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Electrochemical Impedance Spectroscopy Characterization of Silicon - Air Battery

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Abstract

The mechanism of discharge termination and interfacial processes in silicon - air battery employing silicon wafer anode, room-temperature fluorohydrogenate ionic liquid electrolyte and air cathode, is studied by characterizing the electrode - electrolyte interfaces at different stages of discharge, using electrochemical impedance spectroscopy. The analyzed data reveals that the interfacial impedance between the electrolyte and silicon wafer increases upon continuous discharge. In addition, it is shown that the impedance of the air cathode - electrolyte interface is several orders of magnitude lower than that of the anode. Evolution of porous silicon surface at the anode and its properties, by means of calculated equivalent circuit parameters, are also presented. Moreover, it is found that the silicon anode potential has the highest negative impact on the battery discharge voltage, while the air cathode potential is actually stable and invariable along the whole discharge period. The data provide a basic understanding of the degradation of silicon anode in the ionic liquid electrolyte along discharge. The discharge capacity of the battery can be increased significantly by mechanically replacing the silicon anode.