

Thickness dependence of Spin Hall magnetoresistance in CoFe₂O₄/Pt/CoFe₂O₄

Hokkaido Univ., Takumi Yamamoto, Shoto Nodo, Takashi Yanase, Shimada Toshihito

and °Taro Nagahama

E-mail: nagahama@eng.hokudai.ac.jp

Introduction: Recently, spin current generation using spin orbit interaction has attracted much attentions. In particular, the Spin Hall magnetoresistance effect, which was discovered in YIG/Pt bilayers by Nakayama et al. in 2013, was investigated intensively, because it is the effect observed in simple dc measurements with a ferromagnet insulator (FMI) /nonmagnetic heavy metal (HM) interface. Furthermore, it provides some important parameter about spin current transport, e.g. spin diffusion length and spin mixing conductance, by analysis with Chen's theory. In this study, we fabricated CoFe₂O₄/Pt/CoFe₂O₄ trilayers and investigated the SMR. Although there is no report about SMR of trilayers, Chen discussed the difference between the effect in trilayer and bilayer in their theory.

Experiments: Many experiments of SMR has been conducted using YIG/Pt bilayer so far. However, we employed CoFe₂O₄ as the ferromagnetic insulator, because it is not easy to fabricate YIG by physical vapor deposition method. We fabricated the films by reactive molecular beam epitaxy method. The deposition temperature for CoFe₂O₄ and Pt were 300 C and 100 C, respectively. CoFe₂O₄ was deposited in Oxygen radical atmosphere of 4×10^{-4} Pa.

Results: The typical angle dependent magnetoresistance (ADMR) curve was shown in Fig.1 (a). For the angle of α and β , clear sine curves which were coming from SMR were observed. On the other hand, small resistance change was also observed in γ angle, that was considered to be AMR in Pt layer which have ferromagnetic components due to proximity effect. In fig.1 (b), the Pt thickness dependence of SMR was illustrated. It decreased exponentially with increasing of Pt thickness. The solid line was a fitting line with Chen's theory. The comparison between trilayer and bilayer will be discussed at the session.

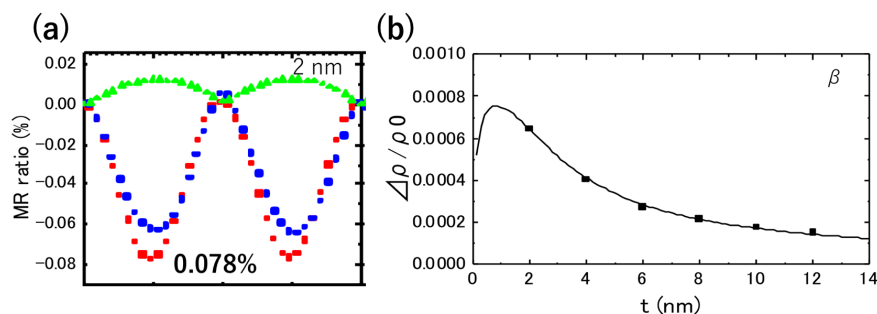


Figure 1.(a) The angle dependent magnetoresistance of CoFe₂O₄/Pt/CoFe₂O₄.

(b) Pt thickness dependence of SMR.