Honeycomb-inspired design of ultrafine SnO_2@C nanospheres embedded in carbon film as anode materials for high performance lithium- and sodium-ion battery

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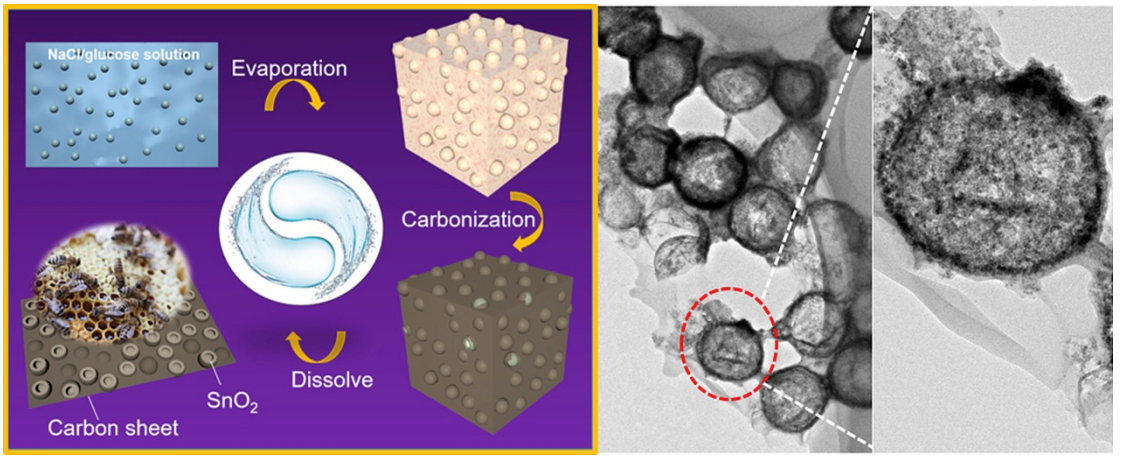
Tin oxide (SnO_2) has been considered as one of the most promising anodes for advanced rechargeable batteries due to its advantages such as high energy density, earth abundance and environmental friendly. However, its large volume change during the Li-Sn/Na-Sn alloying and de-alloying processes will result in a fast capacity degradation over a long term cycling. To solve this issue, in this work we design and synthesize a novel honeycomb-like composite composing of carbon encapsulated SnO_2 nanospheres embedded in carbon film by using dual templates of SiO_2 and NaCl. Using these composites as anodes both in lithium ion batteries and sodium-ion batteries, no discernable capacity degradation is observed over hundreds of long term cycles at both low current density (100 mA g^{-1}) and high current density (500 mA g^{-1}). Such a good cyclic stability and high delivered capacity have been attributed to the high conductivity of the supported carbon film and hollow encapsulated carbon shells, which not only provide enough space to accommodate the volume expansion but also prevent further aggregation of SnO_2 nanoparticles upon cycling. By engineering electrodes of accommodating high volume expansion, we demonstrate a prototype to achieve high performance batteries, especially high-power batteries.



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