Improvement of the Performance of Silicon-Graphite Anodes by Ultrathin Atomic Layer Deposited ZnO Films

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Surface modification or coating of electrodes provides protection against side reactions resulting from liquid electrolyte/interphase interactions and enhances electrochemical properties. In this study, electrochemical properties of the ZnO-coated silicon-graphite anodes prepared by atomic layer deposition (ALD) were examined in a half-cell configuration with Li metal as a counter electrode. Rate capability test was performed to assess the behaviour of the anodes at different current densities in 0.01-1.5 V voltage window. Solid electrolyte interphase (SEI) and charge transfer resistance were investigated by electrochemical impedance spectroscopy (EIS). An important improvement of the discharge capacity for the ZnO-coated anodes was observed, especially at higher C-rates (1 and 2). It was shown that the formation of the SEI layer on porous silicon/graphite anode can be altered by ultrathin ALD application. In addition, X-ray photoelectron spectroscopy (XPS) analyses were carried out to investigate the surface properties of the anode before and after cycling. Inorganic compounds were detected as a consequence of electrolyte/interphase reactions and results were correlated with the obtained impedance values and the specific capacities.

Keywords: Atomic layer deposition, silicon, graphite, ZnO, anode