Mesoporous nitrogen-rich carbons derived from protein for ultra-high capacity battery anodes and supercapacitors

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In this work we demonstrate that biomass-derived *proteins* serve as an ideal precursor for synthesizing carbon materials for energy applications. The unique composition and structure of the carbons resulted in unparalleled electrochemical energy storage performance: We obtained a reversible lithium ion capacity of 1,780 mAh g^{-1}, which is by far the highest ever reported for any carbon-based electrode. Tested as a supercapacitor, the carbons exhibited a capacitance of 390 F g^{-1}, the highest ever reported for any N-rich carbon, yet with an excellent cycle life (7% loss after 10,000 cycles). Such exquisite properties may be attributed to a unique combination of a high specific surface area, partial graphitization and a very high bulk N-content. It is a major challenge to derive carbons possessing all three attributes. By templating the structure of mesoporous cellular foam with egg white-derived proteins, we were able to obtain hierarchically mesoporous partial graphitized carbons with a surface area of 805.7 m^2 g^{-1} and a bulk N-content of 9.3 wt%; a combination that has never been achieved in open literature.