Supporting Information

Nanocarbon armor reinforced Ag particles to build high-rate and long-lifespan aqueous Zn^{2+}/Cl^- dual-ion battery

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Experimental

Material preparation

All reagents were of analytical grade and purchased from Aladdin (Shanghai, China). Ag@C particles were synthesized by CVD. In the synthetic process, 0.2 g of nano silver powder and 1 g of glucose were loaded into two porcelain boats, respectively. They were put in a tube furnace and heated at 500 °C for 2 hours. Finally, core-shell Ag@C particles were obtained.

Materials characterization

The phases and structures of Ag@C were analyzed using XRD (Bruker D8 Focus). The hydrophilicity of Ag@C was determined by measuring the contact angle using a goniometer (JC2000A). The morphologies of Ag@C were analyzed using various techniques including TEM (JEM-2010), SEM (Hitachi SU-70), and EDS. SAED (JEOL JEM-2010) was performed to determine the element composition of Ag and C. The microstructure of Ag@C was observed through high-resolution TEM (JEOL). Additionally, XPS (Thermokalpha) was utilized to assess the surface chemical properties of Ag@C.

Electrochemical measurements

Working electrode was prepared by mixing Ag@C particles, carbon black, and polytetrafluoroethylene in a mass ratio of 8:1:1. Subsequently, the slurry was evenly cast onto the carbon paper, which was dried in vacuum at 60 °C for 5 hours. In each cell, zinc sheet was served as the counter and reference electrode. The electrolyte was 0.1 M $ZnCl_2$ dissolved in distilled water. GCD tests and GITT were measured on

LANHE CT2001A battery testing system. Additionally, CV analysis was conducted using CHI760E electrochemical workstation within a voltage range from 0.7 to 1.4 V.

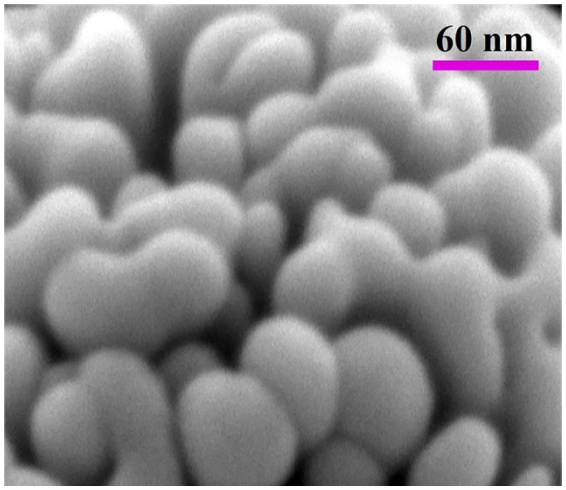

Fig. S1. SEM image of Ag@C.

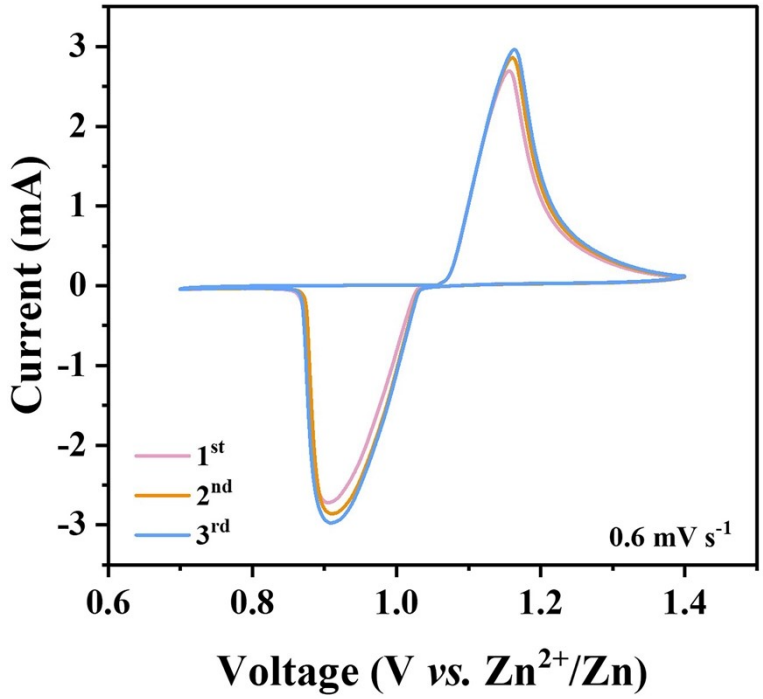

Fig. S2. CV curves of Zn^{2+}/Cl^- dual-ion battery with Ag cathode.

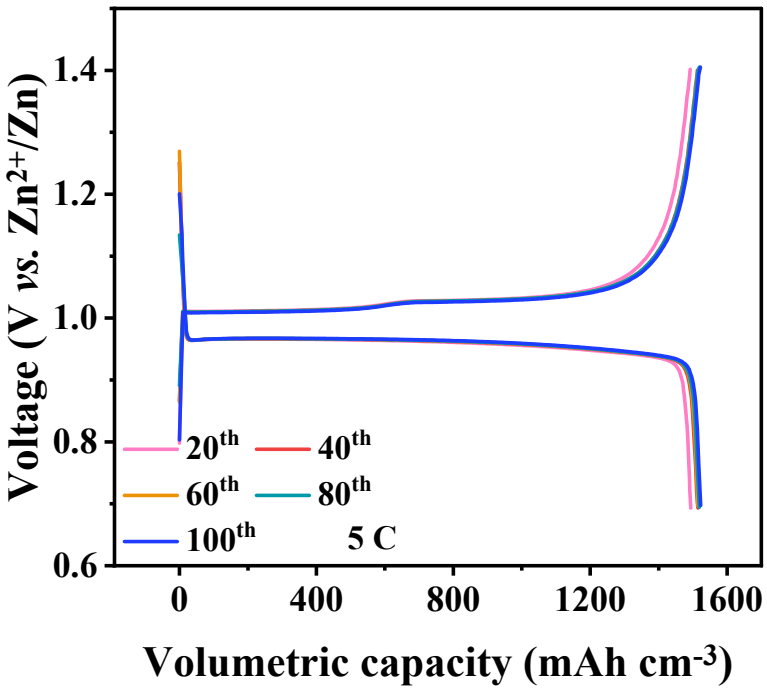

Fig. S3. GCD curves of Zn^{2+}/Cl^- dual-ion battery with Ag@C cathode.

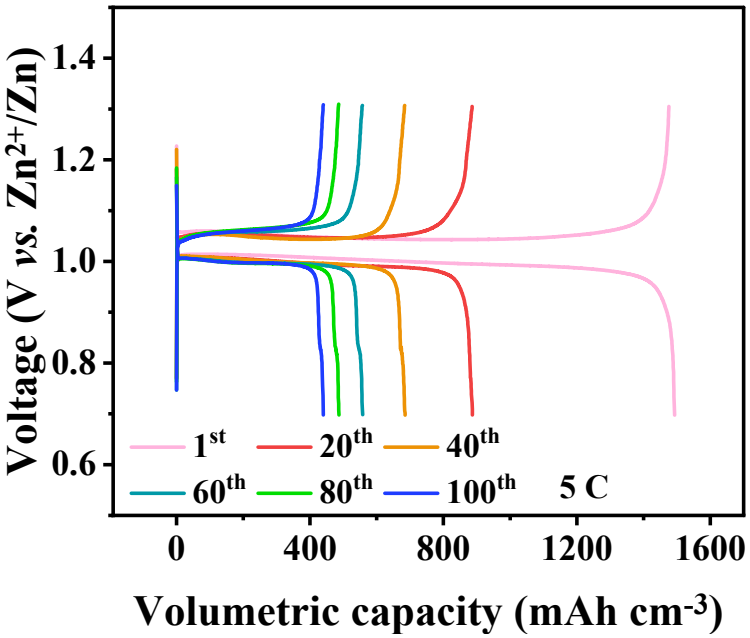

Fig. S4. GCD curves of Zn^{2+}/Cl^- dual-ion battery with Ag cathode.

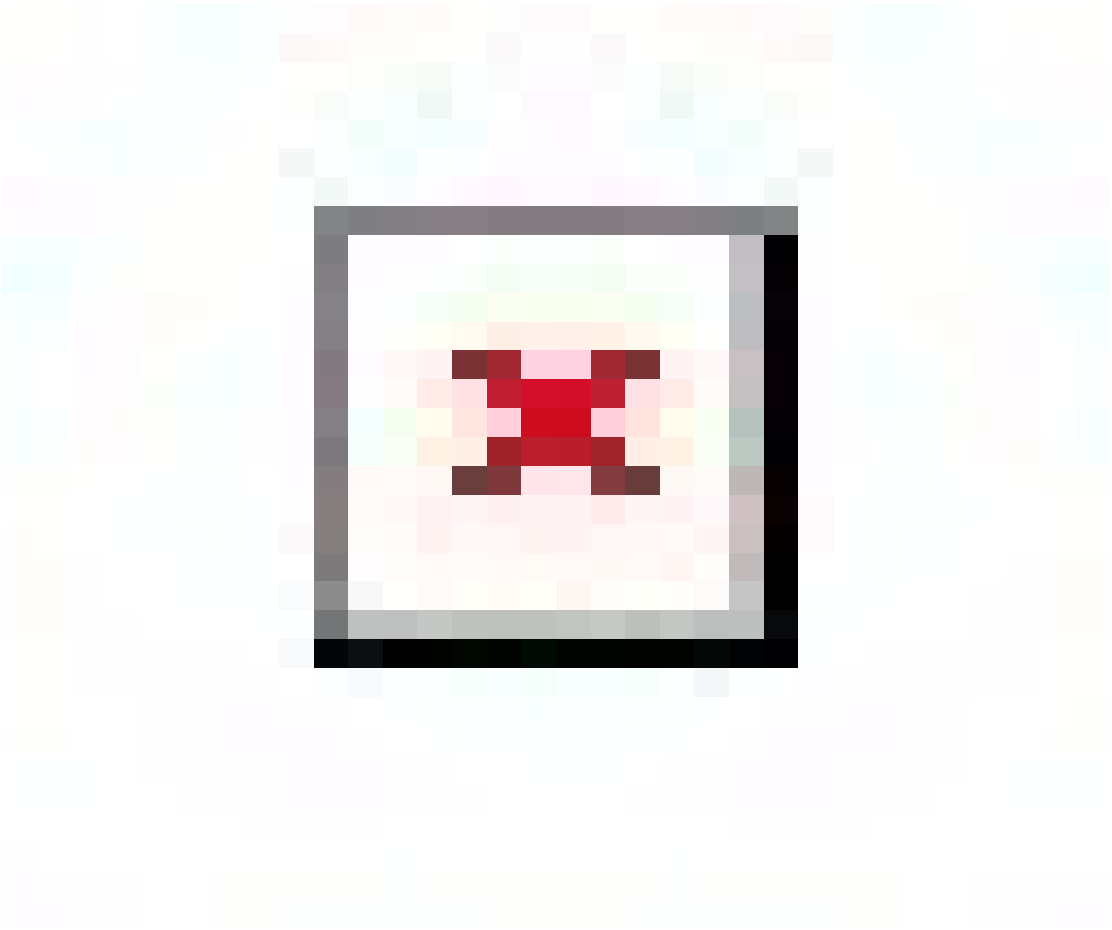

Fig. S5. (a) Galvanostatic charge/discharge (GCD) curves of Zn^{2+}/Cl^- dual-ion battery with Ag cathode at different current rates. (b) Plateau contribution and plateau voltage of discharging process for Zn^{2+}/Cl^- dual-ion battery with Ag cathode at different current rates. (c) Rate performance of Zn^{2+}/Cl^- dual-ion battery with Ag cathode.

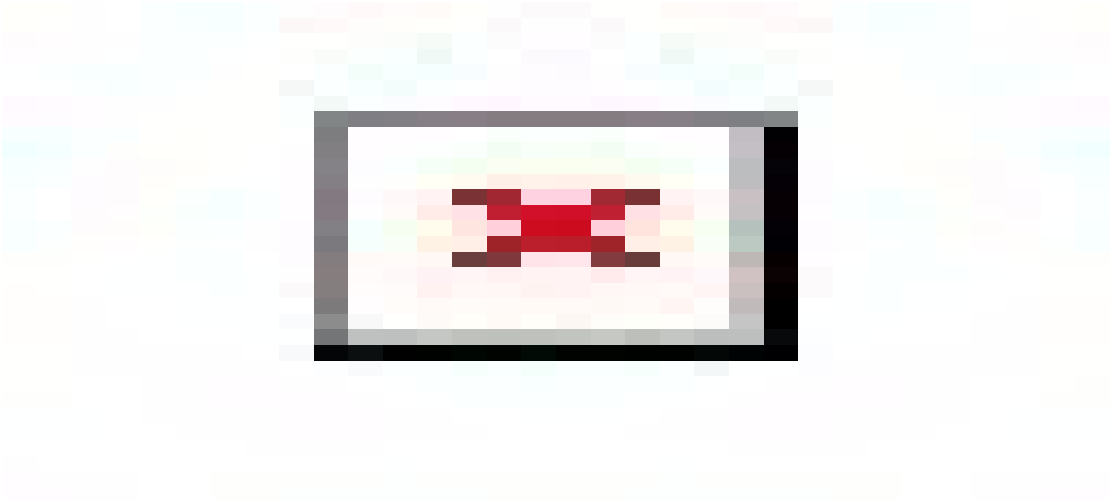

Fig. S6. Cycling performance of Zn^{2+}/Cl^{-} dual-ion battery with Ag cathode at 20 C.

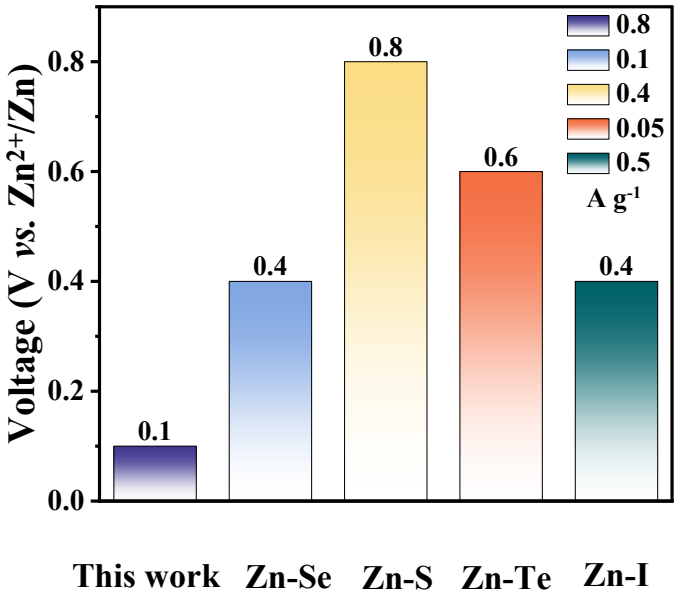

Fig. S7. Comparison in polarization between this work and other ZIBs.

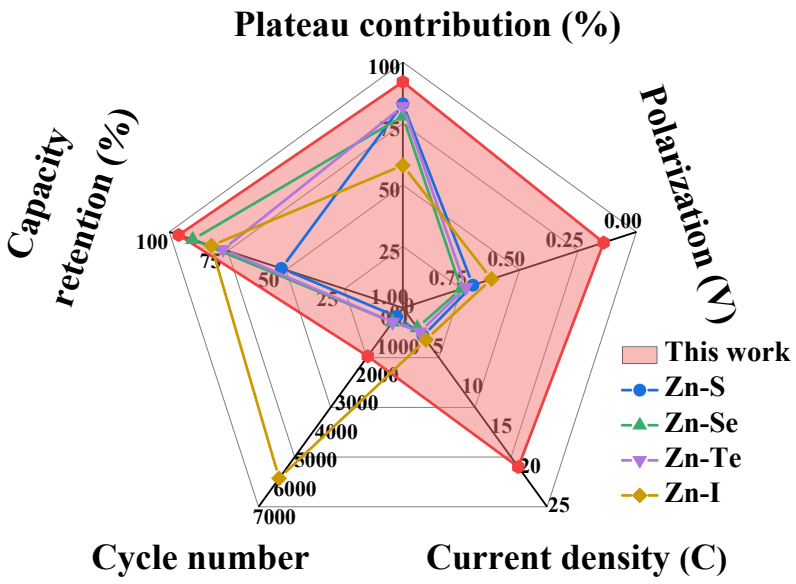

Fig. S8. Comparison between this work and other ZIBs.

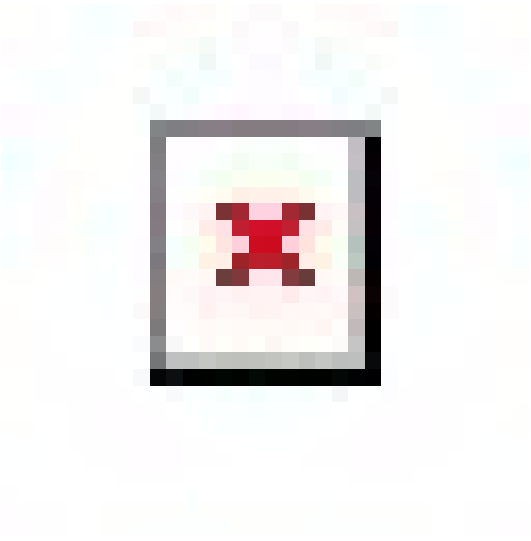

Fig. S9. TEM image of Ag@C cathode after cycling.