Research and Development of Modular Rechargeable Zinc-air Battery System

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Abstract:

Rechargeable zinc-air batteries become promising candidates for energy storage systems due to their low-cost, safety and high energy density. Focused on the problems of poor cycling stability and low energy efficiency of zinc-air batteries, we developed new electrode structure, novel method of electrocatalyst preparation, key technology and innovative battery system. For the zinc electrode, by means of the 3D porous skeletion of Cu foam and uniform distribution of zinc, continuous and stable transfer passages of electron and ions in the porous zinc electrode are estabilished, and excellent cycling stability is also obtained with high specific capacity of 620 mAh g-1 after at least 9000 charge-discharge cycles. Besides, the NiFe-LDH/NF electrode towards oxygen evolution reaction (OER) with an exceptionally facile and easily scalable method is prepared. The resulting electrode shows high OER performance with a low overpotential of 202.4 mV at 10 mA cm-2 constant current density. The formation of NiFe-LDH is confirmed to be nucleation, reaction promotion, crystal growth, phase transformation and deposition. Afterwards, in order to remove the obstacles of carbonate formation, poor cycling stability, and low energy efficiency, oxygen recycling, which utilized the oxygen produced in the charge process for the discharge process, is proposed and used in the rechargeable zinc/air battery. Based on the above investigation, modular zinc-air battery system with the single cell consisting of tri-electrodes is integrated and performs a high energy efficiency of 58% at 20 mA cm-2, and exhibits nearly 4500 cycles.