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Electrospun $NaMnPO_4$/CNF as High-Performance Cathode Material for Sodium Ion Batteries

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Abstract : The large-scale extension of renewable energy led, recently, to the development of efficient and low-cost electrochemical energy storage (EES) systems such as batteries. Although lithium-ion battery (LIB) technology is relatively mature, several issues regarding safety, cyclability, and high costs must be overcome. Thanks to the availability and low cost of sodium, sodium-ion batteries (NIB) have the potential to meet the energy storage needs of the large-scale grid, becoming a valid alternative to LIB in some energy sectors, such as the stationary one. However, important challenges such as low specific energy and short cyclic life due to the large radius of Na+ must be faced to introduce this technology into the market. As an important component of SIBs, cathode materials have a significant effect on the electrochemical performance of SIBs. Recently, sodium layer transition metal oxides, phosphates, and organic compounds have been investigated as cathode materials for SIBs. In particular, phosphate-based compounds such as Na_xMPO_4 (M= Fe, Co, Mn) have been extensively studied as cathodic polyanion materials due to their long cycle stability and appropriate operating voltage. Among these, an interesting cathode material is the $NaMnPO_4$ based one, thanks to the stability and the high redox potential of the Mn^{2+}/Mn^{3+} ion pair (3÷4 V vs. Na+/Na), which allows reaching a high energy density. This work concerns with the synthesis of a composite material based on $NaMnPO_4$ and carbon nanofibers ($NaMnPO_4$-CNF) characterized by a mixed crystalline structure between the maricite and olivine phases and a self-standing manufacture obtained by electrospinning technique. The material was tested in a Na-ion battery coin cell in half cell configuration, and showed outstanding electrocatalytic performances with a specific discharge capacity of 125 $mAhg^{-1}$ and 101 $mAhg^{-1}$ at 0.3C and 0.6C, respectively, and a retention capacity of about 80% a 0.6C after 100 cycles.

Keywords : electrospinning, self standing materials, Na ion battery, cathode materials
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