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Studies on the lithium ion diffusion coefficients of electrospun Nb_2O_5 nanostructures using galvanostatic intermittent titration and electrochemical impedance spectroscopy

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ABSTRACT

We have studied the Li-diffusion coefficient values of electrospun Nb_2O_5 nanofibers and nanonuggets for lithium batteries. In brief, Nb_2O_5 nanofibers were prepared by electrospinning followed by sintering at temperatures range 500–1100 °C for 1 h in air to obtain pseudo-hexagonal, orthorhombic (O), and monoclinic (M) Nb_2O_5 phases. Electrochemical properties were evaluated by galvanostatic technique at room temperature. The H-, O- and M-Nb_2O_5 polymorphs delivered discharge capacities (at second cycle) of 152, 189 and 242 (±5) mA h g^{-1}, respectively. The lithium diffusion coefficients (D_{Li}) are calculated using galvanostatic intermittent titration technique (GITT) and electrochemical impedance spectroscopy (EIS) techniques carried at room temperature. The evaluated D_{Li} values by GITT for H-, O-, and M-Nb_2O_5 phases are in the range 10^{-17}–10^{-16}, 10^{-15}–10^{-14}, and 10^{-13}–10^{-12} cm^2 s^{-1}, respectively, in the voltage range 1.0–2.6 V vs. Li. D_{Li} evaluated by EIS gave similar trend in the values but with a difference of one order higher magnitude.

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