A New Layered Sodium Molybdenum Oxide Anode for Full Intercalation-Type Sodium-Ion Batteries

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Nowdays, lithium-ion batteries (LIBs) have gained a huge success in the portable electronic devices and (hybrid) electric vehicles. However, they are not suitable for large-scale energy storage because of the increasing cost and limited resources of lithium. Thus sodium-ion batteries (SIBs), as a potential alternative to LIBs, attract increasing attention for next generation large-scale energy storage system, on account of sodium's high abundance and low cost.[1,2] Developing favorable anode materials has become a key issue for the application of SIBs. The advantage of low cost, abundant resources and non-toxic makes molybdenum-based materials seem to be a smart choice as well as the titanium-based anode. Furthermore, some molybdenum-based materials, such as MoS_2 or MoO_3, have shown good electrochemical performance for SIBs.[3,4]

Herein, a novel molybdenum-based material, $Na_{0.3}MoO_2$, is synthesized by a simple solid-state reaction, and it presents remarkable electrochemical properties as an anode material for SIBs at room temperature for the first time. A reversible discharge capacity of 146 mAh/g is obtained at a current density of 20 mAh/g with average voltage of 0.8 V in SIBs. Meanwhile, it exhibits remarkable rate ability and capacity retention. To further confirm the application of the materials, we fabricated a $Na_{0.3}MoO_2$ // $Na_{0.8}Ni_{0.4}Ti_{0.6}O_2$ full intercalation-type sodium-ion battery, which can buffer the volume change (cathode expanding companied with anode shrinking almost equally and vice versa). Moreover, the safety concern would be greatly improved due to high potential of 0.8 V in $Na_{0.3}MoO_2$. The full cell displays an excellent cycling stability and rate ability. Thus, this molybdenum-based material might be a promising role as a new insertion anode for SIBs.

References:

[1]. H. Pan, Y.-S. Hu and L. Chen, *Energy Environ. Sci.*, 2013, **6**, 2338-2360.
[2] N. Yabuuchi, K. Kubota, M. Dahbi and S. Komaba, *Chem Rev*, 2014, **114**, 11636-11682.
[3] Z. Hu, L. Wang, K. Zhang, J. Wang, F. Cheng, Z. Tao and J. Chen, *Angew. Chem. Int. Ed*, 2014, **126**, 13008-13012.
[4] Y. Zhao, C. Han, J. Yang, J. Su, X. Xu, S. Li, L. Xu, R. Fang, H. Jiang and X. Zou, *Nano Lett*, 2015, **15**, 2180-2185.