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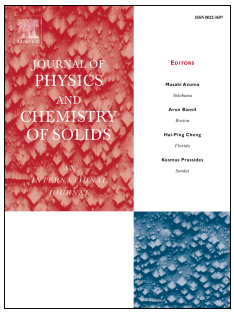

Effect of chelating agent on the sol-gel thermolysis synthesis of $LiNiPO_4$ and its electrochemical properties for hybrid capacitors

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Effect of chelating agent on the sol-gel thermolysis synthesis of $LiNiPO_4$ and its electrochemical properties for hybrid capacitors

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Abstract

The present work reports the preparation of olivine structured $LiNiPO_4$ nanoparticles through sol-gel thermolysis method using three different chelating agents of citric acid (LiNi-C), L-ascorbic acid (LiNi-A) and D-sorbitol (LiNi-S). The flame temperature and enthalpy change of each reaction using the chelating agent is calculated. Further, the sharp X-ray diffraction peak reveals the phase pure and high crystalline nature of the prepared $LiNiPO_4$ nanoparticles with the space group of Pnma (62) irrespective of the chelating agents. The four possible fundamental vibrations of phosphate anion PO_4^{3-} are revealed through Fourier Transform Infrared Spectroscopy (FTIR) studies. The presence of elements such as Ni, P and O and its valence state is identified through X-Ray Photoelectron Spectroscopy analysis. The spherical shape particles with the uniform size distribution of LiNi –S is observed than the LiNi-C, LiNi-A particles through FESEM analysis. The redox peaks and plateau regions in the cyclic voltammetry (CV) and Galvanostatic charge-discharge (GCD) profiles infer the dominance of battery-type charge process rather than a capacitive mechanism. As a result, $LiNiPO_4$ exhibits a maximum specific capacitance of 417 F g^{-1} at 2 mV s^{-1} and 357 F g^{-1} at 1 mA cm^{-2} in 1 M LiOH, which enables as a suitable cathode material for hybrid supercapacitor. Also, the assembled hybrid supercapacitor delivered a high energy density of 12.5 Wh kg^{-1} at 200 W kg^{-1} as well as a longer cycle life of