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Structural investigation of Si nanoparticles-carbon nanofiber composite as flexible anode for high-rate lithium-ion batteries

Self-standing, binder-free and flexible anodes of silicon-carbon nanofiber composite are fabricated via electrospinning. The rate capability of the anodes of different fibers diameter are investigated for lithium-ion batteries. The embedded silicon nanoparticles inside carbon fibers are effectively protected from direct exposure to the electrolyte. This structure leads to vastly improved capacity retention during galvanostatic half-cell cycling. Cycling results showed that an electrode with 230 nm fiber diameter has enhanced cyclability and rate capability when compared to one with 620 nm diameter. Post-cycling investigations of the electrodes via SEM (Scanning Electron Microscopy) and EIS (Electrochemical Impedance Spectroscopy) reveals a better structural stability and less electrical impedance build-up with cycling for the electrode with thinner CNFs. This behavior is a result of a lower linear density of the SiNPs along the thin CNFs which avoids the formation of SiNPs clusters in the CNFs. Accumulated stress-strain over lithiation/de-lithiation is created in the thicker CNFs due to the volume change of Si which leads to breakage of the CNFs.

Biography

Vahide Ghanooni Ahmadabadi has received her MSc in Materials Science and Engineering from Ferdowsi University of Mashhad, Iran. She is currently a PhD candidate at Institute for Frontier Materials, Deakin University since 2015. Her research interest is focused on nanomaterials and metal-ion batteries.

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