

Facile Surface Functionalization of Nanodiamonds

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Nanodiamonds (NDs) have versatile applications in electro-optical devices, sensors, and biomedical. Due to the difficulty in activation of the inert sp^3 C-H bonds on NDs' surface, it is not trivial to modify the surface functionalities on NDs. A few functionalization methods have been reported in the literature for surface modification of NDs. Many of them, however, are either multiple steps/ time consuming, or require the use of highly toxic/ environmentally unfriendly reagents, such as fluorine gas and sulfuric acid. It is necessary to develop a simple process for surface functionalization of NDs to have both hydrophobic and hydrophilic functional groups. In this report, a facile process was developed to allow easy and rapid surface modification of NDs to become dispersible in either water or organic solvents using the same process. The process involves surface graphitization of NDs, followed by radical initiated surface grafting of oligomers with various functionalities, including $-C(=O)OCH_3$, $-COOH$, $-NH_2$, or aliphatic moieties.

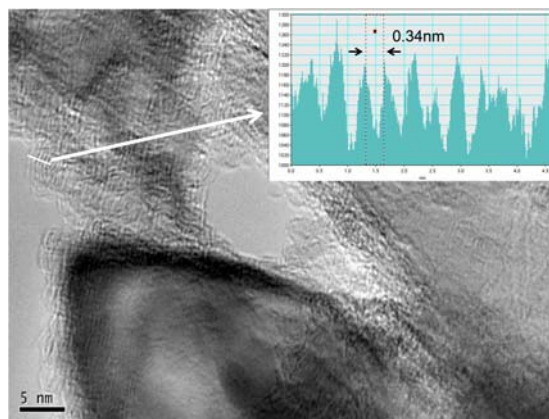


Fig. 2: Transmission electron microscopic image of NDs thermally treated at 1200 °C for 3 hr. The upper right inset shows the spacing between the surface graphene layers on NDs to be ~0.34 nm.

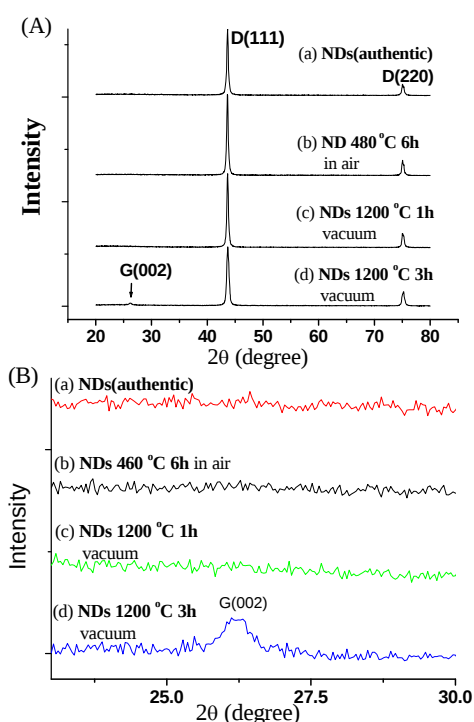


Fig. 1: Powder X-ray diffraction spectra of commercial NDs, and NDs thermally treated at 460 °C in air for 6 hr, 1200 °C in vacuum for 1 hr, and 1200 °C in vacuum for 3 hr. The 22.5~30 degree region of (A) was magnified and shown in (B). The conditions of samples were labeled on the figure.

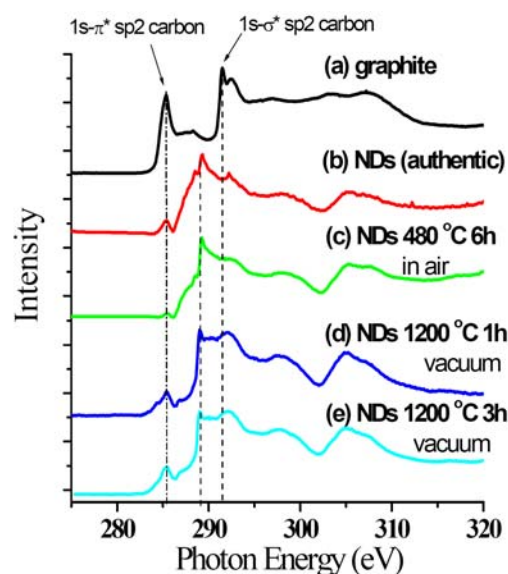


Fig. 3: X-ray absorption near edge spectra of (a) graphite, (b) commercial NDs, (c) NDs thermally treated at 480 °C in air for 6 hrs, (d) NDs thermally treated at 1200 °C in vacuum for 1 hr, and (e) NDs thermally treated at 1200 °C in vacuum for 3 hr.