

The rate capability of Li-O₂ batteries with ether-based electrolyte

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The aprotic Li-O₂ battery system might represent a valid alternative as power source of hybrid electrical and fully electrical vehicles. Although the Li-O₂ batteries have high theoretical energy density, many obstacles need to be overcome before practical applications can be achieved.

One of the main technical issues is the stability of the electrolyte upon cycling. Carbonates-based electrolytes, widely used in Li-ion batteries, decompose when cycled in the harsh environment of a Li-O₂ electrochemical cell [1]. Vice versa ethers have been found more stable allowing the formation of the desired Li-oxide phases upon discharge [2,3].

Another issue of the aprotic Li-O₂ cells is the poor rate capability. Indeed, the capacity gained from aprotic Li-O₂ batteries, as well as the voltage at which the ORR takes place, is strongly influenced by the applied current density.

In this context we will present the latest results obtained from Li-O₂ cells that used metallic lithium as anode, an ether-based electrolyte (1M LiTFSI in Tetraglyme), and air cathodes manufactured with different types of carbonaceous materials. We additionally investigated the influence of small amounts of Au (~0.03 mg cm⁻²) incorporated in the air cathode on the electrochemical performance of the Li-O₂ cells. SEM micrographs as well as XRD patterns of the cycled electrodes will be shown in order to unambiguously demonstrate the formation of Li-oxide phases and their disappearance during discharge and charge of typical Li-O₂ batteries, respectively.

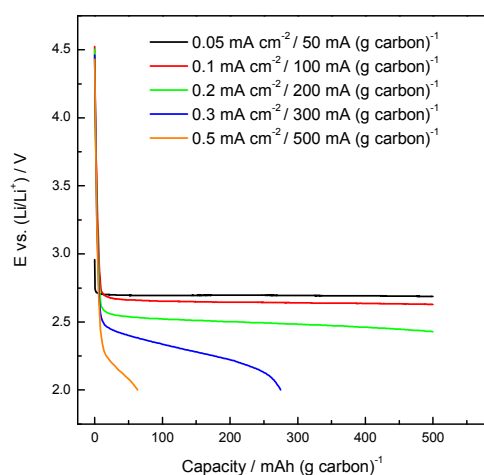


Fig. 1 Galvanostatic discharge curves for Super-P based cathodes cycled in Li-O₂ cells.

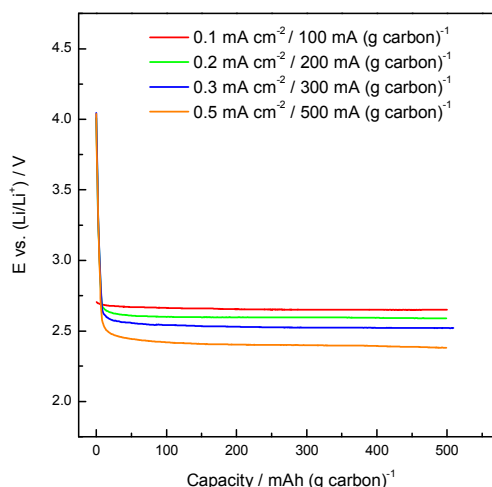


Fig. 2 Galvanostatic discharge curves for Au-containing Super-P based cathodes cycled in Li-O₂ cells.

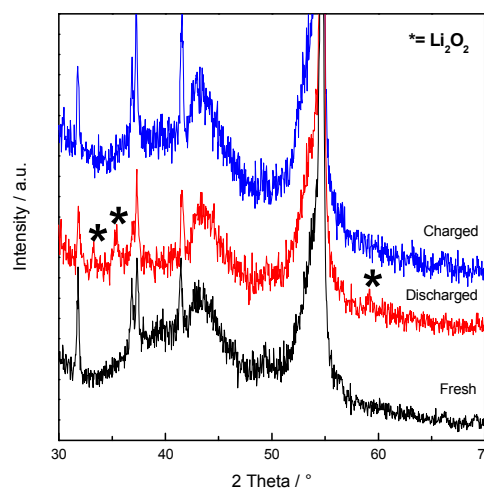


Fig. 3 Ex-situ X-Ray diffraction patterns of fresh, discharged and charged Super-P based cathodes showing the formation/dissolution of Li₂O₂.

References

- [1] S.A. Freunberger, Y. Chen, Z. Peng, J.M. Griffin, L.J. Hardwick, F. Barde, P. Novak, P.G. Bruce, *Journal of the American Chemical Society* 133 (2011) 8040.
- [2] H.-G. Jung, J. Hassoun, J.-B. Park, Y.-K. Sun, B. Scrosati, *Nature Chemistry* 4 (2012) 579.
- [3] S. A. Freunberger, Y. Chen, N. E. Drewett, L. J. Hardwick, F. Bardé, P. G. Bruce, *Angewandte Chemie International Edition* 50 (2011) 8609.

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