David P. Harper – FIB Abstract

Use of lignin based carbons for energy storage applications

Widespread concerns have been raised regarding the need to develop sustainable, domestic technologies to produce materials from feedstocks mined or fossil based. Lignin from plant biomass represents such a renewable feedstock that is carbon-rich and has potential to displace petroleum-based resources for material production. Recently, we have demonstrated that lignin can be converted using a unique reactive carbonization procedure to produce carbon materials with up to 90% composition of nano-sized graphitic domains. These nano-structured carbon materials based on lignin have significant promise for energy storage. Still little is known about how the kinetics of graphitization in a reactive solid-gas environments and the influence of lignin's physiochemical structure on carbon morphology. Specifically, the processing variables include the presence, temperature, and duration of thermal stabilization, pyrolysis, and passivation. The resulting materials are characterized at the atomic- and micro-scales using electron microscopy, elemental analysis, and x-ray diffraction. Cells exhibit specific capacities in ranges of 180–250 and 300–450 mAh g^{-1} based on the mass of lignin material. High temperature carbonization, 2000 °C, produced greater graphitization over 1050 °C carbonization, but had lower charge capacity. Coulombic efficiencies are over 98% for most cycles. Consequently, a properly designed carbonization process for lignin is well suited to generating low-cost, high-efficiency electrodes.