Suppression of spin pumping efficiency at low temperature in Pt/YIG thin films

◦E. Shigematsu[1], Y. Ando[1], R. Ohshima[1,2], S. Dushenko[1,2], Y. Higuchi[3], H. J. von Bardeleben[4] and M. Shiraishi[1]

1. Department of Electronic Science and Engineering, Kyoto University, Japan
2. Graduate School of Engineering Science, Osaka University, Japan
3. Murata Manufacturing Co., Ltd.
4. Institut des Nanosciences de Paris, Université Pierre et Marie Curie, France

E-mail: shigematsu.ei.74w@st.kyoto-u.ac.jp

Yttrium Iron Garnet (YIG) recently can be considered as an effective spin injector because its insulating property makes it easier to identify the origin of the observed electromotive forces (EMFs) induced in nonmagnetic metals on YIG. Combined with dynamical spin injection, YIG is widely applied to investigate spin-related characteristics of wide variety of condensed materials. It has been shown in the past that the parameters of the ferromagnetic resonance and in particular the linewidth depend strongly on the YIG properties[1] and FMR observation can become impossible below 80K. For the sake of more precise experiment using YIG, it is necessary to investigate and grasp the spin injection property of YIG.

We prepared YIG thin films (100 nm in thick) on Gadolinium Gallium Garnet (GGG) substrate. A thin Pt layer (10 nm in thick) was deposited by e-beam at room temperature. Two electrodes were installed at the extremities of the Pt film. The sample was then measured in a standard FMR cavity set-up with a variable temperature equipment. FMR was measured with 50mW power and 1 to 10G field modulation. The EMF was simultaneously measured with a nanovoltmeter. At 150K, a clear EMF spectrum was observed at the FMR resonance. At lower temperatures the linewidth of the FMR started to broaden and the EMF was reduced accordingly. At 80K the FMR signal was no longer observable and no EMF signal could be detected. A similar FMR line broadening behavior has been reported in a FMR precedent study of YIG[1], and attributed to rare earth contamination related relaxation processes[2].

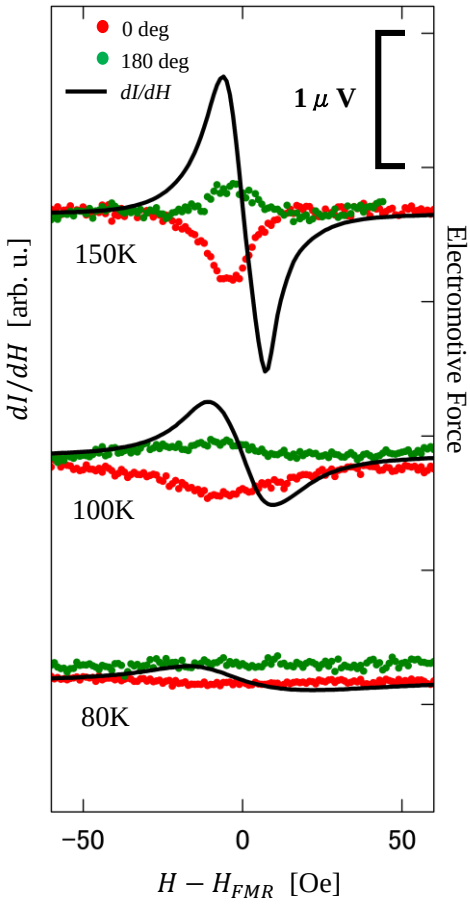

Fig. 1: The EMFs from thin Pt film at different temperatures

Acknowledgements:

E. Shigematsu's stay in France was financially supported by the French Embassy in Japan.

References:

[1] E. G. Spencer et al., Phys. Rev. Lett. 3, 32 (1959).
[2] P. G. De Gennes et al. Phys. Rev., 116, 323 (1959).