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Advanced Materials 2019: Structural investigation of Si nanoparticles-carbon nanofiber composite as flexible anode for highrate lithium-ion batteries- Vahide Ghanooni Ahmadabadi, Deakin University

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Self-standing, binder-free and versatile anodes of silicon-carbon nanofiber composite are fabricated via electrospinning. the speed capability of the anodes of various fibers diameter are investigated for lithium-ion batteries. The embedded silicon nanoparticles inside carbon fibers are effectively shielded from direct exposure to the electrolyte. This structure results in 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 in comparison to at least one with 620 nm diameter. Post-cycling investigations of the electrodes via SEM (Scanning Electron Microscopy) and EIS (Electrochemical Impedance Spectroscopy) reveals a far better structural stability and fewer electrical impedance build-up with cycling for the electrode with thinner CNFs. This behavior may be a results of a lower linear density of the SiNPs along the skinny CNFs which avoids the formation of SiNPs clusters within the CNFs. Accumulated stress-strain over lithiation/de-lithiation is made within the thicker CNFs thanks to the quantity change of Si which results in breakage of the CNFs.

Lithium-ion batteries are a transportable power source with a high energy density and stable electrochemistry that have changed our daily lives. because of technological developments in areas like smartphones and electric vehicles, there's an increased demand for top energy density and fast-charging lithium-ion batteries which will provide greater power capacity. Recent battery fires and explosions have also led to a desire to enhance the security of energy storage systems. the planning of a completely unique negative electrode material can address the energy density, safety, and rate performance problems with conventional graphite electrodes that cause unsatisfactory electrochemical performances like low theoretical capacity (372 mAh/g), irreversible electrolyte and lithium consumption supported solid electrolyte interphase (SEI) formation, slow lithium intercalation, and dendrite formation during fast charging. Resolving these issues has been the main target of publications on novel lithium-ion battery anodes.

Electrospinning has been identified because the most promising route for designing novel anode materials and structures, due to the straightforward process setup and big variety of electrospinnable materials. The electrospinning process can encourage the implementation of existing anode material research supported the method having the ability to mass-produce anodes. Although nanofiber anode material research has mainly focused on developing carbon-, silicon-, and tin-based materials to exchange graphite anodes, there are numerous publications on a good sort of anode materials because of the merits of the electrospinning process. Here, examples to style the advanced anode materials supported the electrospun nanofibers are presented. Heteroatoms and pores were employed to extend the precise capacity of carbon anode. Carbon composited and nanostructured metal and metal oxide anode materials were designed to enhance cycling and rate performance. Lithiophilic nanofiber was fabricated to reinforce the reversibility of lithium plating and stripping. it's necessary to review previous research into electrospun nanofiber-based anode materials to determine better strategies for implementing nanofiber anode materials in commercial lithium-ion batteries and designing novel nanofiber anode materials for next-generation batteries.

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