Experiment report on ESRF proposal entitled
"Investigation of lattice sites for transition metal (Ni) in Diamond matrix"

Abstract on the results obtained from this proposal,

The nickel centre in diamond

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Only a few atoms can incorporate into diamond, such as substitutional dopants (B, P, N), hydrogen, nickel and cobalt. The electronic properties of light atom dopants (H, B, P, N etc.), have been extensively studied in the past and are well described. The knowledge about nickel and cobalt doped diamond is much less. This can be explained by the difficulty to elaborate such Ni or Co-doped samples, as all attempts to incorporate metallic impurities during CVD growth failed and the only method available is high pressure synthesis. The diversity of the lattice sites occupied by these atoms accompanied eventually by vacancies and/or other impurities, and finally the lack of short term application of such material. Recent progress suggests that Ni and Co-doped diamond could be very interesting for specific applications such as single photon source for quantum cryptography, diluted magnetic semiconductor for spintronics, deep traps for radiation dosimetry.

This study focuses on the incorporation of nickel into diamond grown by high pressure synthesis. Two samples were grown in similar conditions, except that for one of the samples a nitrogen getter (Ti) was added into the solvant in order to reduce the nitrogen incorporation. Samples were characterized by cathodoluminescence, superconducting quantum interference device (SQUID) for the magnetic properties, X-ray circular magnetic dichroism (XMCD) and X-ray absorption near edge spectroscopy (XANES), and the results were interpreted with the help of ab initio calculation (DFT) and XANES simulation. Different sites of nickel are observed, with or without magnetic moment, and are discussed taken into account previous studies by electron spin resonance and cathodoluminescence. A comprehensive picture will be presented, detail analysis is under progress.