

One-Dimensional Nanomaterials for Energy Storage

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One-Dimensional nanomaterials with large surface area, more surface active sites and better permeability can significantly increase the energy density, power density and cycling performance for the energy storage. Such hierarchical structure can also be used as targeted intracellular recording for its facile synthesis route. In our present work, a series of hierarchical nanomaterials have been obtained, including kinked hierarchical nanowires, hierarchical heterostructured nanowires and hierarchical scrolled nanowires which shows great electrochemical performance.

To increase the stability of Li-ion battery, V_3O_7 nanowire templated semi-hollow bicontinuous graphene scrolls architecture is designed and constructed through "oriented assembly" and "self-scroll" strategy. The V_3O_7 nanowire templated semi-hollow bicontinuous graphene scrolls with interior cavities provide continuous electron and lithium ion transfer channel and space for free volume expansion of V_3O_7 nanowires during cycling, thus representing a unique architecture for excellent lithium ion storage capacity and cycling performance.¹ Besides, we have designed and synthesized hierarchical $MnMoO_4/CoMoO_4$ heterostructured nanowires by combining "oriented attachment" and "self-assembly". 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.² Recently, we also constructed the hierarchical zigzag $Na_{1.25}V_3O_8$ nanowires,³ $K_3V_2(PO_4)_3$ bundled nanowire,⁴ and $Li_3V_2(PO_4)_3$ mesoporous nanotubes⁵ with enhanced electrochemical performance. Our work presented here can inspire new thought in constructing novel one-dimensional structures and accelerate the development of energy storage applications.

References

- (1) Yan, M. Y. et al., *J. Am. Chem. Soc.* 2013, 135, 18176-18182.
- (2) Mai, L. Q. et al., *Nature Commun.* 2011, 2, 381.
- (3) Dong, Y. F. et al., *Energy Environ. Sci.* 2015, 8, 1267.
- (4) Wang, X. P. et al., *Adv. Energy Mater.* 2015, 5(17).
- (5) Niu, C. J. et al., *Nature Commun.* 2015, 6, 7402.

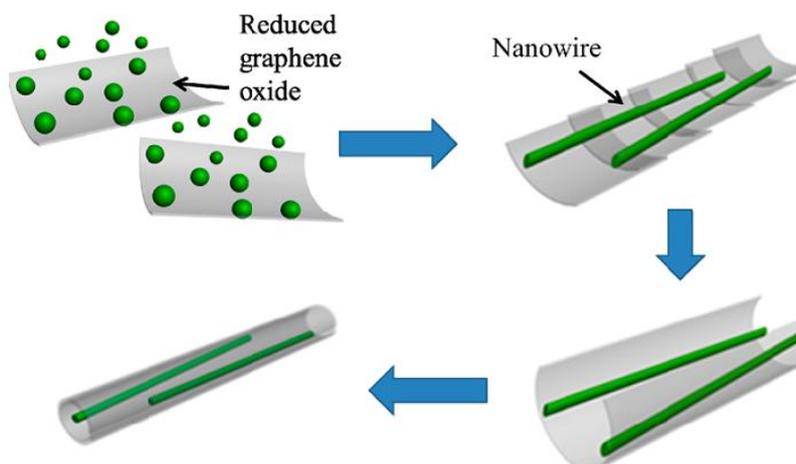


Figure. 1 Nanowire templated semi-hollow bicontinuous graphene scrolls

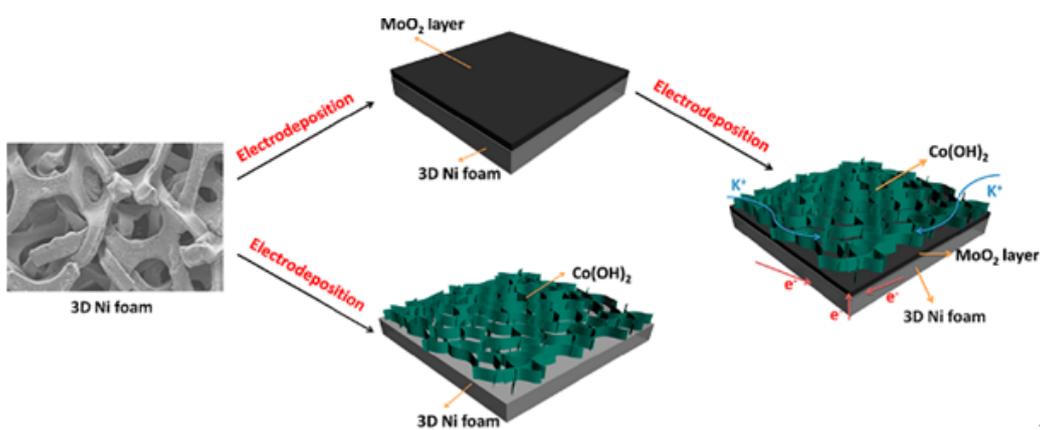


Figure. 2 $\text{MoO}_2/\text{Co(OH)}_2$ hierarchical nanostructure

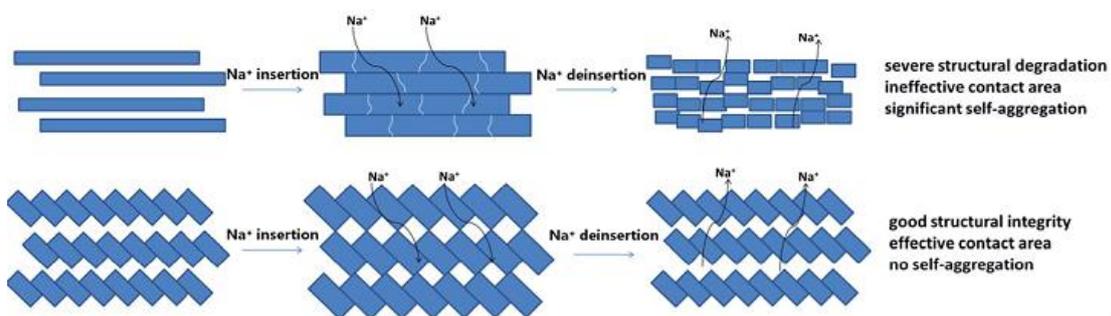


Figure. 3 Hierarchical zigzag $\text{Na}_{1.25}\text{V}_3\text{O}_8$ nanowires