YIG/$Ta_{50}W_{50}$ における Mn,IrMn 挿入によるスピンゼーベック起電力の向上

Spin Seebeck voltage enhancement by inserting Mn or IrMn at interface of YIG/$Ta_{50}W_{50}$

九大シス情 [1], JST PRESTO[2] ○中田記矢 [1], 中村瞭平 [1], 稲見翔 [1], 黒川雄一郎 [1], 湯浅裕美 [1,2]

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

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

Spin Seebeck voltage generation is an attractive technology owing to the simple structure, but the generated voltage is too small for practical use still. Therefore, we successfully enhanced the generated voltage by using $Ta_{50}W_{50}$ alloy with the large spin Hall angle[1]. However, $Ta_{50}W_{50}$ alloy has the small spin mixing conductance at the interface with YIG, it is necessary to increase the spin mixing conductance. It has reported that the insertion of the antiferromagnetic oxide, NiO, was effective to improve the generated voltage and it originated from the magnon scattering[2]. On the other hand, we found that the nonmagnetic layer was slightly oxidized, which is cause of the generated voltage degradation by using XAS analysis[3]. In this report, in order to enhance the magnon scattering without oxidation at the interface, we inserted the metallic layer Mn or IrMn into the interface between YIG and $Ta_{50}W_{50}$.

Figure 1 is a schematic illustration of experimental configuration. We sputtered the nonmagnetic films on the sintered bulk-YIG (1mm) , where the nonmagnetic films are Pt 5nm, $Ta_{50}W_{50}$ 5nm, Mn 0.5 nm/$Ta_{50}W_{50}$ 4.5 nm, IrMn 0.5 nm/$Ta_{50}W_{50}$ 4.5nm. The temperature gradient was applied by a pair of Pertier module and the temperature difference between top and bottom of sample ΔT was monitored. When the temperature difference is stabilized at 8 K or 15 K, a magnetic field was swept from -300 mT to +300 mT. The generated voltage was detected by 2 probes with a distance of 32 mm.

Figure 2 shows the Spin Seebeck coefficient $|S|$ dependence on materials. YIG/ Mn and IrMn / $Ta_{50}W_{50}$ had 3.0 times and 3.3 times larger $|S|$ than YIG/$Ta_{50}W_{50}$, respectively. It indicates that the Mn and IrMn has successfully enhanced the magnetic scattering without the spin mixing conductance degradation due to the interface oxidation.

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References

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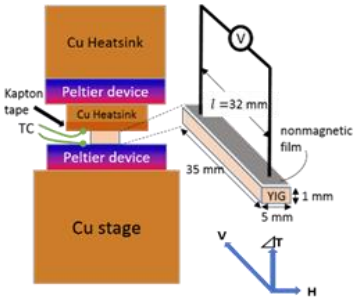

Fig1. Experimental structure.

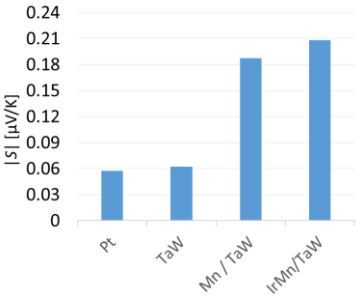

Fig2. Spin Seebeck coefficient dependence on materials.