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Nitrogen control in nanodiamond produced by detonation shock-wave-assisted synthesis

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Abstract

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. ND synthesized from explosives is generally not among the preferred candidates for imaging applications owing to lack of optically active particles containing NV centers. In this paper, we have systematically studied representative classes of NDs produced by detonation shock wave conversion of different carbon precursor materials, namely, graphite and a graphite/hexogen mixture into ND, as well as ND produced from different combinations of explosives using different cooling methods (wet or dry cooling). We demonstrate that (i) the N content in nanodiamond particles can be controlled through a correct selection of the carbon precursor material (addition of graphite, explosives composition); (ii) particles larger than approximately 20 nm may contain in situ produced optically active NV centers, and (iii) in ND produced from explosives, NV centers are detected only in ND produced by wet synthesis. ND synthesized from a mixture of graphite/explosive contains the largest amount of NV centers formed during synthesis and thus deserves special attention. © 2011 American Chemical Society.

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