高周波スロット伝送路を用いたイットリウム鉄ガーネットの磁化ダイナミクス励起

Magnetization dynamics in yttrium iron garnet single crystal thin films induced by slot line waveguides

大島商船高専[1]，秋田大[2]，東北大[3] ○神田 哲典[1]，室賀 翔[2]，遠藤 恭[3]

Natl. Inst. Tech. Oshima College[1], Akita Univ.[2], Tohoku Univ.[3], °Tetsunori Koda[1], Sho Muroga[2], Yasushi Endo[3]

E-mail: koda@oshima-k.ac.jp

Magnetization dynamics is a typical non-linear phenomenon, which is strongly influenced by the conditions of applied DC and RF magnetic fields. We have investigated the utilization of the property for the possible application of a highly sensitive magnetic sensor by detecting the phase change of magnetization dynamics. We successfully obtained the maximum phase change of 50 °/Oe, showing the potential for the detection of bio-magnetic fields [1]. Interestingly, we found that the geometry of high frequency waveguide strongly influenced the magnetization dynamics.

In this study, we investigated the magnetization dynamics induced by slot line waveguides. The slot line waveguide is one of high frequency waveguides, which consists of two electrodes with the same width. We prepared the waveguides with systematically varied width of electrodes and distance between the electrodes on a 10 μm thick YIG (111) single crystal thin film. We evaluated the reflected power of the input microwave from the waveguide. We also performed micromagnetic simulations using the object oriented micromagnetic framework (OOMMF) to understand the magnetization dynamics [2]. Figure 1 shows the result on applied magnetic field dependence of the reflected power with various input microwave frequencies. All the spectrum showed multiple peaks and the peaks shifted higher magnetic field with increasing the input frequency, indicating that the peaks were related with the ferromagnetic resonance (FMR). To understand the origin of multiple peaks, we simulated the dependence of the number of locally applied areas for RF magnetic field. The simulation showed that the multiple local areas' case only appeared multiple peaks. Our further analysis revealed that the origin of the multiple peaks is due to the magnetical interaction between spin waves created from the local magnetization dynamics in one area and the local magnetization dynamics in the other. The detail of the interaction mechanism will be discussed in the presentation.

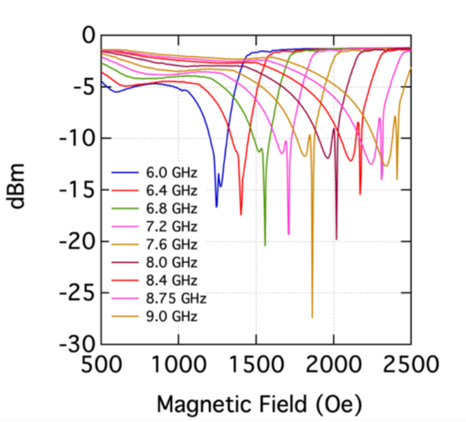

Fig.1 Input Frequency dependence of reflected microwave power. The input power was fixed at 0 dBm.

References 1)T. Koda et al., IEEE. Trans. Magn., 55, (2019) 4002604.
2) The OOMMF package is available at http://math.nist.gov./oommf.

謝辞 本研究にあたり、株式会社グラノプトから測定試料の御協力を頂きました。ここに感謝致します。本研究の一部は，JSPS 科研費 No.18K14114 の助成を受けて行われた。