Selective Oxidation of Carbon Phases in Nanodiamond Powders

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Purification of detonation synthesis nanodiamond from non-diamond carbon is a key step in making products utilizing nanodiamond powders. We have investigated purification of diamond powders by oxidation in air under isothermal and non-isothermal conditions. Thermogravimetric analysis and in-situ Raman spectroscopy were used to study the oxidation of three powders with different contents and structure of non-diamond carbon. Selective removal of amorphous and graphitic carbon without a significant loss of the diamond phase has been demonstrated. In contrast to current purification technologies, the oxidation process avoids the use of toxic or aggressive chemicals and does not require any catalysts or inhibitors. The whole process is conducted in ambient air and results in increasing the content of diamond in the powders from 30-85 wt.% to 95-97 wt.% as measured by X-ray Adsorption Near Edge Spectroscopy (XANES). Transmission electron microscopy (TEM) and Fourier Transform Infrared Spectroscopy (FTIR) studies show a high purity nanodiamond covered by oxygen-containing surface functional groups. These purified powders can be used as an end product or as an intermediate for subsequent surface modifications or functionalization.