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Synthesis of single crystal diamond with colour centres for quantum applications

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Abstract

The negatively charged nitrogen-vacancy centre (NV) in diamond is a point-like defect that has focused a lot of attention in the past few years due to its potential in quantum applications, especially for sensing. It has bright single photon emission and the electronic spin state of this defect can be optically read-out and manipulated leading to exceptionally long coherence time even at room temperature. Harnessing the outstanding properties of NVs mainly relies on the progresses in the synthesis of high quality and purity diamond material using the chemical vapour deposition technique (CVD). Individual or ensembles of NV centres can be created in an environment with low nuclear spin bath using 12C-enriched CVD diamond plates. In addition, NV density can be controlled over a wide range of concentration, from a few ppb to a few ppm with specific spatial localization. An additional advantage includes the ability to promote one orientation among the 4 possible axes of the NV dipole by growing on specific orientations such as (111) and (113). These requirements are however very challenging and are setting an increasing pressure to the diamond synthesis capabilities by CVD. In this talk I will describe the efforts dedicated to the growth of nitrogen-doped CVD diamond single crystals by CVD that have allowed optimizing the material for quantum sensing applications.