

# Electrochemical and Morphological Evaluation of Aluminum-Based Thin-Film Anodes for Lithium-ion Batteries

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Aluminum is an attractive anode material and can be considered as an alternative to carbon-based anode electrodes in lithium-ion batteries due to its high theoretical specific capacity ( $993 \text{ mAh g}^{-1}$ , AlLi), which is much higher than theoretical specific capacity of conventional anode materials ( $372 \text{ mAh g}^{-1}$ , graphite). In addition, aluminum and LiAl alloys have been investigated as an alternative to metallic lithium for batteries since the early 70's [1-3]. Aluminum also has advantages compared to other new alloy anodes because of its low cost and high abundance. However, aluminum as an anode material suffers from fast capacity fading upon cycling [4]. To overcome this issue, several attempts have been made to improve this material for example in aluminum-based composite anodes [5-9]. So far the knowledge concerning the degradation mechanism of aluminum-based anodes is still limited. Accordingly, the present work aims to study the capacity fading mechanism during lithiation/delithiation of aluminum and aluminum-based thin-film anodes synthesized by UHV sputtering. For this purpose, several electrochemical characterization techniques such as cyclic voltammetry, galvanostatic lithiation/delithiation tests and electrochemical impedance spectroscopy were used. Since different electrolytes and solvents produce different solid electrolyte interface (SEI) films and affect the electrochemical performance of the electrode, the effect of the electrolyte on the capacity fading rate of the aluminum-based electrodes were evaluated. The morphological evolution of the aluminum-based thin-film electrodes was also monitored by scanning electron microscopy during the electrochemical lithiation/delithiation process.

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