Advanced Sodium-ion Batteries Based on NASICON-type Materials

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Na-ion batteries (NIBs) have attracted rapidly increasing attention because sodium is abundant resources, low cost and their better safety. However, the development of NIBs is greatly hampered due to the lack of appropriate active materials for both cathodes and anodes, because of the large radius of Na+. NASICON-type $Na_3V_2(PO_4)_3$ (denoted as NVP) has recently been investigated as a promising cathode material for NIBs. While it is difficult to reach high rate performance of $Na_3V_2(PO_4)_3$ cathode due to the poor electronic conductivity of phosphates. For anode materials, $NaTi_2(PO_4)_3$ has shown promising electrochemical performance.

Here, we reported electrode materials for NIBs based on porous carbon with excellent rate performance: Carbon-coated nanosized $Na_3V_2(PO_4)_3$ embedded in the porous carbon matrix.[1] [2-5] The double carbon coating NVP could deliver high rate performance (44 mAhg-1 at 200C). This ultrahigh rate performance is comparable to that of supercapacitor, but with much higher energy density. We also designed $NaTi_2(PO_4)_3$ particles embedded in micro-sized 3D graphene network to improve its electrochemical performance.

The outstanding electrochemical performance of electrode materials with porous carbon network for NIBs is attributed to the special structure design, which confined a variety of advantages: hierarchical porous channels facilitating fast ions and electrons transport, carbon coated structure resulting in low resistances, good mechanical properties leading to the excellent morphology stability.

References:

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