Project N° 270197

DIAMANT
Diamond based atomic nanotechnologies
Small-Medium Collaborative Project

DELIVERY D2.5
Spectroscopy of new defects

A delivery of Work package 2
Engineering atomic and artificial molecular and nanophotonic devices in diamond

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PU	Public	**PU**
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the Consortium (including the Commission services)	
CO	Confidential, only for members of the Consortium (including the Commission services)	
TN	Technical Note, only for members of the Consortium	

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Abstract:
Investigate new defects in diamond suitable for single center optical detection and magnetic resonance

DESCRIPTION

For D2.5, “spectroscopy of new defects”, TUW built a setup capable of performing spectroscopic analyses of a broad variety of defects in diamond as well as other solid-state materials. The system design includes a magnetic cryostat capable of up to 5 Tesla fields, with excitation lasers at wavelengths of 532nm, 637nm, 658nm, 738nm and 780nm. These are intended for the excitation of NV, SiV and Nickel impurities for WP2 and WP4. We have demonstrated the detection of NV and SiV ensembles using an optical fibre with a lens formed at its tip. In addition to these efforts, Partners Ulm and Stuttgart have participated in the spectroscopy of Chromium emitters in diamond. These display little sensitivity to magnetic fields, but are tuneable over a significant range by application of a static electric field and show linear polarizatin of emitted light. This work was published in Müller et al., *N. J. Phys.***13** 075001 (2011),

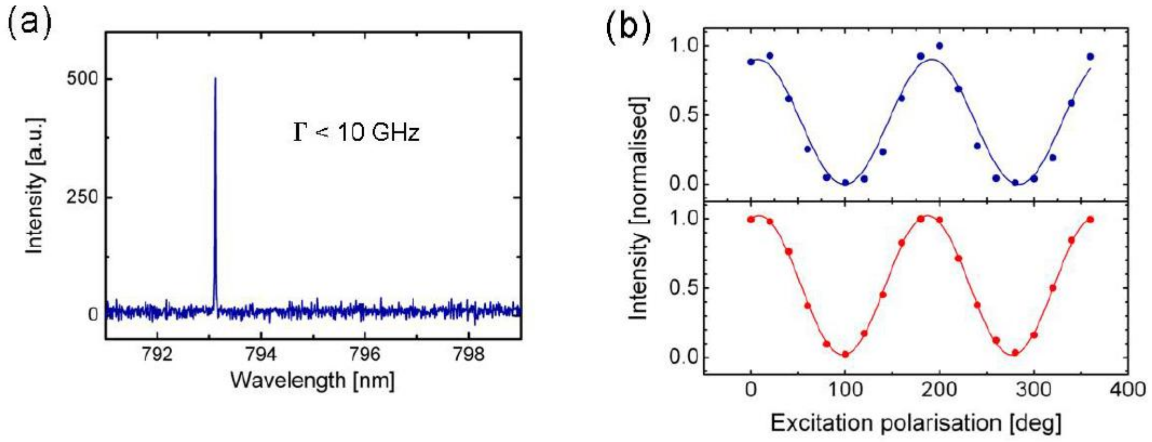

Figure 1. (a) Resolution-limited ZPL spectrum of a chromium-related centreat 4K under non-resonant excitation at 710 nm. The linewidth is well below10 GHz, and no phonon sidebands can be resolved.(b) Polarization dependence of zero-phonon line.

which Partner RISSPO has performed a significant amount of theoretical groundwork. RISSPO has also performed calculations regarding the properties of a number of defects in Silicon Carbide. Some of these have been explored experimentally by Partner UCSB, and were shown to possess many important qualities for the applications envisaged in DIAMANT [Koehl *et al.*, Nature **479** (2011)]. Firstly they can be initialized optically and their ground-state splitting (~1.3 GHz) can be detected by ODMR. Electronic ground state spin coherence times on the order of 200μs were measured, and coherent control of the ground state was demonstrated even at room temperature. This makes these defects an interesting alternative to the NV centre in diamond, and they are particularly attractive for photonics applications as their luminescence has a longer wavelength than the most promising defects in diamond. Further exploration of these defects will show whether it is possible to perform single-defect spectroscopy.

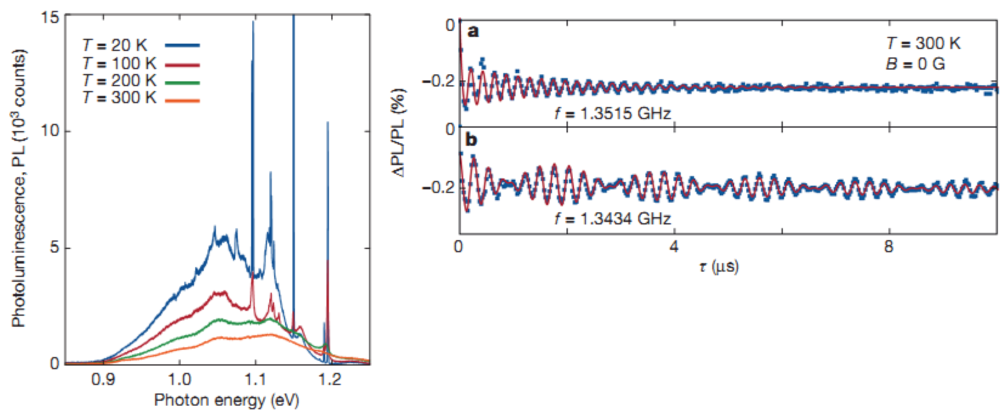

Figure 2. Left: Fluorescence spectra from room temperature to 20K of 4H-Silicon carbide under excitation with 853nm light, displaying zero-phonon lines and phonon sideband luminescence of six distinct defects. Right: Rabi oscillations detected by ODMR at room temperature for two as yet unidentified defects in SiC [Koehl *et al.*, Nature 479 (2011)].