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One-Dimensional Nanomaterials for Energy Storage

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Abstract

One-dimensional nanomaterials can offer large surface area, facile strain relaxation upon cycling and efficient electron transport pathway to achieve high electrochemical performance. Hence, nanowires have attracted increasing interest in energy related fields. We designed the single nanowire electrochemical device for in situ probing the direct relationship between electrical transport, structure, and electrochemical properties of the single nanowire electrode to understand intrinsic reason of capacity fading. The results show that during the electrochemical reaction, conductivity of the nanowire electrode decreased, which limits the cycle life of the devices [1]. We have fabricated hierarchical $MnMoO_4/CoMoO_4$ heterostructured nanowires by combining "oriented attachment" and "self-assembly" [2]. The asymmetric supercapacitors based on the hierarchical heterostructured nanowires show a high specific capacitance and good reversibility with a cycling efficiency of 98% after 1,000 cycles. Then, we designed the general synthesis of complex nanotubes by gradient electrospinning, including $Li_3V_2(PO_4)_3$, $Na_{0.7}Fe_{0.7}Mn_{0.3}O_2$ and Co_3O_4 mesoporous nanotubes, which exhibit ultrastable electrochemical performance when used in lithium-ion batteries, sodium-ion batteries and supercapacitors, respectively [3]. In addition, we have successfully fabricated a field-tuned hydrogen evolution reaction (HER) device with an individual MoS_2 nanosheet to explore the impact of field effect on catalysis [4]. We also constructed a new-type carbon coated $K_{0.7}Fe_{0.5}Mn_{0.5}O_2$ interconnected nanowires through a simply electrospinning method. The interconnected nanowires exhibit a discharge capacity of 101 mAh g^{-1} after 60 cycles, when measured as a cathode for K-ion batteries [5]. Our work presented here can inspire new thought in constructing novel one-dimensional structures and accelerate the development of energy storage applications.

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