High Capacity Prussian Blue Analogue@Reduced Graphene Oxide/Li₄Ti₅O₁₂ Composite as an Anode Material for Lithium-Ion Batteries with a Broad Voltage Window

Daming Sun¹,², Huan Zhang¹,², Hao Wang¹, Bangwei Deng¹,², Yan Ding¹,², Xuan Li¹,², Jianbin Li¹,², Wujie Ge³,*, Meizhen Qu¹,²,*

¹ Chengdu Institute of Organic Chemistry, Chinese Academy of Sciences (CAS), No. 9, 4th section of South Renmin Road, Chengdu 610041, P. R. China
² University of Chinese Academy of Sciences, No. 19 (A) Yuquan Road, Beijing 100049, P. R. China
³ School of Chemical Engineering, Guizhou Institute of Technology, Guiyang, 550003, P. R. China
*E-mail: gewj0359@163.com, mzhqu18@cioc.ac.cn

doi: 10.20964/2019.06.71

Received: 18 February 2019 / Accepted: 8 April 2019 / Published: 10 May 2019

A narrow electrochemical window, poor electronic conductivity and lithium ions transfer capability slow down the mass application of Li₄Ti₅O₁₂ (LTO) as power batteries in passenger cars with a long range. An effective way to improve the capacity and energy density of LTO is to include it in a composite materials to provide a good ionic and electronic conductive network followed by excess discharge to about 0 V vs. Li⁺/Li. Mn-Fe based Prussian blue analogue (Mn-PBA) nanoparticles with special open framework structure anchor on the reduced graphene oxide (rGO) conferred a high electronic and ionic conductivity and similar charge/discharge voltage plateaus with LTO. As a result, the Mn-PBA@rGO/LTO composite takes full advantages of high capacity Mn-PBA and the high electronic conductivity rGO sheets. It delivered a high reversible capacity (301.7 mAh g⁻¹ at 0.2 C) and superior rate performance (208.5 mAh g⁻¹ at 30 C) in a broad electrochemical voltage range between 0.01 and 3 V in half cells. Furthermore, a capacity of 232.6 mAh g⁻¹ at 1 C of Mn-PBA@rGO/LTO–10% was measured and good cycling performance was obtained in pouch cells with LiNi₀.₆Co₀.₂Mn₀.₂O₂ (NCM622) as a cathode and Mn-PBA@rGO/LTO–10% as anode, indicating that the Mn-PBA@rGO/LTO–10% composite is a promising anode material for lithium-ion batteries (LIBs).

Keywords: Prussian blue analogue@reduced graphene oxide; Li₄Ti₅O₁₂; composite anode; broad voltage window; Lithium-ion batteries.

FULL TEXT