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Reaction products in aprotic Li-O_2 batteries

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The rechargeable lithium-oxygen (Li-O_2) battery has attracted extraordinary attention in recent years, owing to the fact that it has theoretical gravimetric energy densities of several times higher than that of rechargeable lithium-ion batteries. However, several obstacles including the instability of electrolyte solvents and salts, poor rate capability, lithium dendrite formation, complex reaction mechanism, etc. have hampered the development of Li-O_2 batteries.

This talk will present an overview of reaction products formed due to the degradation of aprotic solvents (e.g. alkyl carbonates, ethers, and sulfoxide) and lithium salts (e.g. $LiPF_6$, $LiBF_4$, $LiClO_4$, and LiBOB) in Li-O_2 cells.

The advantages of using synchrotron-based photoelectron spectroscopy (PES) and X-ray diffraction (XRD) as analytical tools to reveal reaction products will be discussed. In this regard, results from an operando synchrotron radiation powder XRD study revealing electrochemical decomposition of Li_2O_2 will be reported.

Furthermore, challenges and possibilities regarding utilization of Li-metal in Li-O_2 cells will be described. Owing to its very negative potential, Li-metal decomposes aprotic electrolytes as soon as its surface is exposed to the electrolyte. As a consequence, a solid electrolyte interphase (SEI) can be formed on the surface of Li-metal. This electrode/electrolyte interphase should be stable during cell cycling to protect electrolyte from further decomposition. We have demonstrated that the presence of O_2 gas improves performance of Li-metal.

Keywords: Lithium-Oxygen battery; Li-air; Electroylte decomposition; Synchrotron-based analysis.