Detection and Imaging of Stray Magnetic Field from Magnetic Particle with an Ensemble of Nitrogen Vacancy Center in Diamond

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The spin-1 system in diamond with Nitrogen substitution and adjacent vacancy (NV center) enable us to detect localized stray magnetic field under ambient condition. By using an optical detection method based on magnetic resonance of electron spin, magnetic field vectors in the vicinity of the NV spins can be recovered [1, 2]. Here we present stray magnetic field detection and imaging from NdFeB magnetic microparticle using ensemble of NV centers in a (001) diamond bulk sample. Optically detected magnetic resonance (ODMR) spectrum is obtained by applying continuous irradiation of 532 nm laser while sweeping microwave excitation within the frequency range of the electron spin resonance (Fig. 1(b)). Magnetic particles of NdFeB were placed on a diamond with NV ensemble and investigated to recover stray magnetic field vectors around the particle by analyzing ODMR spectrum. Owing to the lifting of $m_s = \pm 1$ states due to the Zeeman effect when magnetic field is projected along the NV spin axes, the ODMR spectrum varies as magnetic field magnitude and direction changed [1, 2]. The direction of magnetization is decided from the position where shows the largest splitting in ODMR spectrum, and the angle of magnetization with respect to surface can be estimated from the stray field from symmetric position (Fig. 1(a)). An image with 2.837 GHz microwave field subtracted by the image without microwave field is shown in Fig. 1(a), corresponding to spatial variation of stray fields.

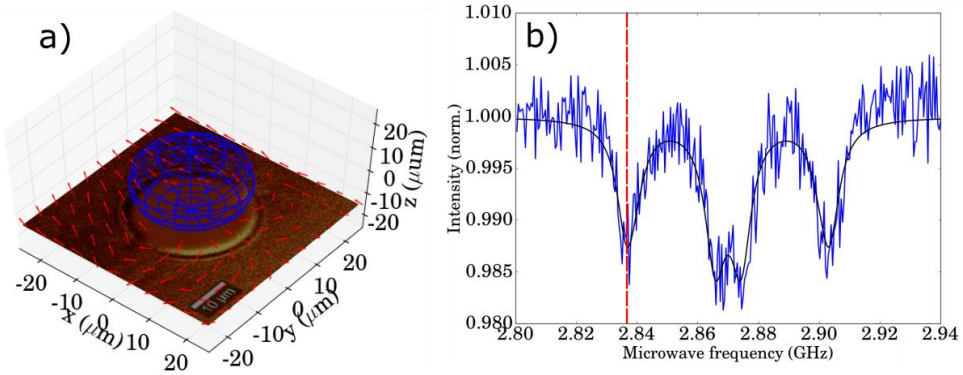

Fig. 1. Stray magnetic field vectors around magnetic particle (a) overlaid to subtracted fluorescence image with and without applying microwave of 2.837 GHz (b).

[1] B. J. Maertz, *et al.*, *Appl. Phys. Lett.*, 96, 092504 (2010).

[2] L. Rodlin, *et al. Rep. Prog. Phys.* 77, 056503 (2014).