CEA - Saclay 91191 Gif-sur-yvette Cedex

Service de Physique de l'Etat Condensé

SÉMINAIRE

Mercredi 12 février 2014 à 11h15

Orme des Merisiers SPEC, Salle Itzykson, Bât.774

Imaging magnetic fields at the nanoscale with a single spin in diamond

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The ability to map magnetic field distributions with high sensitivity and nanoscale resolution is of crucial importance for fundamental studies ranging from material science to biology, as well as for the development of new applications in spintronics and quantum technology. In that context, we follow a recently proposed approach to magnetic sensing based on optically detected electron spin resonance (ESR). It was shown that this method applied to a single nitrogen-vacancy (NV) defect in diamond could provide an unprecedented combination of spatial resolution and magnetic sensitivity under ambient conditions. The principle of the measurement is similar to the one used in optical magnetometers based on the precession of spin-polarized atomic gases. The applied magnetic field is evaluated by measuring the Zeeman shifts of the NV defect spin sublevels. More precisely, a diamond nanocrystal hosting a single NV defect is attached at the end of the tip of an atomic force microscope (AFM) and used as a single spin scanning probe magnetometer [see Fig. 1a]. If the probe spin is brought near a target, it will feel the presence of any local magnetic field emanating from the vicinity, causing a shift of the associated ESR, and thus providing a quantitative measurement of the magnetic field within an atomic-sized detection volume.

In this talk, I will show how scanning-NV magnetometry can be used as a powerful tool for fundamental studies in nanomagnetism, focusing on domain wall structure in ultrathin ferromagnetic wires [see Fig. 1b]. Applications in the field of quantum information processing and biology will also be discussed.

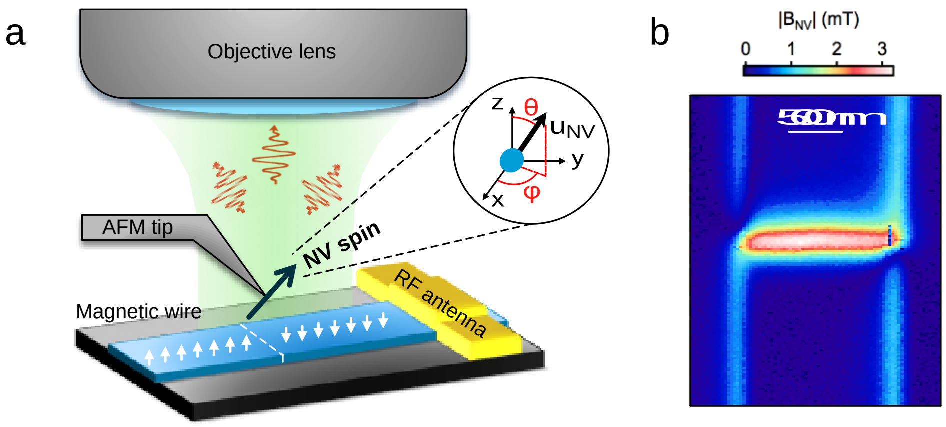

Figure 1 : (a) Schematic of the scanning-NV magnetometer which combines an atomic force microscope (AFM) and a confocal microscope. The AFM tip is functionalized with a 20-nm nanodiamond hosting a single NV center and a radiofrequency (RF) antenna is used to perform optical detection of the NV defect ESR transition. (b) Magnetic field distribution above a domain wall in a 1.5 µm-wide Ta/CoFeB(1 nm)/MgO magnetic wire.

A coffee break will be served at 11h00. The seminar will be given in English.

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