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Rational design of coaxial MWCNTs@Si/SiO_x@C nanocomposites as extending-life anode materials for lithium-ion batteries

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Abstract

One-dimensional (1D) uniform multi-walled carbon nanotubes (MWCNTs)@Si/SiO_x@C nanocomposites were prepared by the magnesiothermic reduction of MWCNT@SiO₂ nanocables and subsequent carbon coating process. Through simply altering the acid-treatment conditions, SiO_x were reserved on the surface of MWCNTs to seal and fix the Si nanoparticles, along with the carbon coating layer, the reduced Si nanoparticles (Si NPs) were entirely encapsulated in the 1D coaxial nanocomposites. Due to the multiple volume expansion limit effects of inner Si nanoparticles, the cycling stability has been greatly improved. When worked as anodes for lithium-ion batteries, the MWCNTs@Si/SiO_x@C electrode exhibits better electrochemical properties than bulk Si and MWCNTs, as well as an extending cycle life of 500 cycles in comparison to our previous MWCNTs@Si nanocomposites. It is believed that the MWCNTs can provide structural support and enhance the electronic mobility, while the SiO_x and carbon buffer component would anchor the Si NPs firmly

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