Alternative method for luminescence centers concentration estimation in diamond

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Diamond is a unique material in physics due to its properties such as a refractive index of 2.4 [1], high strength 90–130 GPa [2] and thermal conductivity 33 W/(cm·K) [3]. In addition, the presence of impurity centers – N3, H3/H4, NV^0/NV^- (zero-phonon lines (ZPL) are 415, 503, 496, 575 and 638 nm) – makes diamond promising for laser generation in a wide range of wavelengths (415–720 nm) [4].
The existing method for measuring the centers concentration is based on the integration of the ZPL in the absorption spectrum. This method faces difficulties associated with the necessity to cool the samples with liquid nitrogen and the requirements for recording spectra capable of detecting ZPL. This increases the lower threshold for measuring the centers concentration to tens of ppb [5].
In this work, an alternative method for assessing the concentration of luminescent centers is proposed, based on measuring their absorption cross-section in selected samples with a predominant content of N3 and H3. The advantage of this method is its ability to measure concentrations of these centers to the level of 0.1 – 1 ppb.

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