Nitrogen of the high energy explosive compounds. variations

Nitrogen (N) is the most common impurity in diamond, comprised into the crystal lattice as isolated substitutional nitrogen atoms or two nearest-neighbour substitutional nitrogen atoms, in all other various N-containing defects.

The empty gap in complex is trapped by the nitrogen results in the formation of different colourcentres. The nitrogen-vacancy (NV) defect is responsible for diamond’s red/near-infrared fluorescence, and NVN colourcentres (H3 centres) with bright green fluorescence, are the optically active defects that have received the most opinion. The NV centre is a defect formed in diamond through one substitutional nitrogen atom and a vacancy, while a NVN centre contain a pair of N atoms attached to the vacancy. On irradiating the diamond with high-energy particles creates the Vacancies. Subsequent annealing at high temperature (> 700 °C) causes vacancy diffusion and formation of complexes with nitrogen atoms18.

Now, the primary condition for the formation of luminescent ND for bioimaging applications are HPHT ND comprises of 100–200 ppm of substitutional nitrogen (Type Ib) and NDs derived from natural diamond (Type Ia) containing the amount of nitrogen upto 3000 ppm (primarily as paired nitrogen atoms, or A centres). During the synthesis of ND using explosives, nitrogen is an exhaustive part of the high energy explosive compounds. Variations in the types of explosives can be seen by the addition of other carbon precursor materials (for example, a combination of graphite and hexanitrostilbene (HNS)) to obtain the required N content19. Shenderova et al. find out the effect of use of precursors on N particle content in DND synthesis (N found in the ND core) and its capability to form

optically active centres through the formation of complexes with vacancies. The quantity of TNT, RDX, HNS and graphite were varied, and combustion analysis for nitrogen content released tunable N content. ND that is formed by the mixture of TNT/RDX explosives consist of more than 2–2.

5 wt% N, whereas the ND formed by the mixture of TNT-HNS consists of less than 1 wt% N, and the ND formed by the graphite/RDX mixtures contain lower than 0. 5 wt% N 7. Detailed studies about N content and defect in detonation NDs formed by the mixture of TNT and RDX was done by various authors 20–22. It was finalised that the insert nitrogen in DND is most likely related to small quantity of single substitutional and/or A-center nitrogen, combined with larger nitrogen clusters as determined by comparing experimental and DFT calculated energy-loss near-edge structure (ELNES) spectra of the fine structure of the nitrogen K-edge.

Spatially resolved electron energy loss spectroscopy (EELS) experiments give the evidence that nitrogen was distributed throughout the whole diamond core but larger in defect regions (multiple twins, stacking faults)23.