

A Creative Strategy to Functionalize TiN/CNC Composites as Cathode for High-Energy Zinc Ion Capacitors

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Abstract : Zinc ion capacitors (ZICs) have garnered tremendous interest recently from researchers due to the perfect integration of batteries and supercapacitors (SC). However, ZICs are currently still facing two major challenges, one is low specific capacitance because of the limited capacity of capacitive cathode materials. In this work, TiN/CNC composites were obtained by a creative method composed of simple mixing and calcination treatment of tetrabutyl titanate (TBOT) and ZIF-8. The formed TiN particles are of ultra-small size and distributed uniformly on the nanoporous carbon matrix, which enhances the conductivity of the composites and the micropores caused by the evaporation of zinc during the calcination process and can serve as the reservoir of electrolytes; both are beneficial to zinc ion storage. When it was used as a cathode with zinc metal and 2M ZnSO₄ as the anode and electrolyte, respectively, in a ZIC device, the assembled device delivered a maximum energy density as high as 153 Wh kg⁻¹ at a power density of 269.4 W kg⁻¹, which is superior to many ZICs as reported. Also, it can maintain an energy density of 83.7 Wh kg⁻¹ at a peak power density of 8.6 kW kg⁻¹, exhibiting good rate performance. Moreover, when it was charged/discharged for 5000 cycles at a current density of 5 A g⁻¹, it remained at 85.8% of the initial capacity with a Coulombic efficiency (CE) of nearly 100%.

Keywords : zinc ion capacitor, metal nitride, zif-8, supercapacitor

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