Oxygen reduction and evolution in an ionic liquid ([BMP][TFSA]) based electrolyte:

A model study of the cathode reactions in Mg-air batteries

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Abstract

Aiming at a molecular scale understanding of the cathode processes in an Mg-air battery, we have investigated the oxygen reduction (ORR) and oxygen evolution (OER) reactions under well-defined conditions, using an ionic liquid (butyl-1-methylpyrrolidinium bis(trifluoromethanesulfonyl)amide, [BMP][TFSA]) based electrolyte and polycrystalline Au and glassy carbon, respectively, as model electrodes. Electrochemical measurements performed under enforced electrolyte flow provide information on the electrochemical and electrocatalytic properties of these electrodes, in particular on the reversibility of the ORR/OER both in the absence and in the presence of Mg²⁺ in the electrolyte, and on the build-up of a reaction inhibiting passivation layer (solid-electrolyte interphase). Further information on the nature of the deposits and their dependence both on the electrode material and on the potential cycling conditions is derived from scanning electron microscopy / energy dispersive X-ray spectroscopy and from X-ray photoelectron spectroscopy measurements performed ex situ after the electrochemical measurements. Consequences of these results on the understanding of the ORR/OER under these conditions and in particular of the nature and role of the solid-electrolyte interphase layer formed during potential cycling and their relevance for the operation of Mg-air batteries are discussed.

Keywords: Mg-air battery, O₂ reduction reaction, O₂ evolution reaction, electrolyte degradation, interphase formation, Ionic liquid,

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