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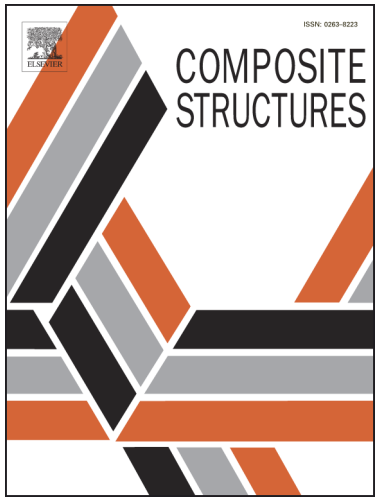

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Diffusion-induced stresses in graphene-based composite bilayer electrode of lithium-ion battery

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Abstract

The diffusion-induced stresses in a bilayer electrode composed of a current collector and a composite active plate of lithium-ion battery are evaluated analytically. The active plate of the bilayer electrode is reinforced by graphene platelets (GPLs), with the corresponding material properties predicted by the combination of the well-established Halpin-Tsai model and the rule of mixture. The diffusion-induced stresses and curvature of the bilayer electrode under either galvanostatic or potentiostatic charging operation are derived. In addition, modified Stoney formulas for the bilayer electrode are developed for the two charging operations. A parametric study is conducted through numerical examples, with a particular focus on the reinforcing effect of GPLs on the stresses and deformation in the bilayer electrode. The size effects of GPLs, including width, length and thickness, on the stresses and deformation are also discussed.

Keywords: Diffusion-induced stresses; graphene-based composite electrode; graphene platelets; Stoney formula.

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