Insights into the electrochemical performance of hard carbon from wood in Na-ion battery negative electrodes

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Sodium-ion batteries (SIBs) are now being commercialized and are already beating lithium-ion batteries when it comes to safety, low-temperature performance, sustainability and cost. One of the most important advantages of SIBs is that they can be made from abundant raw materials in a low-energy process. The state-of-the-art negative electrode is the clearest example. Hard carbon can be made from any type of biomass and is synthesized at considerably lower temperatures and holding times than graphite.

Cellulose and lignin are the most abundant organic compounds on Earth, and in the Nordic countries there is more than enough wood to supply the world's need for batteries. Hard carbon from wood has shown great potential with high capacities and a very high initial coulombic efficiency, which is important in full cells. In this study, wood from different types of trees, as well as leaves, have been used as precursors. To understand the electrochemical properties of hard carbons from different types of wood precursors, electrodes have been made with hard carbons from various combinations of cellulose and different types of lignin. The hard carbons are characterized by XRD, nitrogen adsorption, particle size distribution and SEM. Electrodes made from these hard carbons have been subject to rate performance tests and continuous cycling over 500 cycles, and differences in the electrochemical cycling properties are correlated with the physical properties.