Spinel LiMn_2O_4 with Two-step Nano- Al_2O_3 Coating as High Performance Positive Materials

Yannan Zhang¹, Peng Dong², Xiaohua Yu³, Shubiao Xia⁴, Jinjie Song⁵, Ruiming Yang¹, Huixin Liang², Zhezhong Shi¹, Yao Yao², Xue Li^{2,*}, Yingjie Zhang^{1,*}

¹ National and Local Joint Engineering Laboratory for Lithium-ion Batteries and Materials Preparation Technology, Key Laboratory of Advanced Battery Materials of Yunnan Province, Faculty of Materials Science and Engineering, Kunming University of Science and Technology, Kunming 650093, China.

² National and Local Joint Engineering Laboratory for Lithium-ion Batteries and Materials Preparation Technology, Key Laboratory of Advanced Battery Materials of Yunnan Province, Faculty of Metallurgical and Energy Engineering, Kunming University of Science and Technology, Kunming 650093, China

³ National Engineering Research Center of Waste Resource Recovery, Kunming University of Science and Technology, Kunming 650093, China

⁴ Faculty of Chemistry & Chemical Engineering, Qujing Normal University, Qujing 655011, China

⁵ Key Laboratory of Mesoscale Severe Weather/Ministry of Education, and School of Atmospheric Sciences, Nanjing University, Nanjing 210093, China

*E-mail: 438616074@qq.com, zyjkmust@126.com

doi: 10.20964/2017.07.56

Received: 8 April 2017 / Accepted: 12 May 2017 / Published: 12 June 2017

To study the influence of the uniformity and integrity of amphoteric metal oxide coating layers on the performance of positive materials in Lithium-ion batteries, nano- Al_2O_3 -coated LiMn_2O_4 positive material were synthesized by using a two-step sol-gel process. The products were characterized by power X-ray diffraction (XRD), scanning electron microscopy (SEM), Transmission Electron Microscopy (TEM), energy-dispersive X-ray spectrum (EDX), X-ray photoelectron spectroscopy (XPS), galvanostatic charge-discharge test system, and inductively-coupled plasma emission spectrograph (ICP-AES). The results show that the two step method coating can bring with the uniform and glabrous nano- Al_2O_3 layer tightly coupling with the surface of the LiMn_2O_4 particles, when being positive material for Lithium-ion batteries, which exhibits capacity losses of only 13.2 % at 60 °C, after 300 cycles, much better than those of the pristine material and the sample synthesized by conventional one step sol-gel method (with the same Al_2O_3 -coating content). Moreover, the ICP-AES tests of Mn^{2+} reveal that the Al_2O_3 layers with two step coating layer plays an important role in protecting LiMn_2O_4 from the electrolyte corrosion.

Keywords: LiMn_2O_4 , sol-gel process, positive materials, lithium-ion batteries

[FULL TEXT](#)

© 2017 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/>).