Morphology control of aluminium anodes in secondary aluminium batteries

Sandra Steiner[a], David Moser[b], Gerald Kothleitner[b], Bernhard Gollas[a]

[a]Institute for Chemistry and Technology of Materials, Graz University of Technology, Stremayrgasse 9/II, 8010 Graz, Austria
[b]Institute of Electron Microscopy and Nanoanalysis, Graz University of Technology Steyrergasse 17, 8010 Graz, Austria
sandra.steiner@tugraz.at

A promising alternative to Li-ion batteries are Al-ion batteries, which promise high energy density and low prices. One of the key objectives in the production of secondary Al batteries (e.g. Al-sulfur batteries) is compact Al deposition with high cycling efficiency.[1] However, aluminium, similar to Li, is prone to dendritic growth ultimately leading to device failure.[2] In our work, the deposition characteristics of the aluminium electrode were tested in a deep eutectic solvents (DES) based on aluminium trichloride and urea.[3,4] The open-circuit potential after immersion in the DES was monitored to obtain information about the surface state of the pure Al in contact with the electrolyte showing initial passivation of the surface. Electrochemical impedance data revealed that the electrolyte attacks the native oxide film only at certain sites creating pits of active Al on the surface (pitting corrosion), but the remaining area remained in the passive state.[5] Therefore, Al deposition was subject to high local current densities at pit sites, resulting in dendritic growth.[6] In an attempt to remove the passive layer in-situ, current and potential controlled methods were tested, which ultimately led to an active Al surface. Since battery safety is also a prime objective, the cycling behaviour of Al was also studied when using polymer gel electrolytes.

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