イットリウム鉄ガーネットの磁化ダイナミクスを利用した高感度磁気センシングの検討

Highly sensitive magnetic field sensing using magnezation dynamics in yttrium iron garnet single crystal thin films

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The development of highly sensitive magnetic field sensor operated at room temperature has been attractively investigated in the recent spintronics because of the possible detection of bio magnetic field with low running cost and high usability. Several magnetic field sensing using Tunnel magnetoresistance (TMR) and magneto-impedance effect have been reported already[1]. Magnetization dynamics at the near condition of ferromagnetic resonance shows non-linear changes by changing applied magnetic field, which is a suitable property for the application. Yttrium iron garnet (YIG) shows extremely low damping constant of 0.001-0.0001, which shows large change of magnetization dynamics with the small change of applied magnetic field.

In this study, we investigated magnetization dynamics of YIG single crystal thin films by detecting the phase change of magnetization dynamics owing to the change of applied magnetic field. YIG (111) single crystal thin films with the thickness of 10 μm were epitaxially grown on gadolinium gallium garnet (GGG) (111) single crystal substrates using liquid-phase epitaxial method. We evaluated the high-frequency response of the samples by inputting high-frequency power into asymmetrical Cu coplanar waveguides directly fabricated on the YIG films. The signal and ground line widths were 100 μm and 175 μm, respectively, and the distance between those was 45 μm. We evaluated the phase change of the reflected waves using the double mixer time difference (DMTD) method[2] for increasing the measurement resolution. We found that the power of reflected waves showed strong dependence the size of RF electrodes and the frequency of input power. Figures 1 show magnetic field dependence of the power and phase of the reflected signals with the input frequency at 8.3 GHz. We detected the maximum phase change of 50 °/Oe by optimizing the measurement conditions, showing the potential for the detection of bio-magnetic field. The detail of the dependence will be discussed in the presentation.

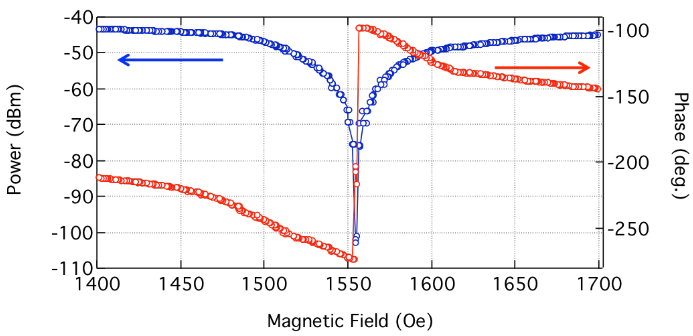

Fig. 1 Magnetic filed dependence of power and phase of reflected wave.

References

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