Chapter 1

Diamond samples

This appendix document the known properties of every diamond samples used in this manuscript.

1.1 CVD samples

Table 1.1: Concentration in nitrogen and NV centers for the CVD samples

Name	[NV^-]	[N]
CVD-pink	4.6 ppm	26 ppm
CVD-B	0.43 ppm	10-30 ppm
CVD-C	0.43 ppm	10-30 ppm

Table 1.1 summarizes the most relevant parameters in our study which are the concentration in (negatively charged) NV centers and the total concentration of nitrogen in the sample.

1.1.1 CVD-pink

The growth process and characterization of sample CVD pink are detailed in [1]. The sample was grown by CVD in a gas environment containing 500 ppm of N_2O. The sample was then irradiated by a 10 MeV electron beam at a fluence of $2 \cdot 10^{18}$ cm^{-2} for 20 hours, while heated to 900 °C during the irradiation process.

The concentration of NV centers and nitrogen impurities was determined via UV-visible absorption and FTIR.

1.1.2 CVD-B and CVD-C

The growth process and characterization of sample CVD pink are detailed in [2]. These two samples were grown with a N_2O concentration of 100 ppm

in the gas phase, and were irradiated similarly to sample CVD-pink. The main difference between the two sample is the further annealing step on sample CVD-B, as detailed in chapter 2.

1.2 HPHT samples

1.2.1 Adamas fluorescent microdimaonds

Table 1.2: Concentration in nitrogen and NV centers for the HPHT samples

Name	$[NV^-]$	[N]
Adamas	2.5-3.5 ppm	∼100 ppm

The main HPHT sample studied in this manuscript are the commercially available red fluorescent agents from Adamas nano. Samples labeled ADM-15-n correspond to 15 μm micro-diamonds, and samples labeled ADM-150-n to 150 μm micro-diamonds. The Adamas website indicates that the fluorescent diamonds contain $\sim$ 100 ppm of nitrogen impurities, and that the micro-diamonds are irradiated with 2-3 MeV electron beams and annealed, without further information. The [NV] concentration, also indicated on the website, was measured via EPR.

1.2.2 Other HPHT samples

Sumi-2

Sample Sumi-2 is a type Ib HPHT sample bought from Sumitomo and irradiated with a 2 MeV electron beam and a fluence of $7 \cdot 10^{18}$ cm^{-2} which were further annealed at 800 °C for two hours. The NV and N concentration were not measured on this sample.

SBST-B and SBST-C

Samples SBST-B and SBST-C are the type Ib HPHT substrates on which the samples CVD-B and CVD-C grew. They were irradiated and annealed along the CVD layers. The NV and N concentrations in these samples has not been measured.

Bibliography

[1] Alexandre Tallaire et al. “High NV density in a pink CVD diamond grown with N2O addition”. In: *Carbon* 170 (2020), pp. 421–429.

[2] Midrel Wilfried Ngandeu Ngambou et al. “Improving NV centre density during diamond growth by CVD process using N2O gas”. In: *Diamond and Related Materials* 123 (2022), p. 108884.