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軟 X 線共鳴磁気散乱装置の開発と磁気散乱円二色性の検出

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An apparatus for soft x-ray resonant magnetic scattering (SXRMS) experiments with polarization-variable undulator radiation has been developed. This instrument is intended for experiments on x-ray magnetic circular (XMCD) and linear (XMLD) dichroism in SXRMS processes in order to study the correlation and competition between electronic and magnetic states and long-range spatial magnetic structure.

The apparatus consists of mechanisms for sample/detector rotations, a temperature-controllable (~6-300 K) sample holder, a gap-variable permanent magnet, beam-defining slits, a main chamber, a sample-preparation chamber, and a load-locked chamber. The system is ultrahigh-vacuum compatible and is to be fully computer-controlled. It has been installed on BL-16A (Fig.1). The sample and detector rotations are achieved with high accuracy. The sample can be cooled down to ~6 K using a helium-flow cryostat. The magnetic field at the sample can be changed (~1-2 kG) by adjusting the magnet gap. A photodiode is used as a detector. The system allows *in-situ* sample preparation, a quick sample-substrate exchange, and transferring samples under ultrahigh vacuum.

SXRMS experiments were made on Co(4ML)/Pt(10ML) superlattices using circularly polarized soft x-rays emitted from the APPLE II undulator. The photon-helicity (h)-dependent, resonantly-scattered light intensity ($I_{\pm}$) was measured at the Co $L_{3,2}$ edges as functions of the scattering angle（SXRMS pattern）or of photon energy (SXRMS spectra). The 0th- and 1st-order diffraction peaks were observed in the SXRMS pattern (Fig.2(a)). A differential SXRMS spectrum, $\Delta I/I = (I_+ - I_-)/[1/2(I_+ + I_-)]$, showed XMCD signals for the 0th and 1st diffraction peaks (Fig.2(b)). This shows a ferromagnetic alignment of the in-plane magnetized Co layers across the Pt layers.

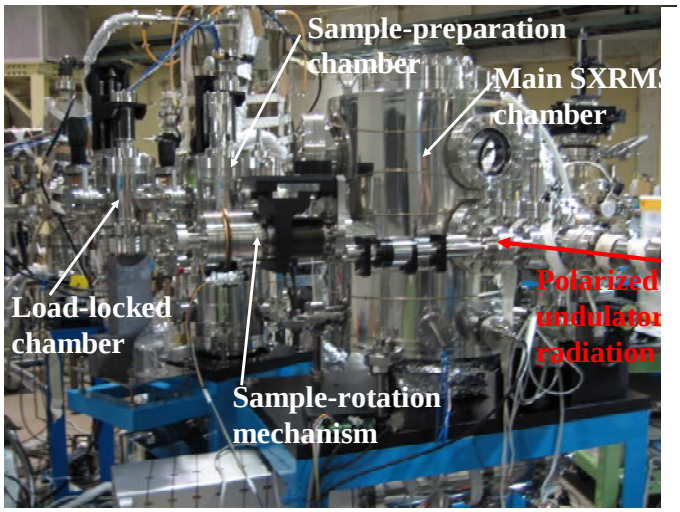

Fig.1 View of the SXRMS apparatus installed on polarization-variable undulator beam line BL-16A. The main SXRMS chamber is seen in the foreground.

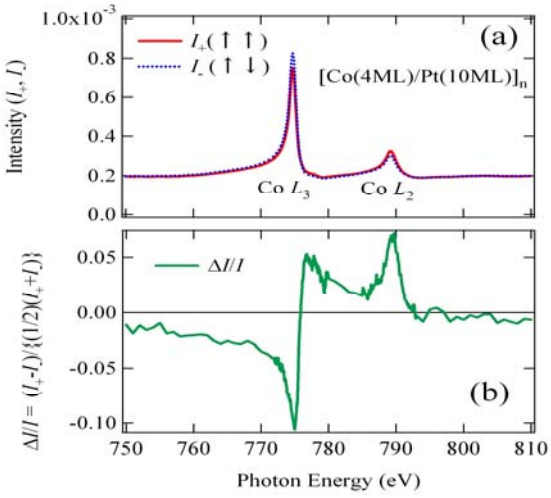

Fig.2 (a) 1st-order scattering spectra in a Co(4ML)/Pt(10ML) superlattice. (b) 1st-order scattering XMCD spectrum $\Delta I/I = (I_+ - I_-)/[1/2(I_+ + I_-)]$.