Name	**Yasuo Ando**
Organization	**Tohoku University**
Division/Department	**Department of Applied Physics, Graduate School of Engineering**
Title	**Prof. Dr.**

Presentation Title

Advanced spintronic materials and transport phenomena (ASPIMATT)

Abstract

The aim of the proposed Japanese-German Research Unit “Advanced spintronic materials and transport phenomena (ASPIMATT)” is to develop the foundations for a future spintronics with the potential to complement and succeed conventional CMOS. The specific approach lies on the development and characterization of new spintronic materials for applications at room temperature and on the study of new spin transport phenomena, in particular lateral spin current phenomena. The research subject lies in the field of nanoelectronics, specifically in the research area “Nanospintronics and related materials and structures”.

Many problems in the field of spintronics still lack good solutions, although there is very high pressure from the market side. The concept of half-metallic Heusler compounds provides a perspective for novel solutions. Heusler compounds can be designed and made with high spin polarization and high Curie temperature, as well as, depending on the application, high spin injection efficiency, very low or high damping, tunable magnetic moment (low and high magnetic moment can be realized), and tunable anisotropy. Thus, there is very high potential, that many material related problems, present in current-day 3d metal systems, can be overcome. A big challenge is still the handling of interfaces with respect to their chemical (atomic diffusion and roughness), electronic (e.g., Schottky barrier design) and spin properties (spin injection and spin pumping). In addition potential for new phenomena and applications exist using novel materials in the Heusler compound family, to name here novel semi-conducting Heusler compounds to be used as non-ferromagnetic spin conductors.

To achieve this highly ambitious aim, the needed thorough experience and expertise is not localized in a single place and not even in a single country, and thus groups from two German universities, the Johannes Gutenberg Universität Mainz and the Technische Universität Kaiserslautern, combine their expertise with groups at the Tohoku University, Sendai, Japan. We feel we have a working unique expertise in understanding and making Heusler compounds as the only consortium in this field worldwide, which covers the full range from the computer based design to applications in real devices.

Until now, our research group showed many pioneering works of advanced spintronic materials and transport phenomena. The principle results are follows.

- High TMR ratio was obtained for $Co_2MnSi/CoFe/MgO/Co_2MnSi$ structure.
- Effect of non-collinear magnetic structures at the interface of Co_2MnSi /MgO/Co_2MnSi to elucidate the origin of the temperature dependence of the TMR ratio was investigated [1].
- Ultrafast spin precession using all-optical pump-probe method in thin films of $Mn_{3-x}Ga$ alloys (x=0.88 and 1.46) was successfully observed [2].
- Compatibility of large magnetic anisotropy and low damping constant in Mn_3Ga was demonstrated [3].
- Large MR ratio was obtained for CPP-GMR devices with the (001)-oriented fully-epitaxial Co_2MnSi /Ag/Co_2MnSi structures [4, 5].
- CPP-GMR with continuous $Co_{75}Fe_{25}$ free layer was prepared on a coplanar wave guide with low microwave transmission loss for BLS measurement. STO was observed electrically without harmonic signal.

References

[1] Y. Miura, K. Abe, and M. Shirai, *Phys. Rev. B* **83** (2011) 214411.

[2] S. Mizukami, F. Wu, A. Sakuma, J. Walowski, D. Watanabe, T. Kubota, X. Zhang, H. Naganuma, M. Oogane, Y. Ando, and T. Miyazaki, *Phys. Rev. Lett.* **106** (2011) 117201.

[3] Feng Wu, Shigemi Mizukami, Daisuke Watanabe, Hiroshi Naganuma, Mikihiko Oogane, Yasuo Ando, Terunobu Miyazaki, *Appl. Phys. Lett.* **94** (2009) 122503.

[4] T. Iwase, Y. Sakuraba, S. Bosu, K. Saito, S. Mitani, and K. Takanashi, *Appl. Phys. Express.* **2** (2009) 063003.

[5] Y. Sakuraba, K. Izumi, T. Iwase, S. Bosu, K. Saito, K. Takanashi, Y. Miura, K. Futatsukawa, K. Abe, and M. Shirai, *Phys. Rev. B* **82** (2010) 094444.