

Chemical stability of DMSO and ACN solvents in contact with Li₂O₂

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Moving to beyond Li-ion batteries has been a main goal in recent years, mainly due to increased demands for more advanced energy storage systems. In this respect, the Li-O₂ (Li-air) battery has been a considerable system among the battery community. It has been predicted that a rechargeable Li-O₂ cell would provide a specific energy 2 to 5 times higher than that of Li-ion cells.

However, the instability of electrolytes solvent and salt in Li-O₂ cells have been major issues hampering further progress.¹ Most common Li-ion battery solvents such as carbonates have been shown to decompose during the cell cycling.²⁻³ Further attempts led to utilization of ether-based solvent for Li-O₂ cells. Ether electrolytes raised hopes to overcome the electrolyte stability issue, since the formation of lithium peroxide (Li₂O₂) was successfully demonstrated in ether based cells.⁴ However, the stability of ether solvents are still questionable.⁵

The decomposition of electrolytes has been mainly referred to attacks by lithium super oxide (LiO₂) intermediate. It has also been shown that Li₂O₂ can decomposed electrolytes solvent and salt.⁶⁻⁷

A few publications have recently shown that Dimethyl sulfoxide (DMSO) and Acetonitrile (ACN) solvents can be stable during the oxygen reduction and evolution reactions in a Li-O₂ cell.⁸⁻⁹ In this study we investigate the chemical stability of DMSO and ACN solvents in contact with Li₂O₂.

X-ray photoelectron spectroscopy (XPS) as a surface sensitive technique was used to analyze surface of Li₂O₂ powder after being in contact with DMSO and Acetonitrile solvent. The relative elemental surface composition obtained from XPS measurements revealed

that the relative amount of C was increased by increasing the exposure time while the relative amount of Li was decreased.

Figure 1 shows the XPS spectra of fresh Li₂O₂ and Li₂O₂ powder exposed to DMSO solvent for 10 min and 2 days. The C1s spectra of all the samples show mainly two peaks at the binding energies of 285 and 290 eV representing hydrocarbons and carbonates, respectively. It can be seen that the relative intensity of carbonate peak was clearly increased after long time exposure. This can originate from a chemical reaction between Li₂O₂ and DMSO or from reaction between Li₂O₂ and trace amount of water dissolved in DMSO.

In this presentation we will present more results from a detailed study regarding the stability of DMSO and CAN electrolytes for application in a Li-O₂ battery.

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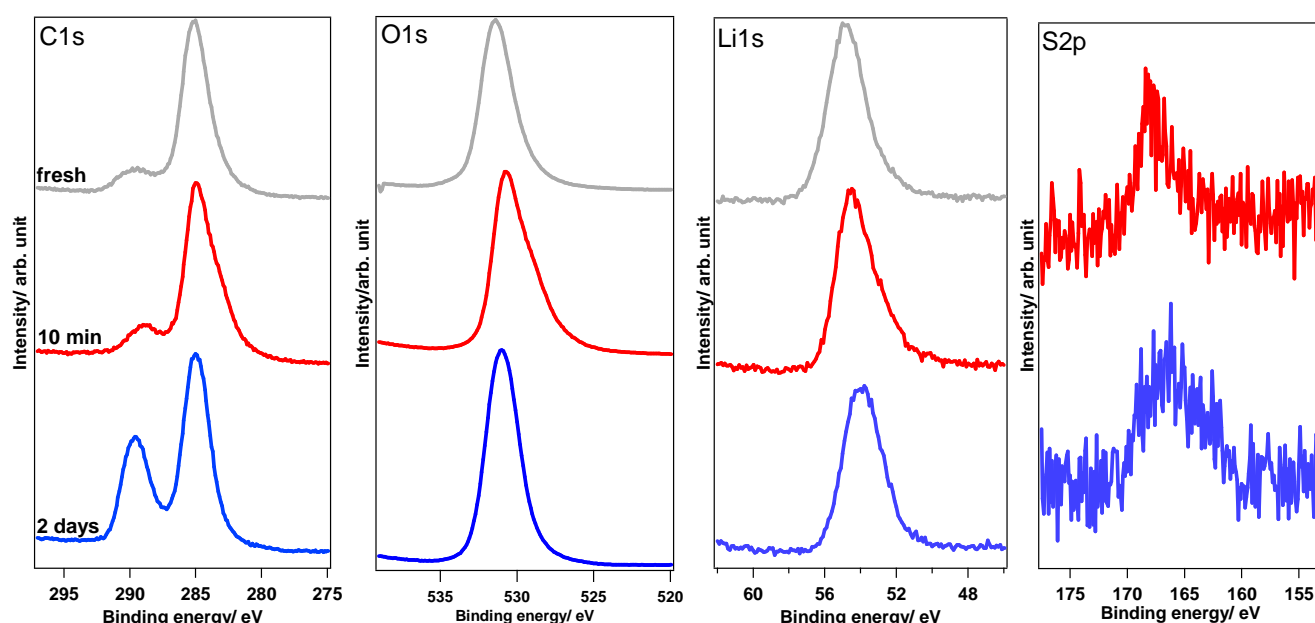


Figure 1. C1s, O1s, Li1s and S2p spectra of fresh Li₂O₂ and Li₂O₂ powder exposed to DMSO solvent for 10 min and 2 days.