YIG/Pt 界面への強磁性層挿入によるスピンミキシングコンダクタンス制御

Control of spin mixing conductance by ferromagnetic layer insertion into YIG/Pt interface

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Recently the energy harvesting attracts attention for energy saving. Since the thermoelectric conversion by the spin Seebeck effect has a uniform structure, it has a potential of large area generator [1, 2]. However, the generated voltage is too small for the practical use. Therefore, in order to enhance the generated voltage, we focus on the spin mixing conductance that is one of the most important parameters determining the voltage. It has been theoretically reported that the magnetic moment density of the interface determines the spin mixing conductance [3]. However, $Y_3Fe_5O_{12}$ (YIG) has the low magnetic moment density because it is a ferromagnetic oxide. FeCu alloy insertion increased the spin Seebeck voltage, which was attributed the magnetic moment density enhancement [4]. In order to increase the magnetic moment density, we inserted the magnetic materials, $Fe_{50}Co_{50}$, $Co_{90}Fe_{10}$, Cr and Fe with various magnetic moment into the sintered bulk-YIG (1 mm)/Pt (5 nm) interface.

We estimated the spin Seebeck coefficient S by application of ΔT and a magnetic field H as shown in Fig.1. Fig.2 shows the spin Seebeck coefficient S dependence on the inserted magnetic layers when the magnetic materials were changed. All inserted materials enhanced the spin Seebeck coefficient S and it is considered that the spin mixing conductance was improved by increasing the magnetic moment density. The samples with $Co_{50}Fe_{50}$ at the interface showed the highest S, which corresponds to the magnitude of the magnetic moment. However, we cannot explain the material dependence of S except for $Fe_{50}Co_{50}$.

In conclusion, we inserted the magnetic material layers $Co_{50}Fe_{50}$, $Co_{90}Fe_{10}$, Cr and Fe into the YIG/Pt interface, which improved the magnetic moment density and as a result the spin Seebeck coefficient S was enhanced. We propose the control method of the spin mixing conductance.

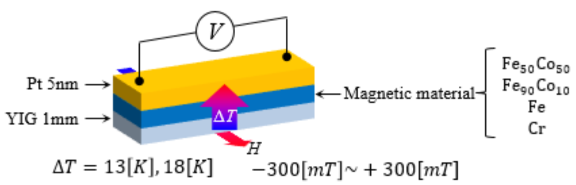

Fig.1 Sample configuration

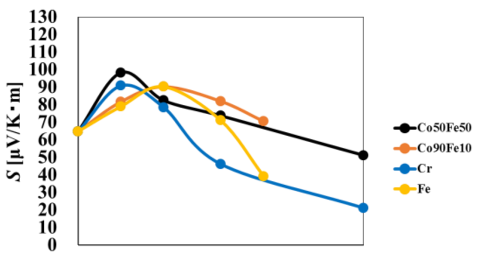

Fig.2 spin Seebeck coefficient dependence on the inserted magnetic material thickness

[1] K. Uchida *et al.*: Nature **455** 778(2008). [2] A. Kirihara *et al.*: Nature materials **11** 686 (2012). [3] X. Jia *et al.*: Europhys. Lett. **96** 17005 (2011). [4] D. Kikuchi *et al.*: Appl. Phys. Lett. **106** 082401 (2015).