Combinatorial experiments of FMR on magnetic garnet films

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Magnetic garnets (MG) such as Yttrium Iron Garnet (YIG: Y3Fe5O12) are recently attractive type of magnets for the use of some applications and also for the stage of research of physical phenomena. Especially the low gilbert damping and strong magneto-optic effects are the important features for the magnetic devices [1]. For instance, it is pointed that YIG dots have potential to be used for probabilistic bit operation [2]. So many reteaches have been performed to produce MGs with good properties, however, it is still challenging to optimize the condition such as the elements selection, composition ratio, and also the shape of devices in the many possible candidates.

In this study, to accelerate the optimization of these conditions, we performed combinatorial experiments for the magnetic garnets. First, we established the sputtering growth process to prepare well crystalline YIG thin films on GGG (111) substrates. We measured the Ferromagnetic Resonance (FMR) of the film whose peak-to-peak linewidth was 0.2mT at 9.5GHz. Based on this sputtering technique, we performed combinatorial magnetron sputtering to obtain widely different composition ratio in a single substrate. By using Vector Network Analyzer(VNA) and semi-auto prober system, we measured the FMR properties of the hundreds YIG-based MGs with different conditions as shown in Fig.1. The effect of the doped elements and the shape will be discussed at the presentation.

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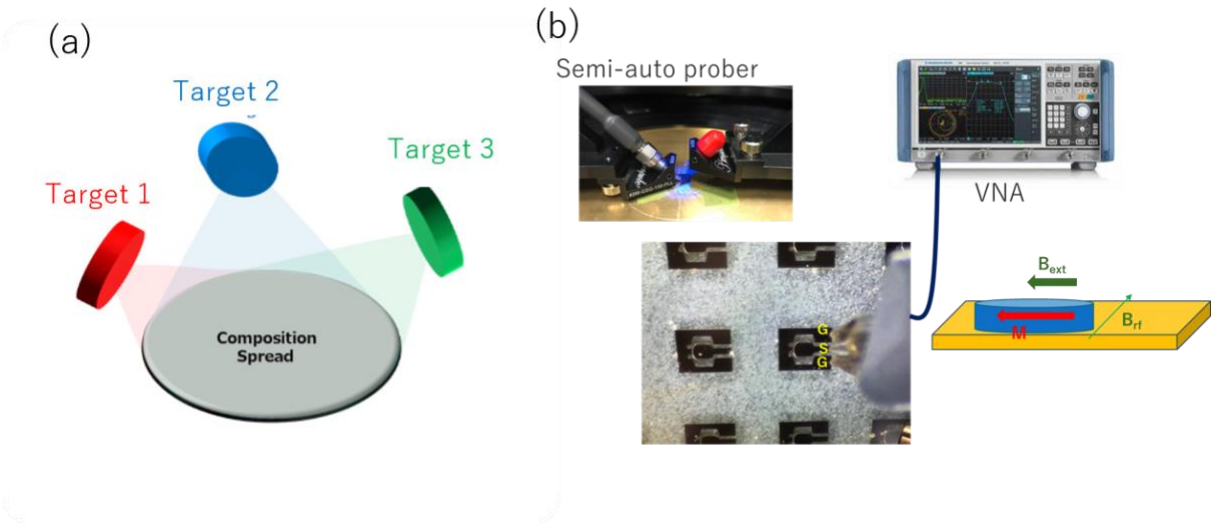

Fig.1: (a) The schematic of combinatorial sputtering to prepare composition spread samples in a single substrate. (b) The samples are fabricated to dot shape and measured FMR with using semi-auto prober and VNA..

[1] Y Yang, et al., “Recent advances in development of magnetic garnet thin films for application in spintronics and photonics”, Journal of alloys and Compounds 860 158235 (2021).

[2] T. Makiuchi, et al., “Parametron on magnetic dot: Stable and stochastic operation”, Appl. Phys. Lett. 118, 022402 (2021).