

Electronic Supplementary Material

Alkaline zinc-based flow battery: chemical stability, morphology evolution and performance of zinc electrode with ionic liquid

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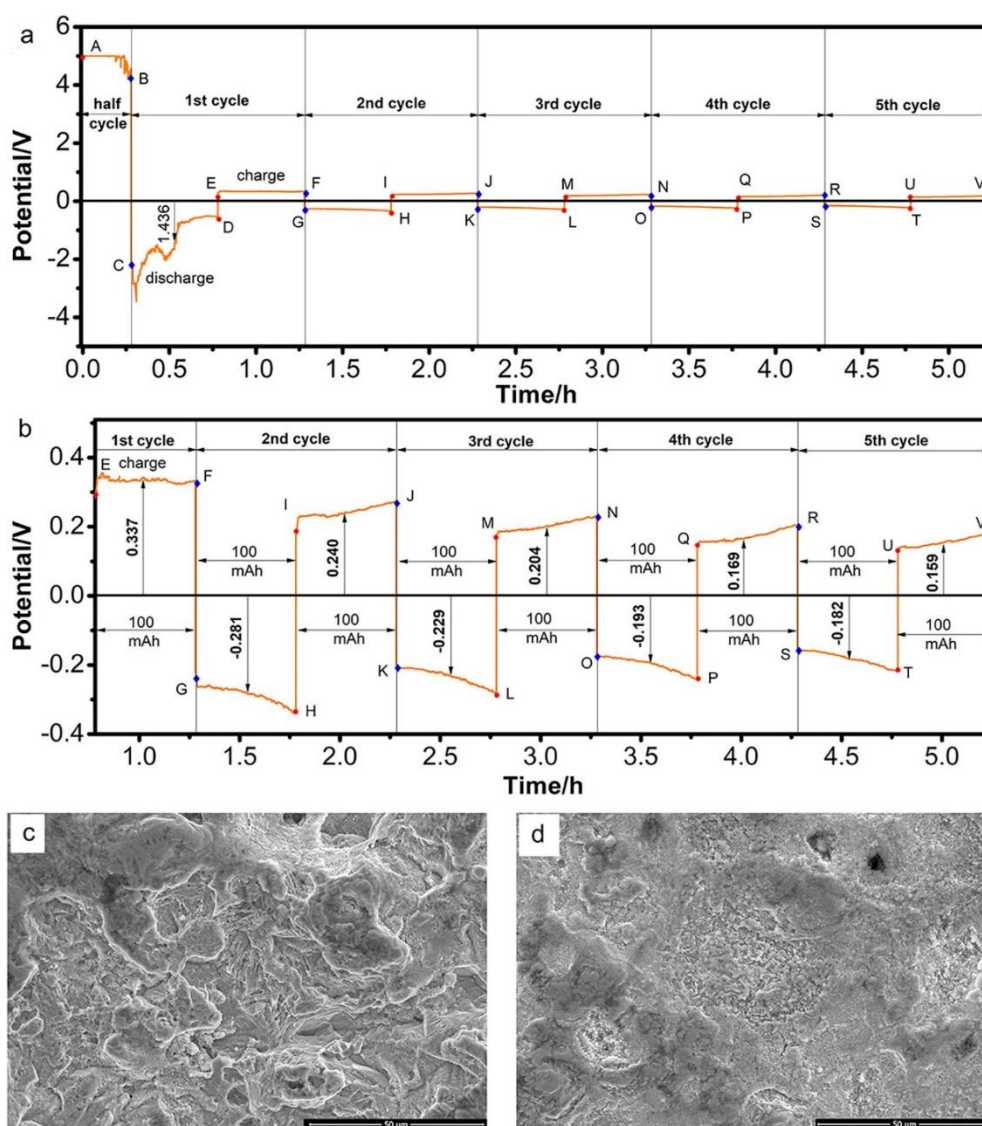


Fig. S1 The relationship between voltage and time for the AZSB: (a) survey profile; (b) a partial enlargement. SEM images of (c) the cathode zinc sheet and (d) the anode zinc sheet of the AZSB after five and a half cycles.

The voltage–time relationship of the first five and half-cycles of AZSB is shown in Fig. S1(a), where 10 mL of $0.1 \text{ mol}\cdot\text{L}^{-1}$ KOH solution containing $0.1 \text{ mol}\cdot\text{L}^{-1}$ ZnO and $1 \text{ mol}\cdot\text{L}^{-1}$ KCl is used for both anolyte and catholyte with zinc sheets as both the anode and the cathode. The flow rate of the electrolyte is $32.5 \text{ mL}\cdot\text{min}^{-1}$. An unusually high voltage occurs during the AZSB's first charge, or half-cycle. There are many factors resulting in this result, but the main one is the oxidation layer (OL) on the surface of zinc sheet. This OL is gradually destroyed in the alkaline environment, so in the second charging process, the charging voltage drops to about 0.337 V (Fig. S1(b)). As shown in Figs. S1(a) and S1(b), the average voltage across the AZSB is 0.343 V without additives of the ionic liquid. The morphology of the zinc electrode changed greatly after five and a half cycles. At point V, the electrode is sampled for SEM test to observe the change of its morphology. At this time, the positive electrode presented the dissolution morphology of zinc electrode (Fig. S1(c), cathode zinc sheet), while the negative electrode presented the deposition morphology of zinc electrode (Fig. S1(d), anode zinc sheet). The zinc electrode looks like a wall in disrepair, peeling very badly, no metallic luster, which is markedly different from the raw zinc sheet, indicating that the zinc electrode undergoes a complicated process.