High Capacity, High Stability and Low Corrosive Al-Treated Ionic Liquid Electrolyte With Al-Deposited Carbon Cloth Anode Used in Aluminum-Ion Battery

Tam, Chong Hin (School: Pui Ching Middle School)
Cheang, Oi Wa (School: Pui Ching Middle School)

Rechargeable aluminum-ion batteries (AIBs) are receiving considerable attention as a desirable device for large-scale energy storage owing to high theoretical capacity and abundance of aluminum. However, due to dendrite formation at Al anode, the AIBs often show rapid capacity fading and poor structural stability, thereby greatly hindering their practical use. To address this challenge, we report an electrodeposition approach to prepare a 3D Al anode on carbon cloth with uniform deposition morphology, low local current density, and mitigatory volume change. The symmetrical cells with the optimized 3D Al anode electrodeposited at 4 mA (Al-4/CC) show superior stable cycling (> 450 h) and low voltage hysteresis (~170 mV) at 0.5 mA cm-2. High reversibility (~99.7%) is achieved for the Al plating/stripping. The graphite || Al-4/CC full batteries show a long lifespan of 800 cycles with 54 mAh g-1 capacity at a high current density of 1000 mA g-1. This work proposes a novel strategy to design 3D Al anodes for metallic-Al-based batteries by eliminating the problems of planar Al anodes and realizing the potential applications of aluminum-graphite batteries.

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