Pyroprotein-based Carbon Nanoplates for Sodium-ion Storage

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The performance of batteries is critically dependent on the electrode, thus the development of electrode materials is at the heart of advancement for Na-ion batteries (NIBs). In Li-ion batteries (LIBs), carbonaceous materials have played a pivotal role as an anode material.[1] The low cost, abundance and availability of large-scale processing systems for carbon materials has allowed LIBs to become commercially successful, and, accordingly, the nature of lithium-ion storage in various types of carbonaceous material is relatively well known. Carbonaceous materials possess many characteristics making them suitable electrodes for rechargeable battery chemistry and have been extensively used to date. While the nature of lithium-ion storage in various carbon materials has been investigated extensively due to the widespread use of graphite anodes in lithium-ion batteries, that of sodium-ion storage and its dependence on carbon structure is not so clearly understood.[2] Herein, we use pyroprotein-based carbon nanoplates from self-assembled silk proteins as a versatile platform to examine sodium-ion storage characteristics in various carbon environments.[3-5] It is found that, depending on the local carbon structure, sodium ions are stored *via* chemi/physisorption, insertion or nanoclustering of metallic sodium. We demonstrate two representative carbon structures that exhibit promising performance as anodes for sodium ion batteries, with high energy, high power and exceptionally stable cyclability (>2,400 cycles).[2] The straightforward dependency of electrochemical properties, such as potential and capacity, on the carbon structure found in this work provides guidelines for tailoring carbon structures to tune the electrochemical performance of carbonaceous materials for NIBs. Thus, the findings in this report not only provide a better understanding of sodium ion storage behaviour in carbonaceous materials but also offer a design strategy for electrode optimisation in various sodium-based electrochemical devices.

References
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