

## Understanding the Electrochemistry of Oxygen in Non-Aqueous Electrolytes

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Li-O<sub>2</sub> batteries attract great interest due to the high theoretical energy storage capacity. However, to approach the high capacity in rechargeable Li-O<sub>2</sub> batteries many challenges have to be solved. The most apparent problem so far seems to be stability of electrolytes in an aggressive environment due to the O<sub>2</sub> presence and possible reduction of O<sub>2</sub> to a variety of reactive species such as superoxide radical. A fundamental understanding of reactivity of electrocatalytic interfaces in oxygen reduction reaction (ORR) is necessary to elucidate the stability issues in aprotic solvents.

We employ extended surfaces of various materials such as Au, Pt and carbon in the ORR so as to enhance understanding to electrochemical interfaces in aprotic media. By varying structure and composition of solvent molecules at defined surfaces we unravel properties of the electrochemical interface. We use in-situ FTIR to characterize chemical processes taking place at these interfaces during potential sweep. In parallel, we characterize 'bulk' chemical properties of the electrolyte by the FTIR and by using 'battery-like' cell that allows for quantitative mass balance of oxygen during charge and discharge and analysis of gases and liquids by means of differential electrochemical mass spectrometry (DEMS) and GC-MS.

We report structural sensitivity of the ORR at the extended surfaces in aprotic solvents that suggest catalytic nature of this process. Further, we investigate role of the electrolyte composition on the electron transfer toward the O<sub>2</sub> molecule and the ORR reactivity. We show how the structure and composition of solvent molecules influences significantly stability of these electrolytes and their reactivity toward expected products of the ORR in aprotic solvents such as superoxide radical. Finally, we outline rational design of the interfaces for the advanced batteries.