The electrochemical performance of $Na_3V_2(PO_4)_3$ as high-voltage cathode material for rechargeable magnesium batteries

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The lack of suitable cathode materials hinders the development of rechargeable magnesium batteries (RMBs).[1] Most of the developed cathode materials for RMBs exhibit relatively low working voltage (< 2 V vs. Mg^{2+}/Mg), which leads to an unsatisfactory energy density. Improving the voltage of cathode materials is an effective way to enhance the energy density. Although a few high-voltage cathode materials have been reported, such as $MgCo_2O_4$ and $V_2(PO_4)_3$, the electrochemical performances of those materials are still needed to be improved.[2, 3] Thus, developing high voltage cathode material with good electrochemical performance is highly desired.

In this work, we report a promising high-voltage cathode material based on $Na_3V_2(PO_4)_3$ (NVP) with Na-superionic conductor (NASICON) structure.[4] To create vacant sites for intercalation of Mg^{2+} ions, two Na are extracted electrochemically from the NVP/C and the resulted phase $NaV_2(PO_4)_3$ (ED-NVP/C), as Mg^{2+} ions insertion host, is investigated (Figure 1a). The ED-NVP/C delivers an initial discharge capacity of 88.8 mAh g^{-1} at 20 mA g^{-1} with good cycling stability (Figure 1b-c). At the 100th cycle, 81% of the capacity is still maintained. The average working voltage of the ED-NVP/C is ~ 2.5 V (vs. Mg^{2+}/Mg), higher than most of the previously reported cathode materials. This advantage provides a good opportunity to enhance the energy density of RMBs.

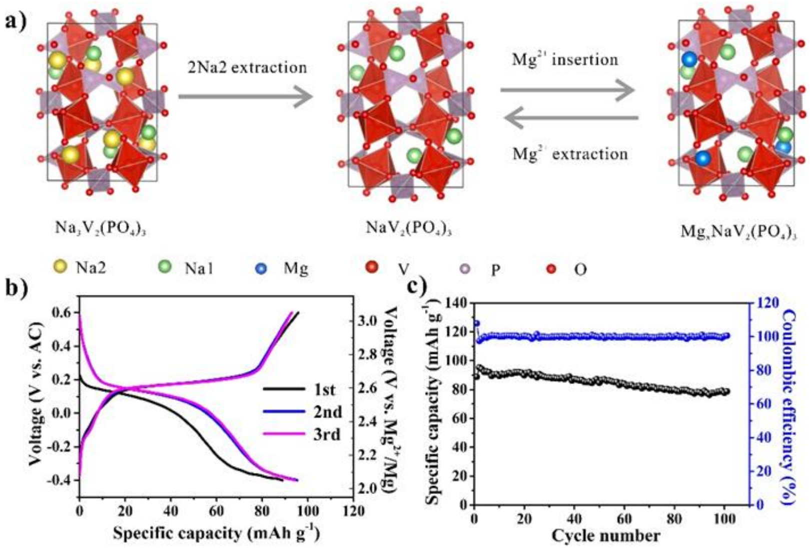

Figure1. (a) Illustration of electrochemical desodiation and (de)magnesiation processes; (b) Galvanostatic charge-discharge voltage profiles and (c) Cycle performance of the ED-NVP/C at 20 mA g^{-1}.

References:

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