Carbon-Coated $Na_3V_2(PO_4)_3$ Micro-Flower as a Superior High-Rate and Long-life Cathode for Sodium-Ion Battery

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Sodium ion batteries (SIBs) operating at ambient temperature hold great promise for large-scale renewable energy storage and conversion because of their abundant resources and low cost advantages.[1] Sodium vanadium phosphate ($Na_3V_2(PO_4)_3$, NVP), as a typical sodium super-ionic conductor (NASICON), has been considered as a promising cathode material for SIBs owing to its high ion conductivity and three-dimensional open framework.[2] However, its intrinsic poor electronic conductivity severely limits its reversible capacity and rate capability. Herein, we report a facile hydrothermal method to synthesis carbon-scaffolded NVP microflower, in which nano-crystalline NVP is embedded in carbon sheets to form porous microflower. Superior cell performance of high rate capability and cycle stability are observed in the well-defined structure. As the cathode for SIBs, it delivers a discharge capacity of 117.3 mAh g^{-1} at 0.1 C, excellent rate capability (high reversible capacity of ~80 mAh g^{-1} even at 200 C) and superior cycling stability (73% capacity retention after 10 000 cycles). Such remarkable performance is attributed to the enhanced electronic conductivity from the interconnected carbon layer and shortened ionic diffusion pathway and improved structural integrity. The results demonstrate the prepared carbon-coated NVP micro-flower has potential for application in sodium ion batteries for grid energy storage.

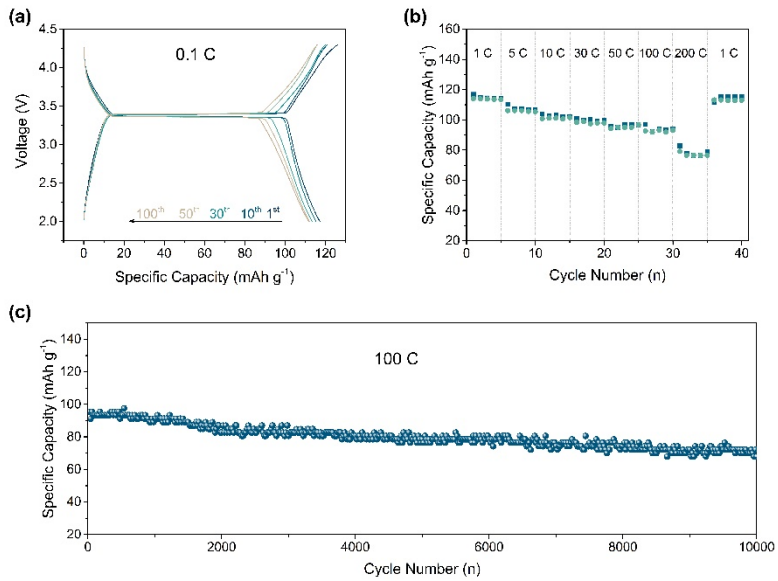

Figure 1. Typical charge-discharge profiles at a current rate of 0.1 C (a), Rate capability (b) and Cycling performance at 100 C (c) of NVP micro-flower.

References:

[1] S. W. Kim, D. H. Seo, X. Ma, G. Ceder, K. Kang, Adv. Energy Mater. 2 (2012) 710-721.

[2] K. Saravanan, C. W. Mason, A. Rudola, K. H. Wong, P. Balaya, Adv.Energy Mater. 3(2013), 444-450.