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BATTERIES & SUPERCAPS
Cover Profile

Advances and Challenges for Aprotic Lithium-Oxygen Batteries using Redox Mediators




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Invited for this month's cover picture is the group of Prof. Ping He. The cover picture shows the reaction mechanism of redox mediators in Li-O_2 batteries. The boat represents the redox mediators (such as I^{3-}), serving as the electron carrier between cathodes and Li_2O_2 products (where the woman stands). The redox mediators offer a promising avenue for reducing the overpotential, promoting the generation of Li_2O_2 during discharge or decomposition during charge, and improving the rate capability. Read the full text of the Review at 10.1002/batt.201900045

What prompted you to investigate this topic/problem?

There are several critical issues hindering the development of practical Li-O_2 batteries. Most importantly, the inherent large resistance brought by the low solid-solid contact between catalysts and discharge products can prevent efficient charge transfer, thus resulting in the high charge overpotential, the reduced round-trip efficiency, and a series of parasitic reactions. Therefore, researchers have been making efforts to mitigate or solve these problems.

Fortunately, the redox mediators (RMs), which dissolve into the aprotic electrolyte, are found to be the fascinating candidates to lower the high charge polarization and thus to alleviate the instability of electrolyte and carbon electrodes at high overpotential. Our group originally reported N-methylphenothiazine (MPT) and 2, 2, 2-trichloroethyl chloroformate (TCCF) as additives in ether electrolyte, and both of them present relative low charge polarization, high energy efficiency, and enhanced cycling life span in Li-O_2 batteries..

Did you initially have to motivate prospective team members to tackle this topic?

Yes, this topic is interesting and meaningful in the field of Li-O_2 batteries. Besides searching new types of RM molecules, the research on the reaction mechanism, solid-state electrolytes (SSEs) applied to prevent the shuttle of RM molecules, metal-O_2 (Na-O_2, K-O_2, Mg-O_2, etc.) batteries with RMs and so on, is worth pursuing further. Prospective team members have been motivated to tackle this topic to boost the performance of Li-O_2 batteries.

What other topics are you working on at the moment?

We are now mainly working on the energy storage and conversion area, especially related to Li-air batteries and Li–S batteries. We are profoundly invested in designing high-efficiency cathode catalysts, in situ analysis of electrochemical processes, searching for suitable redox mediators as electrolyte additives, applying solid-state electrolytes in various electrochemical devices, and so on.