Structural and chemical characterization of N-doped nanocarbons

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Abstract

Fullerene blacks with 0.7-4.5 at % of nitrogen incorporated into their carbon framework were produced by feeding N_2 gas into the center of a carbon arc through a hollow graphite electrode. The formation of toluene-soluble fullerenes is effectively suppressed under these conditions. Optical emission spectroscopy of the arc plasma revealed the presence of N atoms and CN radicals. Chemical composition and stability of the N-doped fullerene blacks were examined and compared to their N-free counterparts produced in pure helium atmosphere by X-ray photoelectron spectroscopy (XPS), electron energy loss spectroscopy and temperature-programmed oxidation with mass-spectrometric detection of the product gases. The nitrogen content was not diminished when N-doped fullerene black was heated to 500°C in an *in situ* XPS experiment. Graphitic onions could be formed from *n*-doped fullerene black by intense electron irradiation in the electron microscope without loss of the nitrogen content. Structural and morphological properties were studied by powder X-ray diffraction, high-resolution transmission electron microscopy and the determination of BET (Brunauen Emme Teller) specific surface areas. The performance of N-doped and undoped fullerene blacks in the removal of ionic contaminants from water was examined in a dynamic adsorption scheme using diammonium chromate(VI) as a test compound.