



A Multi-Physics and Continuum Mechanics Approach of Lithiated Silicon Nanowires

Donald C Boone

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This study considers the electromagnetic stresses and simulates the lithium insertion into a silicon nanowire. The resulting model uses magnetohydrodynamic theory to explain the two detrimental effects that could result during the lithiated silicon process: (1) The partial lithiation effects that are observed in some silicon nanowires under no volume expansion; (2) The excessive volume expansion that is observed after full lithium ion insertion with a resulting Cassini oval shaped silicon nanowire. Magnetic fields are introduced into this simulation via the electromagnetic term in order to introduce additional compressive stresses that slows down the lithiation process and results in a partially lithiated silicon nanowire under certain boundary conditions. Also, additional tensile stresses are introduced via magnetic dipole moments into this simulation to explain the anisotropic volume expansion that can occur under certain situations.

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