

Microwave Irradiation Controls the Manganese Oxidation States of Nanostructured (Li[Li_{0.2}Mn_{0.52}Ni_{0.13}Co_{0.13}Al_{0.02}]O₂) Layered Cathode Materials for High-Performance Lithium Ion Batteries

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Abstract

A hybrid synthesis procedure, combining microwave irradiation and conventional annealing process, is described for the preparation of lithium-rich manganese-rich cathode materials, Li[Li_{0.2}Mn_{0.54}Ni_{0.13}Co_{0.13}]O₂ (LMNC) and its aluminum-doped counterpart, Li[Li_{0.2}Mn_{0.52}Ni_{0.13}Co_{0.13}Al_{0.02}]O₂ (LMNCA). Essentially, this study interrogates the structure and electrochemistry of these layered cathode materials when subjected to microwave irradiation (these microwave-based produced are abbreviated herein as LMNC-mic and LMNCA-mic). The nanoparticulate nature of these layered cathode materials were confirmed by SEM. The crystallinity and layeredness were determined from the XRD analysis. The XPS measurements proved a definite change in the oxidation states of the manganese due to microwave irradiation. The galvanostatic charge-discharge characterization showed that the aluminum-doped cathode material obtained with the assistance of microwave irradiation has superior electrochemical properties. In summary, the electrochemical performance of these cathode materials produced with and without the assistance of microwave irradiation decreased as follows: LMNC_{Amic} > LMNCA > LMNC_{mic} > LMNC.