Nitrogen Related Defects in Diamond Nitrogen is the most abundant impurity in diamond and is responsible for the formation of a wide variety of intrinsic and complex defect structures within the lattice. When incorporated substitutionally, nitrogen replaces a carbon atom and forms the so-called C-center. This isolated defect introduces a deep donor level in the band gap and represents the fundamental nitrogen configuration in diamond. At elevated temperatures isolated nitrogen atoms tend to aggregate. The simplest aggregated form is the A-center, consisting of a pair of substitutional nitrogen atoms occupying adjacent lattice sites. Further aggregation leads to the formation of B-centers, which involve four nitrogen atoms surrounding a lattice vacancy. These aggregated defects significantly modify the optical absorption characteristics of diamond and influence its mechanical and electronic behavior. In addition to these well-known aggregates, nitrogen can associate with vacancies to form nitrogen-vacancy (NV) centers, which exist in different charge states. These complexes introduce localized electronic states within the band gap and play a critical role in determining recombination processes and defect-related luminescence. The diversity of nitrogen-related defects reflects the complex incorporation and migration mechanisms of nitrogen in the diamond lattice and highlights its strong impact on the material's structural and electronic properties.[2]

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