Concentrated Electrolyte in Zinc Rechargeable Aqueous Batteries Studied by *in-operando* X-ray Diffraction

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Abstract

Recently, zinc (Zn) has become a promising ideal anode material for rechargeable aqueous batteries. However, vigorous growth of zinc dendrite during plating/stripping, low CE of the cell, and short cycle life hinder its practical applications in rechargeable batteries. Here in, we report a cost-effective concentrated electrolyte (4.2 M $ZnSO_4$ + 0.1 M $MnSO_4$) in which improves cycling stability of zinc with an average coulombic efficiency (ACE) of ~99.21% cycled for more than 1000 hours at a current density of 0.2 mA/cm^2 within Zn||Cu cells. However, frequently used diluted electrolyte (2 M $ZnSO_4$ + 0.1 M $MnSO_4$) only produces ACE of ~ 97.54% and relatively short cell cycle life. We further used *in-operando* XRD to study the effect of concentrated electrolyte on the intercalation/deintercalation of Zn^{2+} in MnO_2 cathode material. The developed concentrated electrolyte shows the synergetic effects of enhanced solvation/desolvation process, electrostatic shielding and Le Chateier's principle. Consequently, significant suppression of Zn dendrite formation and dissolution of MnO_2 from cathode electrode are obtained. A highly stable and reversible Zn||MnO_2 cell retaining about 88.4% of capacity retention is achieved after more than 1200 cycles under 3 C-rate and 83.7% of capacity retention after cycled for more than 600 cycles under 1 C-rate.

Keywords- Zinc; MnO_2; In-operando XRD; ZIB