

Modelling the Influence of Membrane Characteristics on the Performance of Secondary Alkaline Zinc-based Batteries

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Secondary alkaline zinc-based batteries are promising alternatives to lithium-based batteries for certain applications such as stationary energy storage due to their relatively low cost, resource availability and high theoretic specific capacity [1]. However, their development is still facing major challenges, especially in terms of cyclability and shelf life.

Interestingly, the crossover of multivalent ions through the separator has shown to be the main degradation mechanism in relevant zinc-based batteries - namely $\text{Zn}(\text{OH})_4^{2-}$ in zinc-manganese oxide cells (*degrading the cathode*) and CO_3^{2-} in zinc-air cells (*lowering the alkalinity*) [2]. Hence, a promising approach for cell optimization is the incorporation of a membrane which reduces the crossover of multivalent ions while maintaining a high ionic conductivity for the functionally relevant exchange of OH^- .

Various membranes (such as AEM, CEM, NF, ...) have been investigated experimentally in zinc-based cells [3], but the mechanisms underlying their effect on cycle-life and performance are often not fully understood. Thus, our research aims to analyze the influence of the transport in membranes on the overall cell performance to identify the optimization parameters for future membrane development. This is approached via the integration of membrane models such as DSPM-DE [4] into full cell models of alkaline zinc-based secondary batteries. The simulation tool PyBaMM is used in order to establish synergies to other cell types [5].

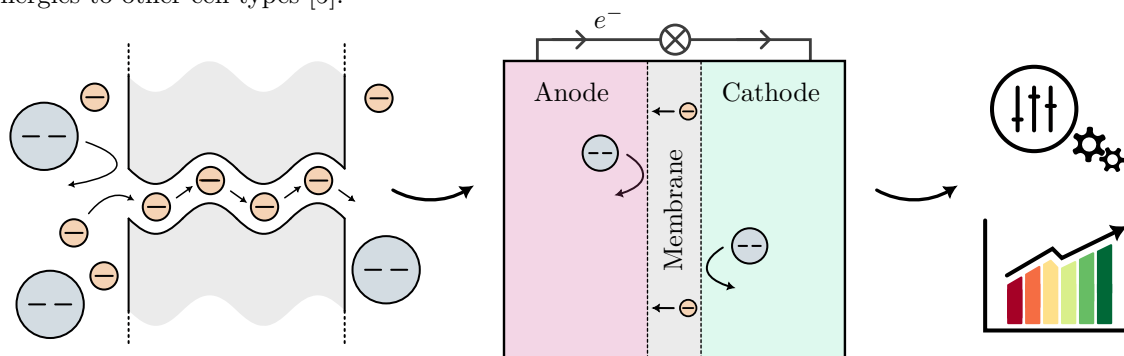


Figure 1: From membrane transport and cell behaviour to the identification of optimization parameters

References

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