Li-Mg Hybrid Battery with Vanadium Oxychloride as Electrode Material

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Abstract

Metallic magnesium represents a promising solution for next generation electrochemical energy storage devices because of its dendrite-free electrodeposition, higher theoretical volumetric energy density, abundancy and safety compared to lithium technology. Nevertheless, Mg$^{2+}$ is strongly polarized, which slows down its diffusion during discharging/charging. An electrochemical energy storage device containing a metallic Mg anode, a Li intercalation cathode and a Li/Mg-electrolyte can be regarded as a solution to circumvent the intrinsic drawbacks linked to both Li- and Mg-electrochemistry.

In this contribution, we report on the performance of a VOCI/Mg cell containing a Li-Mg hybrid electrolyte. The cell delivered 195 mA h g$^{-1}$ at 100 mA g$^{-1}$ with a coulombic efficiency of 97.5 %. At 200 mA g$^{-1}$, after 150 cycles, 107 mA h g$^{-1}$ was measured with 99.5 % coulombic efficiency. At 500 mA g$^{-1}$, after 800 cycles, the cell still produced 75 mA h g$^{-1}$ with 99.8 % coulombic efficiency. Lithium reacted with VOCI first via an intercalation reaction and then in a conversion reaction to LiCl and VO. The co-deposition of Li at the anode, Li-Mg alloy formation or contributions from side reactions could be ruled out.