ナノ狭窄構造を持つ積層膜の熱起電力測定

Thermal induced voltage in magnetic layer with nano-constricted spin valves

1.九州大シス情, 2.JST PRESTO ○稲見 翔[1], 中村 瞭平[1], 中田 記矢[1], 黒川雄一郎[1], 湯浅 裕美[1,2]

1.Kyushu Univ., 2.JST PRESTO ○Sho Inami[1], Ryohei Nakamura[1], Fumiya Nakata[1], Yuichiro Kurokawa[1] and Hiromi Yuasa[1,2]

E-mail: inami@mag.ed.kyushu-u.ac.jp

[Introduction] For the spin current devices, the large spin current generation is demanded. It is generally considered that the larger volume of the magnetic material provides the larger spin current. But it has been reported that the spin current flows like a vortex when the magnetization is twisted in the nano scale region[1]. In that case, we can expect the spin-current enhancement near the nano-constricted region. Our purpose is to enhance the spin current generated by the heat flow in the nano-constricted region with twisted magnetization.

[Experimental] The prepared sample structure is shown in Fig. 1. We used the two kinds of substrate, SiO_2 and GGG. Al-O layer was fabricated by the natural oxidation of 1.5 nm Al and Al-O has the metallic hole of $Co_{90}Fe_{10}$ which plays a role as a nano-constricted region where the heat flows is constricted and the magnetization is changed suddenly. The sample was annealed under the condition of 270 °C in a magnetic field of 4.1 kOe for an hour for pinning the $Co_{90}Fe_{10}$ (A) magnetization. Since the $Co_{90}Fe_{10}$ (B) magnetization is rotated by an applied field, the twisted magnetization is obtained in the nano-constricted regions of $Co_{90}Fe_{10}$. We confirmed the twisted magnetization by *M-H* curves of the samples using SiO_2 substrate. Next, we measured the voltage for the samples using GGG substrate.

[Experimental Result] First, the magnetic coupling between $Co_{90}Fe_{10}$ (A) and $Co_{90}Fe_{10}$ (B) was adjusted by changing the oxygen exposure. The higher oxygen exposure provides the smaller density of nano constricted region, and consequently the smaller ferromagnetic coupling between $Co_{90}Fe_{10}$ (A) and $Co_{90}Fe_{10}$ (B). The nano-constricted regions were successfully fabricated in the Al-O layer[2].

Next, we measured the thermal induced voltage for the samples on GGG. Figure 2 shows the *V-H* curve for the sample with Al-O fabricated by oxygen exposure 20 kL. The voltage was changed corresponding to the magnetic reversal process of $Co_{90}Fe_{10}$ (B). Figure 3 shows the thermal induced voltage dependence on the oxygen exposure. Against our expectations, the sample without nano-constricted region shows the highest voltage. We are going to discuss the relationship between the density of nano-constricted region and the thermal induced voltage.

This work was supported by PRESTO-JST (JPMJPR15R8), Tateisi Science and Technology Foundation, Spin Research Network of Japan and KAKEN (16K13617).

[1]Phys.RevB.84.024416-3 (2011) [2]S. Inami et al.: 第 64 回応用物理学会春季学術講演会 講演予稿集 14p-P10-80 (2017).

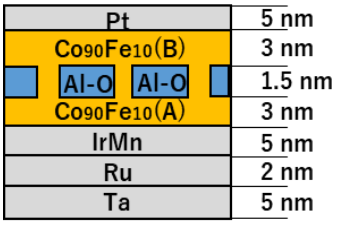

Fig.1 Film structure on Si substrate and GGG substrate

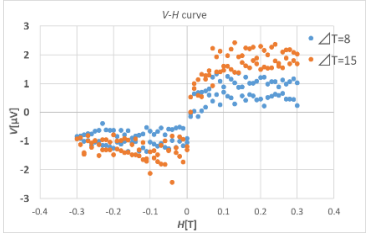

Fig.2 V-H curve (O_2 exposure 20 kL)

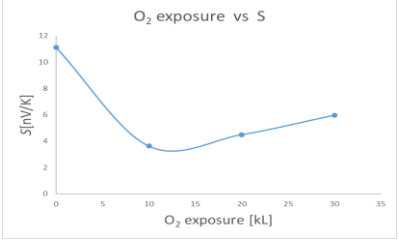

Fig.3 O_2 exposure depemdence of the thermal induced voltage