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

School of Materials Science, JAIST[1], Institute for Chemical Research, Kyoto University[2],

°Dwi Prananto[1], Daisuke Kikuchi[1], Norikazu Mizuochi[2], Toshu An[1]

E-mail: prananto@jaist.ac.jp

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 spins, magnetic field direction and magnitude in the vicinity of the NV spins can be recovered [1-3]. Here we present stray magnetic field detection and imaging from NdFeB magnetic particle using ensemble of NV centers in a (001) bulk diamond. Electron spin resonance (ESR) 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(a)). Magnetic particle of NdFeB placed on diamond NV ensemble was investigated and stray magnetic field surrounding the particle was recovered by analyzing ESR spectra. 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 ESR spectrum varies as magnetic field magnitude and direction changed [1, 2]. The direction of magnetization is decided from the position where shows the largest stray field, and the angle of magnetization respect to surface can be estimated from the stray field from symmetric position (Fig. 1(a)). A subtracted image with 2.89 GHz microwave field (Fig. 1(a)) and without is shown in Fig. 1(b), corresponding to spatial variation of stray fields.

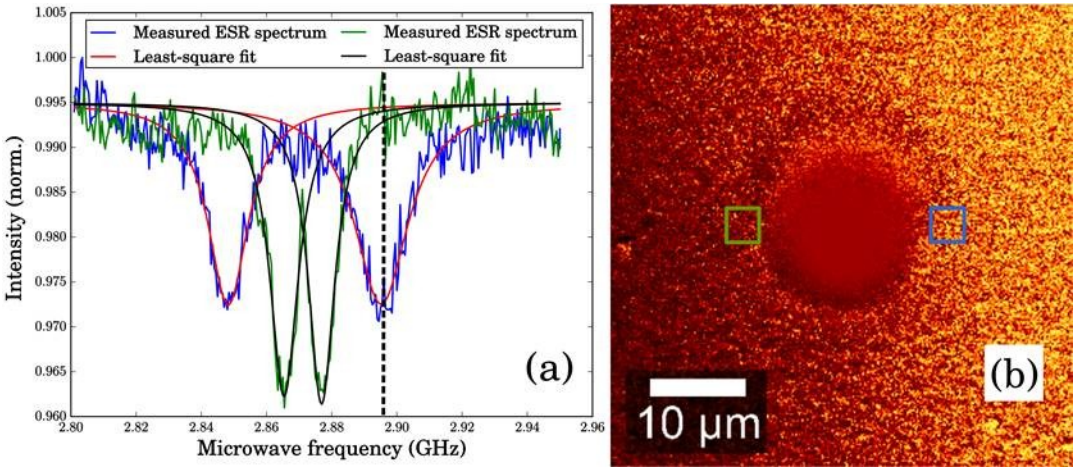

Fig. 1. ESR spectra of stray magnetic field at green and blue squares in the scanning image (Fig. 1(b)). The scanning image is shown subtracting the images with microwave 2.89 GHz on and off.

References:

[1] S. Steinert, *et al., Rev. Sci. Instrum.* 81, 043705 (2010).

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

[3] K. Tahara, *et al.*, *Appl. Phys. Lett.* 107, 193110 (2015).