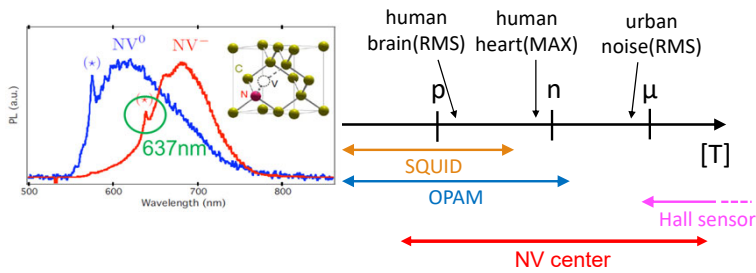


高感度ダイヤモンド量子センサ実現のための ダイヤモンド微細加工技術の開発

Tetsu Takashi and Takashi Yatsui
Toyohashi University of Technology

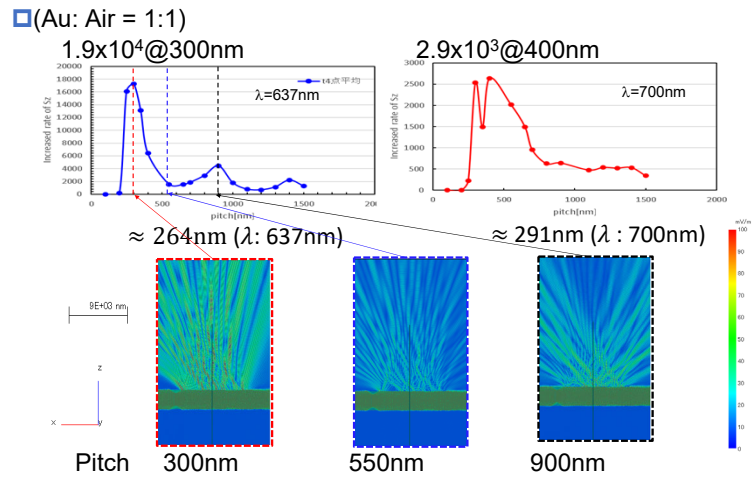
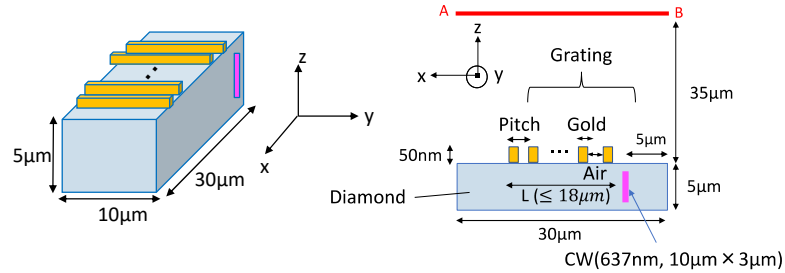
Nitrogen-Vacancy (NV) center in diamond



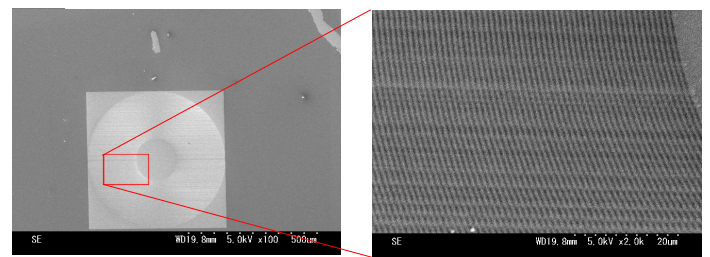
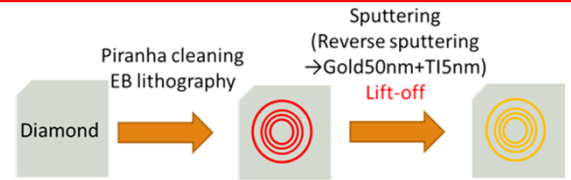
- Color center → Strong PL (red light)
- ○ Wide dynamic range of magnetic sensitivity (pT ~ μT)
- × High refractive index → Low light-extraction efficiency

N. Mizuochi *et al.*, *Nature Photonics* **6**, 299 (2012)
M. W. Doherty *et al.*, *New Journal of Physics* **13**, 025019 (2011)
Cohen, D. *IEEE Transactions on Magnetics* **11**, 2 (1975)

Numerical simulation



Fabrication of grating



Verification of emission increase from diamond

Publications

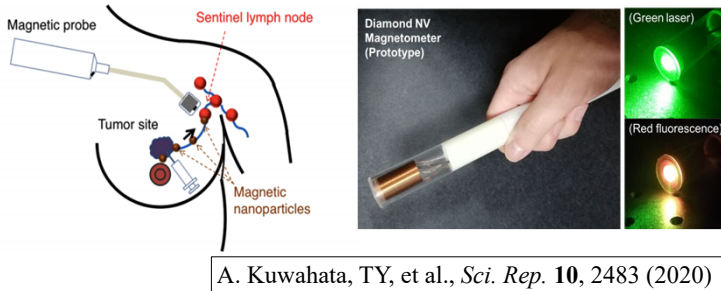
- A. Kuwahata, T. Kitaizumi, K. Saichi, T. Sato, R. Igarashi, T. Ohshima, Y. Masuyama, T. Iwasaki, M. Hatano, F. Jelezko, M. Kusakabe, T. Yatsui, M. Sekino, *Scientific Reports*, **10**, pp. 2483, 2020
- S. R. Nair, L. J. Rogers, X. Vidal, R. P. Roberts, H. Abe, T. Ohshima, T. Yatsui, A. D. Greentree, J. Jeske, T. Volz, *Nanophotonics*, **9** (15), pp. 4505-4518, 2020
- T. Kitaizumi, A. Kuwahata, K. Saichi, T. Sato, R. Igarashi, T. Ohshima, Y. Masuyama, T. Iwasaki, M. Hatano, F. Jelezko, M. Kusakabe, T. Yatsui, Masaki Sekino, *IEEE Transactions on Magnetics*, **57** (2), pp. 5100405, 2021

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Research purpose

1. Develop **high-sensitivity magnetic sensor** with NV center



A. Kuwahata, TY, et al., *Sci. Rep.* **10**, 2483 (2020)

2. Improve **light-extraction efficiency** (our experimental setup ≈ 10⁻¹¹) of NV center using **grating coupler**

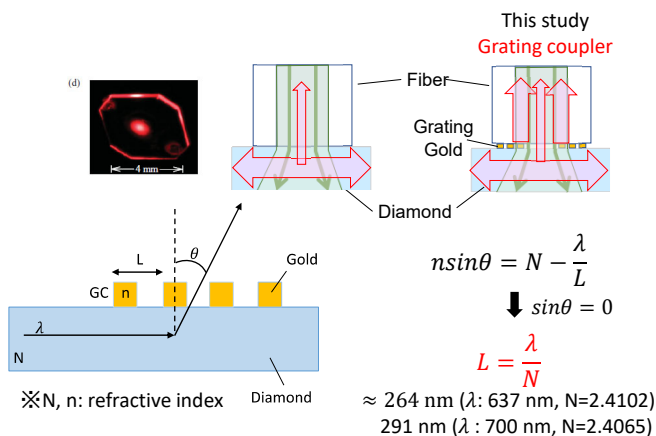
$$\eta \propto \frac{\Delta\nu}{C\sqrt{I_0}}$$

η: Minimal magnetic sensitivity of NV center

I₀: PL intensity from NV center

I₀ ↑ → Better magnetic sensitivity

Improving the emission output from bulk diamond



S. Ura *et al.*, *Journal of The Japan Institute of Electronics Packaging* **4**, 489 (2001)