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## Highly stable Na-storage performance of $\text{Na}_{0.5}\text{Mn}_{0.5}\text{Ti}_{0.5}\text{O}_2$ microrods as cathode for aqueous sodium-ion batteries

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### Abstract

Tunnel-structured  $\text{Na}_{0.5}\text{Mn}_{0.5}\text{Ti}_{0.5}\text{O}_2$  has been synthesized with a simple solid-phase reaction route as highly stable Na-storage cathode for aqueous sodium-ion batteries (SIBs). Combined characterizations of X-ray diffraction, scanning electron microscope and electrochemical measurements reveal that the material is mainly composed of rod-shaped particles with a diameter of 500 nm and a length of  $\sim 5 \mu\text{m}$ . During Na extraction/insertion process, it undergoes a single-phase reaction mechanism in the potential range of 0–1.0 V (vs Ag/AgCl), showing a reversible capacity of  $46 \text{ mAh g}^{-1}$  at a current density of  $30 \text{ mA g}^{-1}$  and an average operating potential of 0.41 V. In particular, excellent cycling performance is achieved owing to the favorable tunnel channel and robust structural framework, with a capacity retention of 95% after 100 cycles. The finding in this study demonstrates application potential of the  $\text{Na}_{0.5}\text{Mn}_{0.5}\text{Ti}_{0.5}\text{O}_2$  material as cathode for low-cost, long-cycling aqueous SIBs.

**Keywords:** Aqueous batteries, tunnel oxide, reaction mechanism, cycling stability

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