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Nanoscale imaging using color centers in diamond nanoparticles

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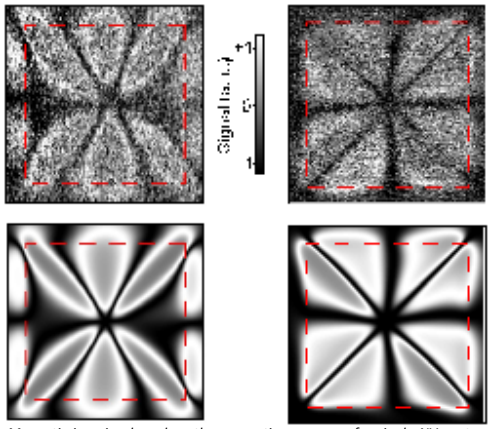
Abstract

Numerous works have been devoted to the development of efficient probes for nanoscale imaging. NV color centers residing in nanosized diamond particles [1] are particularly attractive because they provide close proximity to the samples. Exploiting their unbleachable optical and magnetic response, I will describe how these artificial atoms can be used to map the stray magnetic field which is produced by a magnetic nanostructure (see figure). The NV-based microscope enables a quantitative vectorial measurement of the magnetic field with nanoscale resolution and high sensitivity, depending on the relative orientation of the NV compared to the tip axis [2,3]. I will also explain how the orientation of the NV magnetic dipole can be perfectly controlled in CVD-grown layers on diamond single-crystal substrates with [111] orientation [4].



Magnetic imaging based on the magnetic response of a single NV center located at the apex of a scanning AFM tip. The recorded images of the stray fied above a square magnetic vortex in permalloy agree quantitatively with simulations, without any perturbation associated to the measurement technique like in magnetic force microscopy.

[1] L. Rondin et al., Phys. Rev. B 15, 115449 (2010)

[2] L. Rondin et al., Appl. Phys. Lett. 100, 153118 (2012)

[3] L. Rondin et al., Nature Communications 4, 2279 (2013)

[4] M. Lesik et al., "Perfect preferential orientation of nitrogen-vacancy defects in a synthetic diamond sample", arxiv : 1401.2795 (January 2014)

The speaker

Jean-François Roch is Full Professor at the University of Paris-Sud and at the École Normale Supérieure de Cachan. He is the Director of the Laboratoire Aimé Cotton (CNRS), where he coordinates an extensive research program on atomic, molecular and optical quantum physics. He published over 100 broadly cited papers on these topics, and his multiple research interests include a strong focus on diamond-based quantum physics: nanoscale implantation of single defects, spin qubits, scanning probe magnetometry, etc.