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NiFe を挿入した YIG/Pt 界面のスピンミキシングコンダクタンス

Spin Mixing Conductance Enhancement by NiFe Insertion at YIG/Pt Interface

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The spin Seebeck effect and the inverse spin Hall effect generate the voltage by a temperature gradient in the ferrimagnetic oxide and nonmagnetic metal systems, which has a potential of thermoelectric generation by a uniform film [1, 2]. However, the voltage is so small that we have to enhance it for application. One of important physical parameters determining the voltage is the spin mixing conductance at the interface between ferromagnetic oxide and nonmagnetic metal. Although it was theoretically reported that the spin mixing conductance depends on the magnetic density at the interface [3], the ferrimagnetic oxide such as $Y_3Fe_5O_{12}$ (YIG) has the small magnetic moment density because iron ions in the two coordination sites exhibit opposite moments and oxygen does not have any moment. FeCu alloy insertion increased the spin Seebeck voltage, which was attributed the magnetic moment density enhancement [4]. In this paper, we inserted the very thin ferromagnetic $Ni_{80}Fe_{20}$ (NiFe) to enhance the magnetic moment density at the interface between YIG and Pt because NiFe is a typical ferromagnetic material with the high magnetic moment density. We sputtered NiFe (0 to 2 nm) and sequentially Pt (5 nm) on the sintered YIG (1 mm). Figure 1 shows the NiFe thickness dependence of spin Seebeck coefficient S estimated as $V/\Delta T/l$, where each parameter is shown in inset. By thickening NiFe from 0 to 0.6 nm S was increased up to twice, which means the increase of the magnetic moment density was realized by NiFe insertion as expected. However, S was decreased over 0.6 nm of NIFe. It indicates that the magnetic moment density saturated at 0.6nm where NiFe coverage saturated. As far as the spin Seebeck current does not change, thickening the total conductive part decreases the resistance, as a result the voltage decreases. In conclusion, we inserted the ferromagnetic NiFe layer into the YIG/Pt interface, which improved the magnetic moment density and the spin mixing conductance, and as a result the spin Seebeck coefficient S was enhanced.

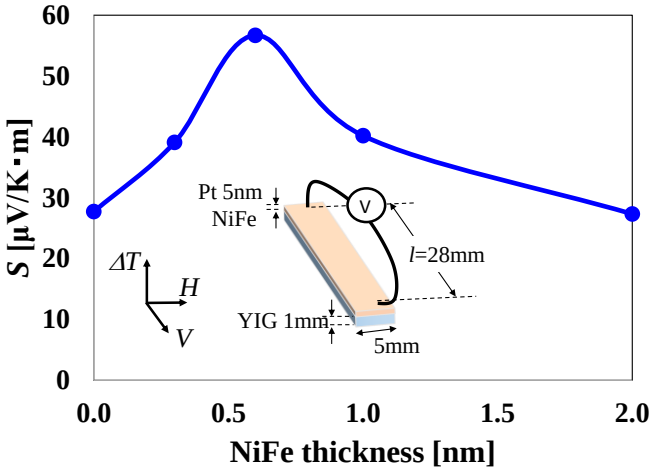

Fig. 1 Spin Seebeck coefficient S dependence on NiFe thickness. Inset is the experimental configuration.

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