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Electrochemical performance of n-type Cu_2O anode material synthesized by electrodeposition method for rechargeable lithium-ion batteries

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Recently, Cu_2O has received more attention for the anode application of the rechargeable Lithium-Ion Battery (LIB) than the other competing materials because of its high theoretical capacity (375 $mAhg^{-1}$), good capacity retention, affordability, non-toxicity and ease of storage. The electrochemical performance of Cu_2O typically depends on its crystallinity and morphology, which significantly based on the synthesizing technique. However, a simple and convenient electrodeposition technique, which can improve crystallinity with favorable morphology for electrode materials, has not yet been studied for synthesizing Cu_2O. Hence, this study aims for preparing n - type Cu_2O anode materials by the electrodeposition method with enhanced crystallinity and morphology. The lithium-ion rechargeable coin cells were assembled in an argon-filled glove box with anodes fabricated with synthesized Cu_2O, lithium as the reference electrode and counter electrodes together with the non-aqueous electrolyte of 1M $LiPF_6$ in ethylene carbonate and dimethyl carbonate (1:1 wt%). The assembled coin cells subjected to galvanostatic charge-discharge tastings revealed a significantly high initial specific discharge capacity of 623.9 $mAhg^{-1}$ at a rate of 0.2C. That is even after it reported a higher irreversible capacity of 395.4 $mAhg^{-1}$ at the first cycle. Moreover, it displayed a discharge capacity of 200.3 $mAhg^{-1}$ and a noticeably lower irreversible capacity of 2.6 $mAhg^{-1}$ even after 50 cycles. The improved electrochemical performance can mainly be ascribed for the enhanced contact surface area for Cu_2O and electrolyte. It could have resulted due to the enhanced contact between Cu_2O and electrolyte by decreasing diffusion lengths for lithium ions. Electrochemical impedance spectroscopy and cyclic voltammetry analyses also provided evidences for improved electrochemical performance. Altogether, this study reveals that n-type Cu_2O synthesized by electrodeposition method processes very promising electrochemical performance for the anode application of LIB. Hence, this study reveals that Cu_2O synthesized by simple, cost-effective, electrodeposition method has very promising electrochemical performance for the anode application of next-generation high-performance LIBs.

Keywords: Anode materials, Cu_2O, Electrodeposition, Li-ion battery

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