Imaging magnetic fields from Magnetic nanospheres using a thin layer of NV centers in diamond on an Inverted Microscope

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NV centers in diamonds are defects of the lattice where nitrogen atom replaces one carbon atom and nearby it vacancy is located. The physical properties of NV centers are similar to "frozen" atom properties in lattice of diamond and electron spins of these atoms can be easily manipulated by light, magnetic field and microwaves [1]. Magnetic sensor created by using a thin layer of NV centers in diamond due to its specific properties can be used to image the distribution of magnetic field amplitude as well as magnetic field direction [2]. Small diamond sample (Fig.1) with size 5x5x0.1 mm with doped NV centers near the top surface is placed on stage of inverted microscope. The magnetic material is deployed on the surface of diamond over which a small antenna for microwave irradiation is placed. To split energy levels in NV centers external magnetic field is applied by large neodymium magnet symmetrically to four possible directions of NV centers in lattice. 532 nm laser illuminates the NV centers and the resulted fluorescence images are captured by CCD camera. Applying microwaves with specific frequency range close to 2.86 GHz which dependents on external magnetic field allows to register optically detectible magnetic resonance (ODMR). To visualize magnetic field created by ferromagnetic micro particles (Fig.1) averaged image sequences on different frequencies are obtained and then local ODMR frequency shifts initiated by magnetic moments of particles are calculated by MATLAB code and plotted (Fig.1).

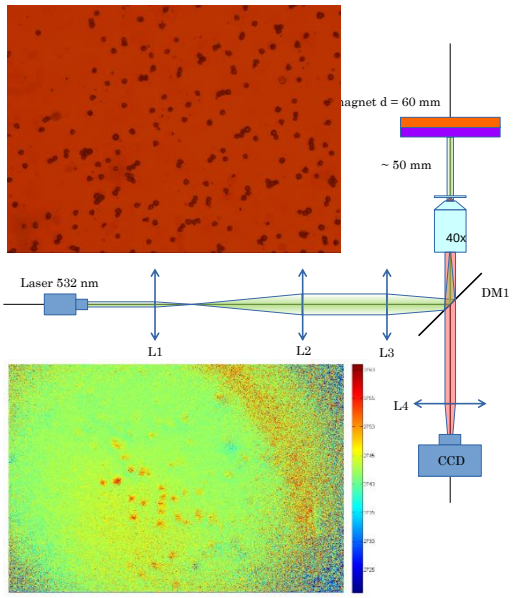

Fig.1 Experimental setup and images of ferromagnetic particles with diameter 4.26 µm from Spherotech and field distribution created by particles.

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References

1. Linh My Pham, PhD thesis, Harvard University (2013)
2. D. Le Sage at al., Nature **496**, 486–489 (2013)