Interlayer-Expanded VOCl as Electrode Material for Magnesium-Based Batteries

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Abstract

Mg-based batteries, which use the Mg\textsuperscript{2+} shuttle, theoretically offer several advantages compared to the lithium technology such as higher theoretical volumetric capacity (3833 mA h cm\textsuperscript{-3}) of the Mg-metal anode, the possibility to be safely handled in air and dendrite-free electrodeposition.

In this study, vanadium oxychloride was employed as electrode material in a Mg-based battery. Since the cell delivered just 45 mA h g\textsuperscript{-1} in the first cycle, we tried to improve the delivered capacity by a preliminary cycling of the VOCl electrode with Li. The strategy is based on the ability of VOCl to expand its interlayer spacing upon intercalation of ions or molecules within them. In fact, a VOCl-electrode with expanded interlayer spacing should facilitate the intercalation of Mg\textsuperscript{2+}, thus leading to higher specific capacities. Structural and electrochemical characterisation was carried out by galvanostatic charge/ discharge tests, cyclic voltammetry (CV) and ex-situ X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD) as well as transmission electron microscopy (HR-TEM) coupled with energy dispersive X-ray spectroscopy (EDX) and electron energy loss spectroscopy (EELS).

The lithium-pre-treatment was able to promote the specific capacity by a factor of four (170 mA h g\textsuperscript{-1}) after the first discharge at 25 °C. Over 130 mA h g\textsuperscript{-1} were retained at 5 mA g\textsuperscript{-1} after 70 cycles

Submitted for publication: 02.08.2016

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