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Detection of paramagnetic particle using spin-torque oscillator 産総研ナノスピン¹, 阪大院基礎エ²

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Spin-torque oscillator (STO) has attracted much attention not only as a nano-meter size microwave oscillator with high emission power and high Q factor ^[1] but also as a magnetic sensor with fast response ^[2] and high sensitivity ^[3]. We have seen high potential in STO to be a useful sensor of a single electron spin as a final goal. In this study, to prove that STO can efficiently detect a paramagnetic particle with a resonance absorption phenomena, we conducted a macro-spin simulation of the magnetization dynamics of the in-planed magnetized magnetic tunnel junction with paramagnetic particle under the finite temperature (300 K).

The below figures show the simulation results under the external magnetic field (H) of 150 mT (a) and 180 mT (b). As shown in the figure (b), the spectrum of STO was changed by a paramagnetic particle at the resonance condition. This result indicates that STO absorption technique is effective for detecting a paramagnetic particle. We will show H (amplitude and direction) dependence of STO spectrum with paramagnetic particle.



Figure: Macro-spin simulation results of STO spectra without a paramagnetic particle (blue) and with a particle (red) at (a) H = 150 mT and (b) H = 180 mT.

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References

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