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Synthesis of $Li_3V_2(PO_4)_3$/C nanocomposites as positive electrode for Lithium-ion hybrid Supercapacitors

Biying Zhuang and **Yanfang Gao**
Inner Mongolia University of Technology, P.R. China

Now-a-days lithium-ion hybrid supercapacitors (LIHSs) by virtue of a higher energy density and longer cycle life by the electrical and electronic industry wide attention. Because LIHSs special intercalation structure, it combines the lithium-ion battery and supercapacitor energy storage advantages. However LIHSs still face many challenges, such as poor rate capability and limited long-term cycling stability. Lithium vanadium phosphate ($Li_3V_2(PO_4)_3$) has a higher Li^+ diffusion coefficient, higher discharge voltage, higher energy density , higher specific capacity, it is the one of has great potential in the future Electrode material. In this work, we find that $Li_3V_2(PO_4)_3$ is the three-dimensional (3D) network that is built from the slightly distorted VO_6 octahedra and PO_4 tetrahedra sharing oxygen vertexes, because of this special structure will make the interlayer spacing of $Li_3V_2(PO_4)_3$ expand, reduce the resistance of the intercalation/de-intercalation of cations (e.g. Li^+) in the bulk of active materials, more conducive to reflect the intercalation pseudocapacitive behaviour. However the phosphate family has been known to have poor conductivity. Carbon based nanocomposites have been broadly studied in electrochemical energy storage. We prepared the carbon-coated $Li_3V_2(PO_4)_3$ by hydrothermal method is one more time widen the interlayer spacing in the material, providing a wider channel for the rapid intercalation of cations, thus improving the electronic conductivity of the material and enhancing the overall performance of the lithium-ion hybrid supercapacitor. In addition, hydrothermal method uses water as the main reaction medium; it's easy to obtain, in line with the concept of green chemistry.

yf_gao@imut.edu.cn