Development of FeCu_x/FeS/Graphite Composite Electrode Materials for Iron-Based Alkaline Batteries

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In an attempt to enhance the electrochemical performance of the iron-based electrode, an iron-core copper-shell nano-structured material was synthesized and incorporated with ferrous sulphide, and graphite additives. An electrically conductive nickel mesh as a current collector, coupled with a low-cost hot-pressing technique, was employed to formulate the electrodes. The ferrous and graphite integrated iron-core copper-shell nano-structured negative electrode was investigated for applications in Fe-based alkaline batteries energy storage. FeCu_{0.25}/15%FeS/5%C composite electrode delivered a specific discharge capacity of 385 mAh g⁻¹ an approximately 71% coulombic efficiency. The nominal specific capacity of the electrode exhibited negligible capacity degradation after 40 cycles. Ex-situ X-ray Diffraction characterisations and scanning electrode microscopy images of both the fresh and the discharged electrode surfaces show that particle arrangement was still intact after 40 cycles, with negligible particle agglomeration compared to the pure iron electrode surface which was marked with massive agglomeration. Energy filtered transmission electrode microscopy images confirmed the iron-core copper-shell particle arrangement. The FeCu_{0.25}/15%FeS/5%C electrode exhibited stable performances marked by high specific capacity coupled with negligible capacity decay and high efficiency. The ferrous/graphite integrated iron-core copper-shell electrode is consequently a conductive negative electrode candidate in alkaline iron-air and nickel-iron battery systems.

Keywords: Energy Storage, Iron-based Alkaline Battery, Iron-Core Copper-Shell, Composite Iron-Copper/Sulphide Electrode

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