Poster Presentation

MS085.P01

Measurement of spin selective magnetization curve by magnetic Compton scattering

Akane Agui[1], Naruki Tsuji[2], Xiaoxi Liu[3], Kosuke Suzuki[4], Hiroshi Sakurai[4]
[1]*Synchrotron Radiation Research Center, National Institutes For Quantum And Radio, Sayo-gun, Japan,* [2]*Japan Synchrotron Radiation Research Institute, Kouto, Japan,* [3]*Department of Electrical and Computer Engineering, Shinshu University, Nagano, Japan,* [4]*Division of Electronics and Informatics, Gunma University, Gunnma, Japan*
E-mail: agui@spring8.or.jp

Magnetic Compton scattering profile (MCP) measurement is a unique technique to detect the momentum density of magnetically active electron in materials. Specially, a double integral of MCP in momentum space provides spin magnetic moment. Recently we have proposed a new method to obtain a spin selective magnetization curve (SSMH) by applying MCP measurement [1-3]. Moreover, we proposed orbital-specific magnetization curve (OSMH) which obtained by combing with a conventional total magnetization curve measurement. Also, using prolife shape analysis, element selective magnetization curve (ESMH) was proposed.

Since we have developed the technique of SSMH, OSMH, and ESMH, we have been investigating the microscopic, ie spin , orbital and element selective, magnetization process of perpendicular magnetic amorphous rare-earth and transition metal (RE–TM) alloy films. RE–TM films have been attracting much interest as materials for magnetic devices. Magnetic moment of RE and TM are ferri-magnetically coupled. The magnetic structure is known as sperri magnetism.

In the most cases, the MCP intensity from thin film is very low. In order to obtain enough intensity for SSMH measurement within realistic measurement time, one needs a high intensity light source. We preformed MCP measurement at BL08W of SPring-8, Japan. The BL08W provides high brilliant circularly polarized x-ray and the MCP measurement system consists of solid state detectors. BL08W of SPring-8 is the best place to measure MCP for SSMH measurement.

Here, we introduce the result of perpendicular magnetic Tb-Co with paramagnetism [2]. SSMH and OSMH of Tb43Co57 film were measured and it was observed that the shapes of SSMH and OSMH are different. In low magnetic field region, the spin magnetic moment well follow the field changing and in high magnetic field region the opening angle of the RE magnetic moment cone close following the field change. It was attributed that the paramagnetic property originated from the narrowing of the distribution of the RE magnetic moment.

And, we introduce the case of oxygen doped perpendicular magnetic Tb-Fe [3]. SSMH, OSMH and ESMH of Tb32Fe55O13 film was measured and it was observed that the Fe atoms assume the major magnetic moment, which were distributed in-plane and that the out-of-plane components of Tb were enhanced at low magnetic fields. The oxygen atoms affected the long range magnetic interaction and hence the field dependence of both the magnetic moments of Tb and Fe.

Newly, we measured SSMH of the high squareness perpendicular magnetic Tb-Co: Ti(5 nm)/[Tb23Co77 (200 nm) / Ti (5 nm)]10/Al multilayer film. It was observed that the shapes of SSMH and OSMH change as magnetic field change cooperatively and synchronously. It was assumed that entire of the system occurs magnetization reverse at the same time once the a nucleus of magnetic switching generates.

At last, it should be mentioned that the measurements of SSMH and OSMH using MCP are a powerful tool to study the microscopic magnetization process as above examples show.

[1] Agui, A. et al.(2010) J. Synchrotron Rad. 17 32.
[2] Agui, A. et al.(2011) APEX 4 083002.
[3] Agui, A. et al. (2013) J. Appl. Phys. 114 183904.

Keywords: magnetic Compton scattering