Optimizing Zinc Anode Porosity for Suppressing Dendrite Growth in Aqueous Zinc-Ion Batteries to Improve Performance and Prolong Cycle Life

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With the high demand for renewable energy resources, large-scale energy storage systems are required to safely store the energy produced. Lithium-Ion batteries are the commercially dominant batteries in our time, but due to the limited resources of Lithium, and the safety hazards accompanied with these batteries, they need to be replaced. Aqueous zinc-Ion batteries (AZIBs) are considered a promising option owing to their advantages of low cost, safety, and high energy density. However, pristine zinc suffers from uneven surface charge distribution causing one of the major issues facing AZIBs: the formation of zinc dendrites that grow to puncture the batteries' separator and cause them to short circuit and die early on. In this research, I worked on addressing the dendrite formation issue using an acid etching strategy that works on suppressing dendrite growth. The method used was altering the zinc anode's surface morphology by etching with trifluoromethanesulfonic acid, which increases the porosity of the zinc foil, therefore, suppressing dendrite growth. The SEM images show a decrease in the growth of dendrites in the TFA@Zn batteries, and the long-time cycling performance shows an increase in the cycle life of the TFA@Zn anode up to eight times the battery's life span at 4.0 mA cm−2-2.0 mAh cm−2 over 900 hours, and the full Zn-MnO2 sustained a prolonged cycle life of 3000 cycles with improved performance. Using the proposed method, we address this problem in a simple, yet effective way, potentially eliminating the dendrite issue in zinc-ion batteries.