2012A期 採択長期利用課題の紹介

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2012A期は2件の長期利用課題の応募があり、そのうち1件が採択されました。採択された課題の審査結果および実験責任者による研究概要を以下に示します。

課題名	Development of Spin-HAXPES technique for the Exploration of the Electronic structure of Buried layers and Interfaces
実験責任者名	Claudia Felser (Johannes Gutenberg-University, Mainz)
採択時の課題番号	2012A0043
ビームライン	BL47XU

〔実験責任者による研究概要〕

The performance of spintronic devices depends on the spin polarization of the current. Of particular importance is the tunneling of spin-polarized electrons from ferromagnetic electrodes through insulating barriers. It has attracted enormous interest in the technology due to its application in magnetic tunnel junctions (MTJs) and its potential to improve the spin injection into semiconductors. The electronic structure of ferromagnet-insulator interfaces plays a key role in spin-dependent transport processes. Therefore, a spin-resolved exploration of the electronic structure of buried ferromagnetic layers and interfaces is of great importance.

Hard X-ray photoelectron spectroscopy (HAXPES) has emerged as a powerful tool to investigate the electronic structure of solids as well as multilayer systems and buried thin films.

Recently, a spin polarized high-resolution hard X-ray photoemission spectroscopy (Spin-HAXPES) was successfully developed using a spin detector -based on Spin-Polarized Low-Energy Electron Diffraction (SPLEED) at a W(100) surface- in combination with a high-energy hemispherical electron analyzer at the high-brilliance BL47XU beamline (SPring-8, Japan)[1]. A spin-resolved electronic structure of buried magnetic layers was studied. The implemented Spin-HAXPES technique facilitated the direct observation of the spin polarization of emitted electrons. The measurements proved that a spin polarization of about 50% is retained during the transmission of photoelectrons emitted from the Fe $2p_{3/2}$ state through a 3 nm thick oxide capping layer.

The long-term goal of the proposal is to explore the spin resolved electronic structure (core as well as valence band states) of buried magnetic interface with Spin-HAXPES. This inevitably needs introduction of a high efficient spin detector such as a multichannel spin filter. The experiments imply the delivery of a multichannel electron spin filtering detector from Germany to SPring-8 and its off-line test before the in-line experiments. Before the multichannel spin detector is taken into operation, the performance of conventional SPLEED-type spin detector will be tested in combination with Scienta R4000 analyser equipped with wide-angle acceptance lens system.

Spin-HAXPES experiment will enable to study the electronic band structure resolving electron energy, momentum and spin degrees of freedom with rather high bulk sensitivity.

[1] *G. Stryganyuk, X. Kozina, G. H. Fecher, S. Ouardi, S. Chadov, C. Felser, G. Schoenhense, P. Lushchyk, A. Oelsner, P. Bernhard, E. Ikenaga, T. Sugiyama, H. Sukegawa, Z. Wen, K. Inomata, and K. Kobayashi, Jpn. J. Appl. Phys. 51 (2012) 016602.*

〔審査コメント〕

The purpose of this proposal is to realize spin-polarized hard-x-ray photoemission spectroscopy (Spin-

HAXPES). By introducing the newly developed multi-detection spin filter system into the HAXPES system at SPring-8, it is expected that the progress in the field investigating spintronics materials is very much. In the previous long-term proposal, the achievement of Spin-HAXPES has been limited to detect the spin-polarized signals from Fe 2p core levels. The detection of valence band structures is strongly required. If the present project is going well, world-wide users may be interested in the Spin-HAXPES studies. It is also expected that the system will become user-friendly and widely used for material science.

In order to use the beamtime effectively, it is recommended to perform the preliminarily setup and preparation of the system such as optimizing lens and the detector systems, atomization of the cleaning procedure of the spin-filter targets. Especially, the setup and optimizing procedure without synchrotron radiation will be essential. The detailed purpose to measure Spin-HAXPES of CoFe, Co2FeAl1-xSix, and Co2MnxSiy samples in this long-term proposal is not so clear at present. According to the progress of the project, the detailed target of samples should also be reconsidered.