

Article title: Rechargeable Sodium-ion Battery: High Capacity Ammonium Vanadate Cathode with Enhanced Stability at High Rate

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DOI: 10.1021/acsami.5b03210

Web link: <http://pubs.acs.org/doi/pdf/10.1021/acsami.5b03210>

Source/Publisher: ACS Applied Materials & Interfaces

Abstract:

A sodium-ion battery (NIB) cathode performance based on ammonium vanadate is demonstrated here as high capacity, long cycle life and good rate capability. The simple preparation process and morphology study enable us to explore this electrode as suitable NIB cathode. Furthermore, density functional theory (DFT) calculation is envisioned for the $\text{NH}_4\text{V}_4\text{O}_{10}$ cathode and three possible sodium arrangements in the structure are depicted for the first time. Relevant NIB-related properties have been derived like average voltage, lattice constants and atomic coordinates etc. and the estimated values are in good agreement with the current experimental values. A screening study shows ammonium vanadate electrodes prepared on carbon coat onto Al-current collector exhibits a better electrochemical performance towards sodium, with a sustained reversible capacity and outstanding rate capability. The current cathode with nano-belt morphology, a reversible capacity of 190 mAh g⁻¹ is attained at a charging rate of 200 mA g⁻¹, and a stable capacity of above 120 mAh g⁻¹ is retained for extended 50 cycles tested at 1000 mA g⁻¹ without addition of any expensive electrolyte additive. The current electrode material is low-cost and scalable for mass production and by capturing the main stability and high energy density issues of NIB cathode and giving a strategic solution to the problems.