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Influence of synthesis parameters on the physicochemical and electrochemical properties of $LiFePO_4$ for Li-ion battery

Swapnil J. Rajoba[1], Lata D. Jadhav[1*], Ramchandra S. Kalubarme[2], Sanket N. Yadav[3]

[1]Electrochemical Energy Materials Laboratory, Department of Physics, Rajaram College. Kolhapur - 416 004, India

[2]Centre for Materials for Electronics Technology, Thrissur-680581, India

[3]School of Nano Science and Technology, Shivaji University, Kolhapur-416004, India

* Corresponding author: ldjadhav.phy@gmail.com

Abstracts:

$LiFePO_4$ (LFP) has been developed as a cathode for lithium ion batteries (LIBs) by solution combustion method. The present work includes effect of fuel, residual carbon and graphene oxide on the phase purity and electrochemical performance of combustion synthesized $LiFePO_4$. As revealed in XRD, single phase $LiFePO_4$ is obtained in glycine assisted combustion (G-LFP) and it delivers 97 mA.h/g discharge capacity, which is higher than urea assisted combustion (U-LFP). Further, the G-LFP was calcined for different lengths of time (4, 5 and 7 hrs). The amount of in-situ carbon is observed to decrease from 2.57 to 1.40 % and specific capacity increases from 97 (4 hr) to 106 mA.h/g (7 hr). The composites with 4 wt. % GO were formed and they show enhanced electrochemical performance. 5LFP/GO delivers discharge capacity of 164 mA.h/g at 0.1 C, which is 96 % of its theoretical capacity.

Keywords: Lithium iron phosphate; Solution combustion; Fuel; graphene oxide and electrochemical performance.

1. Introduction:

Lithium ion batteries (LIBs) are one of the most popular secondary batteries for portable electronic devices due to their high energy and power densities, long cycle life and a broad temperature range of operation **[1]**. The selection of active materials and electrolyte especially, cathode material, is very critical governing the energy and power densities. Frequently, oxide materials with layered $LiMO_2$ (M= Co, Ni, and Mn) **[2]**, spinel $LiMn_2O_4$ **[3]** and olivine $LiFePO_4$ **[4]** type structures are used as cathode for LIBs. Among these materials, $LiFePO_4$ (LFP) exhibits high theoretical capacity (~170 mAh/g) **[5]**. Moreover, it is stable, low cost and environmentally friendly material **[6]**. Nevertheless, due to its slow Li-ion diffusion rate (~10^{-14} cm^2/s) and poor electronic conductivity (~10^{-9} s/cm) **[7]**, it is difficult to achieve the theoretical capacity. The three routes to raise the observed capacity to