

Impact of cycling conditions on the lifetime of aqueous rechargeable lithium-air cells

Philippe Stevens*¹, Gwenaëlle Toussaint¹
Philippe Vinatier², Laurent Puech²

1. *Electricité de France, R&D division, LME/M29, Avenue des Renardières F-77818 Moret sur Loing Cedex, France*
2. *CNRS, Univ. Bordeaux, ICMCB, UPR 9048, F-33600 Pessac, France*

* *Corresponding author*

Lithium-air batteries have the potential to be very high energy density batteries but also low cost. There are two approaches to the development of these batteries: the anhydrous system inspired from lithium-ion batteries which uses an organic electrolyte, and the aqueous system which is inspired from alkaline fuel cells and uses an aqueous electrolyte. The aqueous system has the advantage of being safe and it does not use any toxic or inflammable solvents. The negative lithium electrode is separated from the aqueous electrolyte by a thin ceramic water and gas tight membrane which enables the battery to have an extremely low self-discharge rate.

During discharge, the product of the reaction ($\text{LiOH}\cdot\text{H}_2\text{O}$) is stored in the aqueous compartment as a precipitate. The battery is charged from the aqueous solution to produce lithium metal. The high solubility of lithium hydroxide (5.3M) provides a sufficiently large buffer of Li^+ ions in solution during charge. This gives sufficient time for $\text{LiOH}\cdot\text{H}_2\text{O}$ to re-dissolve and compensate for Li^+ ion consumption from the solution.

During charge, lithium metal grows on the ceramic electrolyte interface in a one dimensional growth mechanism. Very high areal capacities can be obtained to form a thick dense lithium metal layer during charge.

The cycling behaviour of the negative electrode is analysed and the cycling parameters which have an effect on the lifetime of the battery are explored.