

Public Abstract

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Title:DESIGN OF LITHIUM AIR BATTERIES WITH AQUEOUS ELECTROLYTE

Aqueous lithium-air batteries (LABs) show a great promise as energy storage devices due to their high energy densities. However, there are currently numerous scientific and technical challenges that must be addressed before becoming practical in applications. This study was aimed at understanding some of the problems, including hydrophobic effect on the air cathode structure, catholyte pH effect on cell performance, and Nafion® coating to reduce corrosion of the lithium ion conducting glassy ceramic membrane.

(1) The air cathode for aqueous LABs is made with a thin transition layer using carbon nanofibers decorated with Teflon (PTFE) particles to make it partially hydrophobic. It was found that 30 wt.% PTFE produced the best results in balancing water vapor diffusion and air (oxygen) diffusion through the cathode. (2) Catholyte pH is an indication of acidity of an aqueous electrolyte. It was found that the catholyte pH has a significant effect on battery performances. The good performances were found to be when the pH is less than 3 or higher than 12, i.e., when the catholyte is either highly acidic or highly basic. When the pH is in between, the battery discharge performance was poor and much less efficient. (3) The electrolyte separator is a lithium ion conducting ceramic membrane. It is prone to corrosion in either acidic or basic electrolytes. Protection of the ceramic membrane was studied by coating it with a Nafion® film. The addition of a layer of lithiated Nafion thin film was found to be effective to increase the lifespan of the membrane in acidic electrolytes. It was demonstrated that the operational life of a LAB can be fairly extended with a coating of ca. 6 micrometer.