Nitrogen in nanodiamonds of dynamic synthesis

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Development of efficient production methods of nanodiamond (ND) particles containing substitutional nitrogen and nitrogen-vacancy (NV) complexes remains an important goal in the nanodiamond community. We report on systematic studies of the microstructure, concentration, and spatial distribution of nitrogen-related defects in different classes of dynamically synthesized nanodiamonds with primary particle sizes ranging from 5 to 50 nm using high-resolution transmission electron microscopy, spatially resolved electron energy loss spectroscopy, confocal Raman and photoluminescence spectroscopy, and pulsed electron paramagnetic resonance spectroscopy. The highest concentration of atomic nitrogen in a diamond core (3-5 at.%) was found for ND produced from explosive. The highest concentration of nitrogen paramagnetic centers (1.2 ppm) was detected in ND synthesized from a mixture of graphite and explosive. Well-pronounced narrow-band photoluminescence at 575 nm and 637 nm wavelengths related to NV centers was observed in primary ND particles of different origin with sizes larger than 20-30 nm. Perspectives and ways to control nitrogen state and content in dynamically synthesized NDs is discussed.

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