Sub-GHz linewidths ensembles of SiV centers in a diamond nano-pyramid revealed by charge state conversion

Louis Nicolas [1], Clément Pellet-Mary [1], Tom Delord [1], Paul Huillery [1], Gabriel Hétet[1]

[1] Laboratoire de Physique de l'Ecole normale supérieure, ENS, Universite PSL, CNRS,Sorbonne Université, Université Paris-Diderot, Sorbonne Paris Cité, Paris, France.

Efficient interfaces between two-level emitters and photons are key components of quantum networks and sensing. SiV^- centers embedded into a diamond nanostructure are promising for such purpose. We have studied photoluminescence properties at cryogenic temperatures of diamond AFM probes [1,2] and observed photochromism of a very dense ensemble of SiV^- centers consisting in trapping into a dark state under resonant excitation when nitrogen impurities are present. We suppose that this effect is a charge state switching between negatively charged and neutral SiV charge states. This effect is used to perform persistent hole burning which reveals very low homogeneous broading, only twice the lifetime limit. It is promising for quantum optics experiments and paves the way to sub-wavelength microscopy technics. We will also present our latest results on the modification of the lifetime of solid state emitters in a half-cavity set-up.

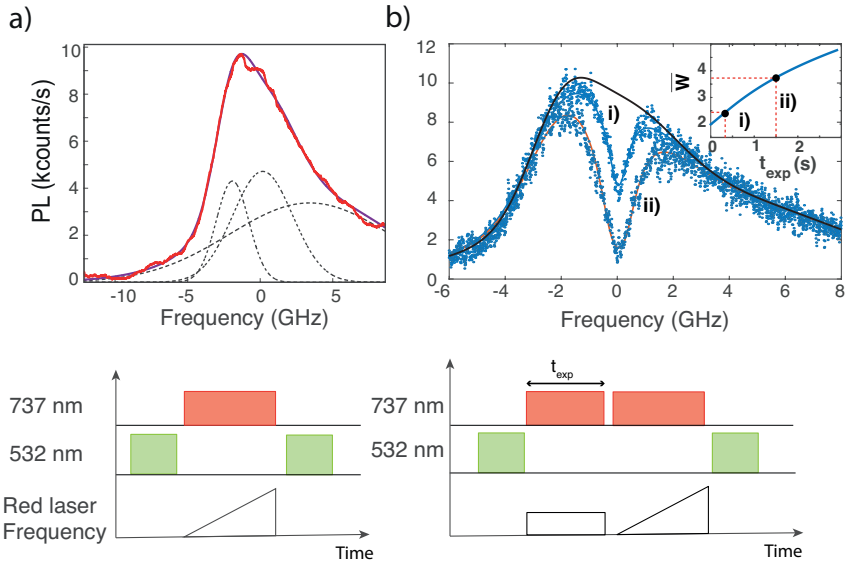

Figure 1. a) Averaged PLE measured at 6K by scanning the resonant laser at 737 nm around an electronic transition transition in the presence of green laser light between scans. b) PLE spectra after three different exposure times at 6K : in black without hole burning, in blue t_{exp} = 300 ms and in orange, t_{exp} = 1500 ms. The dots represent raw data and the continuous lines are fitted data. Here P_{737}= 0.877 μW. The inset shows the width of the holes Γ_h inferred from the fit and normalized to the homogeneous linewidth Γ_e(W= Γ_h/Γ_e).

[1] R. Nelz et al., Applied Physics Letters, 109, 19, 193105, (2016).
[2] L. Nicolas et al., AIP Advances, 8, 6, 065102, (2018).

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