

331d Exfoliated Graphite Nanofibers: Structure, Adsorption, and Electric Double-Layer Capacitance

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Herringbone graphite nanofibers (GNF) provide an interesting candidate for carbon exfoliation, with their slit-pore geometry, nano-scale dimensions, high aspect ratio, and graphitic layers that terminate along the fiber axis. Well-established graphite exfoliation techniques of acid intercalation followed by thermal treatment were applied to herringbone GNF, and the resulting fibers were characterized by HRTEM, XRD, EELS, EDS, TPO, gas adsorption, and cyclic voltammetry. Variations in thermal treatment led to drastic variations in the resulting fiber structure: A mild thermal treatment led to dislocations within the graphitic lattice and a 5% lattice expansion, whereas an extended thermal treatment led to an estimated 20-fold expansion and a ten-fold increase in surface area. The latter fiber had a unique structure with repeating interior amorphous carbon mesopores sandwiched between graphitic regions from the original herringbone morphology. The increased surface area of the exfoliated GNF correlated with increased low temperature hydrogen physisorption, whereas the observed dislocations in the graphitic structure correlated with ambient temperature hydrogen adsorption. Mild oxidation of the exfoliated GNF allowed access to the interior mesopores and led to an increased electrical double layer capacitance. These results suggest that selective exfoliation of a nanocarbon is a means to induce interior mesopores with a controlled pore size distribution which in turn will control the relative adsorption binding energy and the accessibility of mesopores for electrical double layer capacitors. Work to control the interior pore size to provide optimal lattice spacing for a given application will be discussed.