Postgraduate Institute of Science
University of Peradeniya

PROCEEDINGS

PGIS RESCON
RESEARCH CONGRESS 2024

Volume 11

Abstract No: 94 ***Physical Sciences***

COMPARISON OF THE ELECTROCHEMICAL PERFORMANCE OF p-Cu_2O AND n-Cu_2O ANODE MATERIALS SYNTHESIZED BY ELECTRODEPOSITION TECHNIQUE FOR RECHARGEABLE LITHIUM-ION BATTERIES

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Cu_2O has gained attention for the anode application of the rechargeable Lithium-Ion Battery (LIB) than the other competing materials due to its high theoretical capacity (375.0 mAh/g), good capacity retention, affordability, non-toxicity and ease of storage. The crystallinity, morphology and interfacial properties between the current collector/anode and anode/electrolyte are crucial for the electrochemical performance of Cu_2O electrodes. The aforementioned properties can be optimized by the synthesis method. A simple, low-cost, and convenient electrodeposition technique, which is a promising technique that enhances crystallinity with favourable morphology and interfacial properties for electrode materials, has not been studied. This study aimed to investigate the possibility of using p-Cu_2O and n-Cu_2O anode materials for LIBs synthesized by the electrodeposition technique. The favourable morphology of synthesized p-Cu_2O and n-Cu_2O enhanced the contact area of the active materials with the electrolyte, facilitating Li ion diffusion. Mott-Schottky plots confirmed the formation of p-type and n-type conductivity in Cu_2O with dopant densities of 2.0685×10^{17} cm^{-3} and 2.9692×10^{17} cm^{-3}, respectively. The electron densities are more crucial for the conversion mechanism reaction during the charging and discharging process. Therefore, n-Cu_2O attributes better conversion mechanism reactions than p-Cu_2O. Current-voltage characterizations of p-Cu_2O and n-Cu_2O electrodes confirmed the Ohmic contact in between the anode and current collector. The p-Cu_2O and n-Cu_2O electrodes exhibited a high initial specific discharge capacities of 533.0 mAh/g and 623.9 mAh/g at a rate of C/5, respectively. The electrodes showed a specific discharge capacities of 143.2 mAh/g and 203.4 mAh/g with Coulombic efficiencies of 99.9% and 98.7% after 50 cycles for p-Cu_2O and n-Cu_2O, respectively. Altogether, this study revealed that n-Cu_2O has better electrochemical performance than p-Cu_2O. Hence, n-Cu_2O has a potential for the anode application in next-generation high-performance LIBs.

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