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Is there life in the Li-air(O_2) battery?

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Li-ion and related battery technologies will be important for years to come. However, society needs energy storage that exceeds the capacity of Li-ion batteries. We must explore alternatives to Li-ion if we are to have any hope of meeting the long-term needs for energy storage. One such alternative is the Li-air(O_2) battery; its theoretical specific energy exceeds that of Li-ion, but many hurdles face its realization.[1-5] First, we must understand the processes that occur in the cell on discharge and charge, then use such knowledge to address the hurdles.

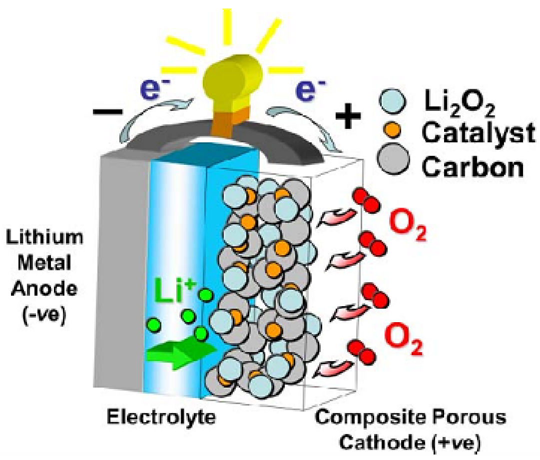

Figure 1. Schematic representation of a rechargeable Li-air battery.

A typical aprotic Li-O_2 battery, shown in Figure 1, consists of a Li anode and a porous cathode, the two being separated by an organic electrolyte. On discharge, O_2 from the atmosphere enters the porous cathode where it is reduced and is supposed to form Li_2O_2, which can be then be oxidized on charging.[1-5] Charge is stored in the cathode by reversible Li_2O_2 formation/decomposition. However, it is now understood that the reactive nature of reduced O_2 species results in decomposition of many electrolytes and the cathode.[6-8]

Recent results on electrolyte and cathode stability will be discussed, with a particular focus on the instability of the ubiquitous carbon cathode.[9-10] By understanding these instabilities, it has been possible to demonstration a cell that does sustain reversible Li_2O_2 formation/ decomposition at the cathode on cycling, essential if the Li-O_2 battery is ever to succeed.[11] Recharging the Li-O_2 cell presents a particular problem at the cathode; an approach to the problem will also be considered.

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