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Assessment of Thermo-electrochemical Performance on Cathode Materials for Lithium Ion Cells

Zhongliang Xiao[1], *Qingqing Zhou*[1], *Liubin Song*[1*], *LingjunLi*[2], *Zhong Cao*[1], *Chaoming Hu*[1], *Yipeng Lu*[1]

[1] Collaborative Innovation Center of Micro/nano Bio-sensing and Food Safety Inspection, Hunan Provincial Key Laboratory of Materials Protection for Electric Power and Transportation, School of Chemistry and Biological Engineering, Changsha University of Science and Technology, Hunan Changsha 410004, PR China.
[2] School of Physics and Electronic Science, Changsha University of Science and Technology, Hunan Changsha 410004, PR China.
[*]E-mail: liubinsong1981@126.com

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In this paper, we adopted electrochemical-calorimetric method to study the heat production of lithium ion batteries in which $LiNi_{0.5}Co_{0.2}Mn_{0.3}O_2$ acted as cathode materials at a constant ambient temperature (313.15 K) during different charge-discharge processes. And the results of thermo-electrochemical properties on $LiNi_{0.5}Co_{0.2}Mn_{0.3}O_2$ cathode materials have been compared to the results on $LiFePO_4$ and $LiMn_2O_4$ materials from our previous studies [1,2]. By comparing results of different electrode materials, we concluded that charge-discharge rate was one of the key factors affecting the lithium-ion batteries. With the increasing of rate, heat production and enthalpy change of different cathode materials increased and discharge capacity decreased. The greater the entropy value was, the greater the confusion degree and reversible worse were. At low rate (0.2 C) entropy value of $LiFePO_4$ was the largest, followed by $LiMn_2O_4$ and $LiNi_{0.5}Co_{0.2}Mn_{0.3}O_2$. Cycle performance of $LiFePO_4$ was the worst, which was consistent with electrochemical performance analysis. These results provide a theoretical basis for optimizing design of the battery structure and reveal that the choosing of suitable charge-discharge rate is critical to the thermal management.

Keywords: assessment, lithium ion cell, thermo-electrochemistry, cathode material, electrochemical-calorimetry

FULL TEXT