

An analysis of the electrochemical process of Li-air cells by transmission electron microscopy

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Lithium–oxygen batteries have recently received a great deal of attention due to the value of their energy density, the highest among all other existing electrochemical power sources.[1–3] The basic cell reaction: $2\text{Li} + \text{O}_2 \leftrightarrow \text{Li}_2\text{O}_2$, gives a theoretical energy density of the order of 3500 Wh kg⁻¹ considering the Li₂O₂ mass. However, many issues associated with both electrodes and electrolyte still prevent the practical achievement of this outstanding energy value. This apparently simple process is, in reality, quite complex since it proceeds via a series of steps involving an intermediate O₂^{•-} radical anion species,[4,5] namely, a very strong base with high deprotonation activity that may seriously degrade the stability of the electrolyte. Indeed, as recently demonstrated, conventional lithium-ion electrolyte solutions, such as organic carbonates, cannot be used in lithium-air batteries because they decompose, leading to the rapid decay of the battery performance.

Consequently, the identification of a stable electrolyte capable of allowing extended electrochemical cycling is still a major challenge in the Li–air battery technology. We have recently shown[6] that a solution of lithium triflate, LiCF₃SO₃ in tetraethylene glycol dimethyl ether (TEGDME)-LiCF₃SO₃, is a promising candidate.[1,3]

The electrochemical reaction of a lithium–oxygen cell using a tetraethylene glycol dimethyl ether-lithium triflate, TEGDME-LiCF₃SO₃ electrolyte, is investigated by a

detailed transmission electron microscopy analysis. The results confirm the reversibility of the process by showing the formation–dissolution of lithium peroxide, Li₂O₂, upon repeating cell charge and discharge cycles.

References

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