Effect of Calcination Time on Lithium Ion Diffusion Coefficient of $\text{LiMg}_{0.04}\text{Mn}_{1.96}\text{O}_4$ Prepared by a Solid-State Combustion Method

Tao Feng^{1,2,3}, Wangqiong Xu^{1,2,3}, Xiaofang Liu^{1,2,3}, Miaomiao Shao^{1,2,3},
Junming Guo^{1,2,3,*}, Changwei Su^{1,2,3,*}

¹ Key Laboratory of Comprehensive Utilization of Mineral Resources in Ethnic Regions, Yunnan Minzu University, Kunming 650500, PR China

² Key Laboratory of Resource Clean Conversion in Ethnic Regions, Education Department of Yunnan, Yunnan Minzu University, Kunming 650500, PR China

³ Joint Research Centre for International Cross-border Ethnic Regions Biomass Clean Utilization in Yunnan, Yunnan Minzu University, Kunming 650500, PR China

*E-mail: guojunming@tsinghua.org.cn ; abrastein@163.com

doi: 10.20964/2018.01.50

Received: 26 September 2017 / Accepted: 30 October 2017 / Published: 16 December 2017

A series of $\text{LiMg}_{0.04}\text{Mn}_{1.96}\text{O}_4$ cathode materials were prepared by a solid-state combustion method at temperature of 500°C for 1h and then calcined at 700°C for 3, 6, 9 and 12h. The effects of two-stage calcination time on structure, morphology, electrochemical properties and diffusion coefficient of lithium ions of $\text{LiMg}_{0.04}\text{Mn}_{1.96}\text{O}_4$ were studied. X-ray diffraction (XRD) results showed that the two-stage calcination time at 700°C is ineffective to change crystalline structure and phase composition, still retaining intrinsic spinel structure without any other impurity phases, but the crystallinity become well and particle size increases with calcination time increases. Scanning electron microscope (SEM) shows that $\text{LiMg}_{0.04}\text{Mn}_{1.96}\text{O}_4$ calcined at 700°C for 6h (LMMO-6h) has uniform, nearly octahedron structure morphology with narrow size distribution. Diffusion coefficient of lithium ions (D_{Li^+}) of $\text{LiMg}_{0.04}\text{Mn}_{1.96}\text{O}_4$ two-stage calcined at 700°C for 3-12 hours was calculated according to the charging peaks in cyclic voltammetric (CV) curves, it was found that the D_{Li^+} value first increases and then slightly decreased with the calcined time at 700°C. The highest value of 7.19×10^{-11} and $7.48 \times 10^{-11} \text{ cm}^2 \text{ s}^{-1}$ for the first and second oxidation peaks of LMMO-6h, respectively. The electrochemical tests also show LMMO-6h exhibited a better electrochemical than other samples.

Keywords: $\text{LiMg}_{0.04}\text{Mn}_{1.96}\text{O}_4$; solid-state combustion method; diffusion coefficient; calcination time; lithium ion batteries

[FULL TEXT](#)

© 2018 The Authors. Published by ESG (www.electrochemsci.org). This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).