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ALD deposited thin films as model electrodes: a case study of the synergistic effect in Fe₂O₃-SnO₂

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TOPIC 4: Devices: integrating ALD processes for oxides, sulfides and nitrides

Abstract: Developing higher capacity electrode materials is a key challenge in battery research [1]. Materials which undergo conversion and/or alloying reactions such as Fe₂O₃ and SnO₂ offer a high theoretical capacity, but suffer from huge volumetric changes and poor conductivities [2], [3]. However, it is shown that combining the SnO₂ and Fe₂O₃ into a single electrode layer can induce a synergistic effect, enhancing electrode characteristics [3]–[6]. Using atomic layer deposition (ALD), we deposited carefully controlled model system thin-film electrodes of both phase-pure Fe₂O₃ and SnO₂, as well as mixtures thereof in the form of either nanolaminates and 'atomically intermixed' films. These were

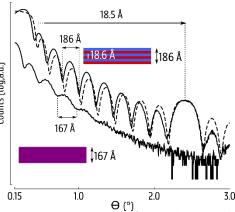


Figure 1: XRR spectrum of a nanolaminated and an intermixed sample, together with a nanolaminate simulation.

used to investigate the length scale of mixing at which these synergistic effects are maximized. It was found that intermixing at length scales at least lower than 2 nm is required for good cycling performance of intermixed transition metal oxide anodes.

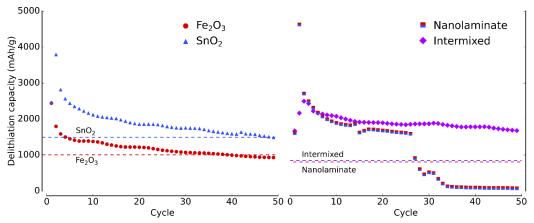


Figure 2: Capacities for 50 cycles for the four samples under investigation.

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