based on its stable performance. The bonding of PEG-funtional group layers minimize the exposed area of silicon to the electrolyte during lithium-ion storage.