

Lithium vanadate hydrates with high lithium storage capacity and superior rate capability

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Among the cathode materials of lithium-ion batteries, lithium vanadate and vanadium oxide have attracted considerable attention owing to their high energy density and abundant resource. However, they still suffer from poor cycling performance and rate capability mainly due to the poor electric conductivity and low lithium-ion diffusion kinetics. Layered structure can facilitate lithium-ion diffusion in vanadium compounds. But it is unstable when undergo high-temperature treatment leading to the decrease of its electrochemical performance.

Our group developed an optimized dehydration induced nanostructuring (ODIN) approach which could promote the structural diversity while maintaining the layered characteristic of compounds [1]. Accordingly, a series of novel lithium vanadate hydrate (LHVO) cathode materials were synthesized by hydrothermal reaction followed by elaborate dehydration process ranging from 80 to 400 °C.

When used as lithium-ion battery cathode, layered LHVO showed high reversible capacities of 386, 300, 275, 236, 207, 185 and 157 mA h g⁻¹ under the current density of 0.05, 0.1, 0.2, 0.5, 1, 2 and 4 A g⁻¹, respectively. Furthermore, it sustained more than 500 cycles with the capacity fade of only 0.02% per cycle at 4 A g⁻¹. We suggest that the remained water (trapped in the lattice) can insure the stability of layered structure and dehydration may promote structure diversity and nanostructure refinement, which greatly improves the lithium-ion diffusion of the LHVO.

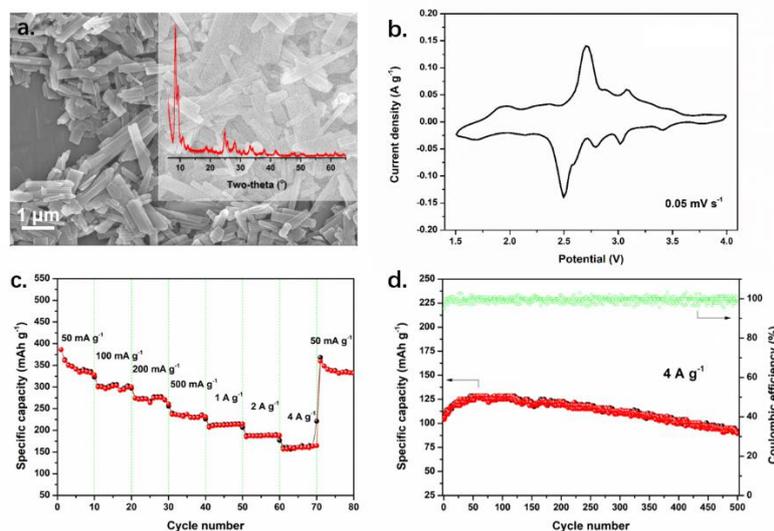


Figure 1. (a) SEM image and XRD diffraction pattern (the inserted figure), (b) CV curves, (c) charge-discharge curves under different current densities, (d) cycling stability at 4 A g⁻¹ of LHVO.

References:

[1] Shitong Wang, Wei Quan, Zhi Zhu, Yong Yang, Qi Liu, Yang Ren, Xiaoyi Zhang, Rui Xu, Ye Hong, Zhongtai Zhang, Khalil Amine, Zilong Tang, Jun Lu, Ju Li, Nat. Commun. 8 (2017) 627.