**Ionic Liquid Electrolytes for Metal-Air Batteries: Interactions between O₂, Zn²⁺ and H₂O Impurities**

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**Abstract**
Motivated by the potential of ionic liquids (ILs) to replace traditional aqueous electrolytes in Zn-air batteries, we investigated the effects arising from mutual interactions between O₂ and Zn(TFSI)₂ as well as the influence of H₂O impurities in the oxygen reduction / oxygen evolution reaction (ORR/OER) and in Zn deposition / dissolution on a glassy carbon (GC) electrode in the ionic liquid N-butyl-N-methylpyrrolidinium bis(trifluoromethanesulfonyl)imide (BMP-TFSI) by differential electrochemical mass spectrometry. This allowed us to determine the number of electrons transferred per reduced / evolved O₂ molecule. In O₂ saturated neat BMP-TFSI the ORR and OER were found to be reversible, in Zn²⁺ containing IL Zn deposition/striping proceeds reversibly as well. Simultaneous addition of O₂ and Zn²⁺ suppresses Zn metal deposition, instead ZnO₂ is formed in the ORR, which is reversible only after excursions to very negative potentials (-1.4 V). The addition of water leads to an enhancement of all processes described above, which is at least partly explained by a higher mobility of O₂ and Zn²⁺ in the water containing electrolytes. Consequences for the operation of Zn-air batteries in these electrolytes are discussed.

Keywords: ionic liquid, oxygen reduction reaction, oxygen evolution reaction

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