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| Abstract | |  | | |
| Aqueous Zn-ion batteries (ZIBs) have emerged as promising and eco-friendly next-generation energy storage systems to substitute lithium-ion batteries. Therefore, discovering new electrode materials for ZIBs with high performance and unraveling their electrochemical reactions during Zn-ion insertion/extraction are of great interest. Here, we present, for the first time, tunnel-type β-MnO2 nanorods with exposed (101) planes, prepared via a facile microwave-assisted hydrothermal synthesis within only 10 min, for use as a high performance cathode for ZIBs. In contrast to its bulk counterpart, which showed no electrochemical reactivity, the present β-MnO2 nanorod electrode exhibited a high discharge capacity of 270 mA h g−1 at 100 mA g−1, high rate capability (123 and 86 mA h g−1 at 528 and 1056 mA g−1, respectively), and long cycling stability (75% capacity retention with 100% coulombic efficiency at 200 mA g−1) over 200 cycles. The Zn-ion storage mechanism of the cathode was also unraveled using in situ synchrotron, ex situ X-ray diffraction, ex situ X-ray photoelectron spectroscopy, and ex situ X-ray absorption spectroscopy. Our present study indicates that Zn intercalation occurred via a combination of solid solution and conversion reactions. During initial cycles, the β-MnO2 cathode was able to maintain its structure; however, after prolonged cycles, it transformed into a spinel structure. The present results challenge the common views on the β-MnO2 electrode and pave the way for the further development of ZIBs as cost-effective and environmentally friendly next-generation energy storage systems. | | | | |