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A dual-carbon phase modified and nanostructured nickel sulfide anode for sodium-ion batteries

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Lithium-ion batteries (LIBs) are extensively used from portable electronic appliances such as in mobile phones and laptops to bulky items such as in electric vehicles and large-scale energy storage. The extensive usage of LIBs for various energy storage purposes is due to their high energy and power densities. Their ability to store three times more energy than other batteries increases their competitiveness coupled with the virtual lack of waste during mining. Unfortunately, due to the rapid increase in demand for lithium and the geographical scarcity of it as the bulk availability of lithium reserves is found in South America. Therefore, there is an urgent need for an alternative source of lithium in the manufacture of rechargeable batteries. Sodium ion batteries (SIBs) have attracted considerable attention in recent years due to the high abundance, scattered distribution and low cost of sodium. Based on the concept of nano-confinement reaction, a synthetic strategy is developed to construct an ultrathin carbon film-coated and nanostructured nickel sulfide anchored on carbon nanotubes (CNTs). The synthesis involves direct growth of nickel hydroxide on the CNTs followed by dehydration, sulfidation and carbon coating. When used as an anode material in SIBs, the nickel sulfide-based anode shows a high utilization rate of active material and a favorable specific capacity of 390 mAh g^{-1}. The excellent performance of the nickel sulfide-based anode in SIBs demonstrates the potential of nickel sulfide to be used as the anode material in SIBs when it is engineered to alleviate its structural constraints. In principle, this strategy can be conveniently adapted to engineer other transition metal-based materials for applications in energy storage.

Biography

Zhiqiang Gao is an Associate Professor in Department of Chemistry at National University of Singapore (NUS). He completed his BSc and PhD in Chemistry at Wuhan University. He worked as a Postdoctoral Fellow at Åbo Akademi University and Weizmann Institute of Science. After spending three years in the United States and eight years at Institute of Bioengineering and Nanotechnology, he joined NUS in April 2011. His research interest includes "Bioengineering, renewable energy, electrochemistry, analytical chemistry and materials science".

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