

TFSI based electrolyte solutions for secondary magnesium batteries

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MgTFSI₂ is the only known ether-soluble “simple” magnesium salt. The lack of suitable electrolyte solutions in which Mg metal anodes exhibit electrochemically reversible stripping/deposition behavior hinders the progress towards development of secondary magnesium batteries. MgTFSI₂/DME solutions were demonstrated to dissolve large quantities of MgCl₂ and produce electrolyte solutions with superior performance in terms of reversible behavior of Mg electrodes and a wide electrochemical window. However, ethereal MgTFSI₂/MgCl₂ electrolyte solutions don't reach the level of organometallic based electrolyte solutions in terms of prolonged reversibility of Mg anodes. We believe that the solutions purity level governs the overall electrochemical performance, especially in solutions where strong reducing moieties (i.e Grignard reagents) are not present to act as impurities scavengers. In this work, we improved the performance of the MgTFSI₂/MgCl₂ (DME) solutions through chemical and electrochemical conditioning and demonstrate the effect on the solutions' electrochemical characteristics during repeated prolonged Mg deposition/dissolution processes. We demonstrate relatively high reversible behavior of Mg deposition/dissolution with crystalline uniformity of the Mg deposits, complemented by a fully reversible intercalation/de-intercalation process of Mg ions into Mo₆S₈ reference model cathodes.

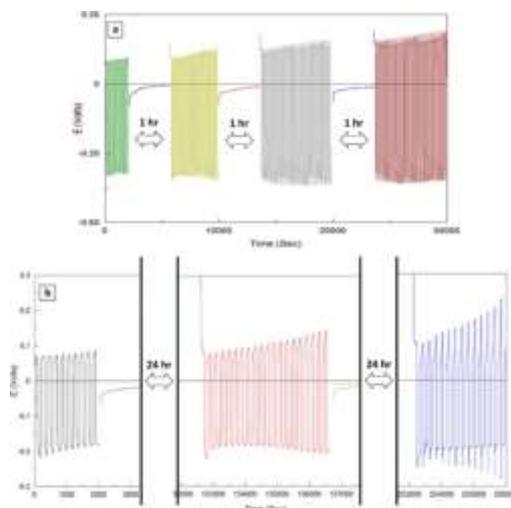


Figure 1- Macro reversibility cycling-hold measurements for conditioned MgTFSI₂ 0.25 M + MgCl₂ 0.5 M/DME solutions. Certain amounts of magnesium were deposited on Pt electrodes (corresponding to 0.5 Coulombs per cm²). These Mg (on Pt) electrodes thus formed were cycled galvanostatically at 20% depth of discharge (around 0.1 Coulombs per cm²) and at 1 mA/cm². Voltage profiles are presented (as indicated). Mg foils served as CE and RE. (a) The electrodes were held for 1 hr at OCV after each cycling period. (b) The electrodes here held for 24 hrs at OCV after each cycling period.