Performance of soft-x-ray circular polarization switching for magnetic domain observation by photoelectron emission microscope

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Photoemission electron microscope (PEEM) with circularly polarized soft x-rays enables us to observe magnetic domains via the magnetic circular dichroism (MCD) effect [1]. To obtain clear contrasts of magnetic domains, it is effective to take a difference image between two images observed with left- and right-handed circularly-polarized light. Fast helicity switching of the circularly polarization is a key technique for this method. Nowadays, highly polarized soft x-rays with high brilliance are available by virtue of the development of insertion devices in synchrotron radiation facilities. However, the helicity switching with a short switching time is not an easy technique because there is no effective polarizing device covering the soft x-ray region. At the soft x-ray beamline BL25SU of SPring-8, a helicity switching technique is realized by using twin helical undulators with switching frequencies of 0.1, 1 and 10 Hz [2,3]. We report the performance of the helicity switching technique for magnetic domain observations by PEEM.

The opposite-helicity beams emitted from the twin helical undulators should impinge on the same position of a sample surface with the same intensity distribution. Otherwise, some artificial contrast would appear in an MCD image. We have examined the light spot positions and profiles under the helicity switching. MCD images are observed by a PEEM combined with a CCD data acquisition system synchronized with the helicity switching frequency [4]. A low frequency of 0.1 Hz is currently applied to the MCD imaging due to the trade-off between the increasing frequency and the data degradation caused by the readout noise of our CCD camera presently used. The image acquisition frequency can be increased up to 10 Hz by employing a low-noise and fast-response CCD camera in future.

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