Biomass Waste-Derived Silicon with Carbon coating as Anode Material for Sodium Ion Batteries

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To this day, sodium-ion batteries (NIBs) have been regarded as potential alternatives to lithium-ion batteries (LIBs) owing to the abundant resources of sodium and its low cost. To increase the capacity of NIBs in large-scale energy storage systems, researchers are focusing on developing low-cost raw materials as high-performance electrodes. Silicon has the highest theoretical capacity (4200 mA h g^{-1}) as the most promising anode materials because of their high energy density and worldwide distribution. Si also has high theoretical capacity of 954 mA h g^{-1}.[1] However, silicon suffers from large volume change during charge/discharge processes which leads electrode pulverization and large irreversible capacity.

In our research, we utilized biomass waste-derived silica as precursor for anode materials. Solid-state reduction method at high temperature was employed to reduce silica to silicon, and coated carbon on the surface of silicon in order to reduce the pulverization of electrode thus improve the irreversible capacity. The silicon with carbon coating serve as an anode material for NIBs because of its environmental friendly and low-cost properties. Various method for carbon coating were carried out in this study.[2] The configuration and microstructure of silicon with carbon coating were characterized by X-ray photoelectron spectroscopy (XPS) and transmission electron microscopy (TEM), respectively. The electrochemical properties were measured by cyclic voltammetry and galvanostatic charge/discharge cycle measurements. High capacity of around 200 mA h g^{-1} could be obtained with good cycling stability, indicating that biomass waste-derived silicon with carbon coating is a promising anode material for NIBs in large-scale energy storage applications.

References:

[1] Xu, Y., et al. Advanced Energy Materials, 2016. 6(2).

[2] Zuo, X., et al. Nano Energy, 2017. 31. p.113-143.