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High-performance V-based electrode materials for sodium-ion batteries

Sodium ion batteries have been considered as one of the promising candidates for large-scale energy storage systems [1, 2]. From the application perspective of an integrated sodium ion full-cell system, it is important to develop a practical sodium-ion full-cell system with excellent cycling life, superior safety, and good rate capability to tolerate the frequent current impulses during the grid peak period [3]. Therefore, exploring appropriate electrode materials with excellent electrochemical properties is the key issue.

In this work, a series of high-performance V-based electrode materials for sodium-ion batteries have been synthesized by solvothermal and sol-gel methods. The microstructure and electrochemical properties of the materials are investigated by physical characterization and electrochemical measurement techniques. The electrode materials exhibit excellent electrochemical performance, including high capacity, superior rate capability, and remarkable cycling performance. $Na_3V_2(PO_4)_3$@C/CNT anode delivers a reversible capacity of 60.2 mA h g^{-1} after 10000 cycles at 50 C. The fabricated symmetric full cell exhibits an initial discharge capacities of 89 mA h g^{-1} at a high current density of 20 C and can still maintain a capacity of 72.1 mA h g^{-1} over 5000 cycles, corresponding to a capacity retention of about 81%. In addition, micro-sized two-phase structured $Li_{2.6}Na_{0.4}V_2(PO_4)_3$/C composite is comprised of numerous primary nanocrystals. It shows excellent long-term cycling stability with capacity retention of about 83 % and 100 % after 3000 cycles at 10 C, for the cathode and anode, respectively. Moreover, the symmetric sodium-ion full cells made of the $Na_2LiV_2(PO4)_3$/C nanocomposite have good rate capability and cycling stability, which verifies the feasibility for practical applications of the $Na_2LiV_2(PO4)_3$/C nanocomposite in sodium-ion batteries.

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Page margins are 2,00 cm top and down; 1,90 cm left and right.
Greek letters, sub- and superscripts should be formatted as such.

References

[1] H. Pan, Y.-S. Hu, L. Chen, *Energ Environ Sci*, 2013, **6**, 2338-2360.
[2] X. Xiang, K. Zhang, J. Chen, *Adv Mater*, 2015, **27**, 5343-5364.
[3] J. Deng, W.-B. Luo, S.-L. Chou, H.-K. Liu, S.-X. Dou, *Adv. Energy Mater.*, 2018, **8**, 1701428.

Figures

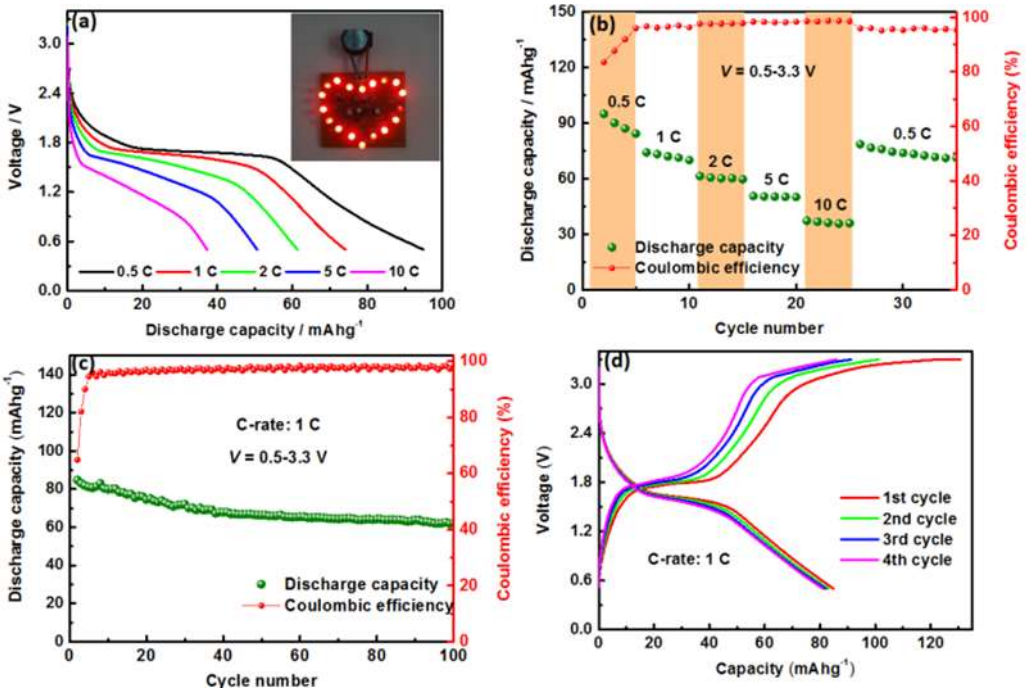

Figure 1: The electrochemical performance of symmetric full cells based on the NLVP/C.