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| Title | Triggering the theoretical capacity of Na1.1V3O7.9 nanorod cathode by polypyrrole coating for high-energy zinc-ion batteries | | |
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| Abstract |  |
| The exploration of advanced cathode materials for aqueous rechargeable zinc-ion batteries (ZIBs) is currently a major research topic. In this study, we propose the microwave-assisted hydrothermal synthesis of polypyrrole (PPy)-coated Na1.1V3O7.9 (P-NVO) nanorods for the first time as a high-energy and high-power cathode material for ZIBs. The highly conductive PPy surface-coating layer is significant to enhance the electronic conductivity and Zn2+ diffusion kinetics, leading to utilize the V3+/V4+/V5+ multiple redox reactions of the NVO cathode in ZIBs. Compared to the NVO cathode, therefore, the P-NVO cathode offers higher discharge capacity, power capability and cycling stability; in particular, PPy coating triggers the full theoretical capacity of the NVO cathode (527 mAh g−1 with ∼ 3 mol Zn insertion per formula unit) and directly reflects a superior energy density of 408 Wh kg−1. Even at a high current density of 6000 mA g−1, the P-NVO cathode shows unprecedented cycling stability over 1100 cycles without capacity loss. Galvanostatic intermittent titration technique, cyclic voltammetry, *in situ* X-ray diffraction, and *ex situ* X-ray absorption near edge structure analyses are combined to verify the superior Zn storage mechanism of the P-NVO cathode.  Manganese (Mn)-based cathode materials have garnered huge research  interest for rechargeable aqueous zinc-ion batteries (AZIBs) due to the  abundance and low cost of manganese and the plentiful advantages of  manganese oxides including their dierent structures, wide range of phases,  and various stoichiometries. A novel in situ generated Mn-deﬁcient  ZnMn    O    @C (Mn-d-ZMO@C) nanoarchitecture cathode material from  self-assembly of ZnO-MnO@C for rechargeable AZIBs is reported. Analytical  techniques conﬁrm the porous and crystalline structure of ZnO-MnO@C and  theinsitugrowthofMndeﬁcientZnMn    O    @C. The Zn/Mn-d-ZMO@C cell  displays a promising capacity of  mAh g  −  at a current density of   mA g  −  with % of capacity retained after  cycles (at  mA g  −  rate). The improved performance of this cathode originates from in situ  orientation, porosity, and carbon coating. Additionally, ﬁrst-principles  calculations conﬁrm the high electronic conductivity of Mn-d-ZMO@C  cathode. Importantly, a good capacity retention (%) is obtained with a  year-old cell (after  cycles) at  mA g  −  current density. This study,  therefore, indicates that the in situ grown Mn-d-ZMO@C nanoarchitecture  cathode is a promising material to prepare a durable AZIB  Manganese (Mn)-based cathode materials have garnered huge research  interest for rechargeable aqueous zinc-ion batteries (AZIBs) due to the  abundance and low cost of manganese and the plentiful advantages of  manganese oxides including their dierent structures, wide range of phases,  and various stoichiometries. A novel in situ generated Mn-deﬁcient  ZnMn    O    @C (Mn-d-ZMO@C) nanoarchitecture cathode material from  self-assembly of ZnO-MnO@C for rechargeable AZIBs is reported. Analytical  techniques conﬁrm the porous and crystalline structure of ZnO-MnO@C and  theinsitugrowthofMndeﬁcientZnMn    O    @C. The Zn/Mn-d-ZMO@C cell  displays a promising capacity of  mAh g  −  at a current density of   mA g  −  with % of capacity retained after  cycles (at  mA g  −  rate). The improved performance of this cathode originates from in situ  orientation, porosity, and carbon coating. Additionally, ﬁrst-principles  calculations conﬁrm the high electronic conductivity of Mn-d-ZMO@C  cathode. Importantly, a good capacity retention (%) is obtained with a  year-old cell (after  cycles) at  mA g  −  current density. This study,  therefore, indicates that the in situ grown Mn-d-ZMO@C nanoarchitecture  cathode is a promising material to prepare a durable AZIB | |