Development of quantum Hall array resistance standards

Toward the next generation quantum resistance standard

The quantized Hall resistance (QHR) device is widely used by national metrology institutes (NMIs) as DC resistance standards. The plateau at $i = 2$ is practically used for DC resistance calibration, and the nominal value of QHR at this plateau is 12 906.403 5 Ω. This non-decade value requires sophisticated technology to be used for actual resistance calibration, therefore several NMIs tried to make convenient quantum resistance standards which have nominally decade values: 100 Ω, 1 kΩ, 10 kΩ and so on by combining QHR elements in series and in parallel.

We are now trying to establish the next generation standards of DC resistance, and an experimental device of quantum Hall array resistance standard (QHARS) with a nominal value close to 10 kΩ has been developed. This QHARS device consists of 266 Hall bar elements. This device will play an important role in future calibration services due to the growing demand of 10 kΩ resistance calibration.

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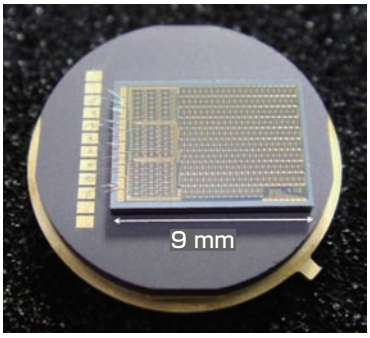

10 kΩ quantum hall array resistance standard (QHARS) device. 266 single Hall bar elements are integrated on this 9 mm × 7 mm chip.

First observation of natural circular dichroism in extreme ultraviolet region

A polarizing undulator exceeds the wavelength coverage of natural circular dichroism measurement

We have developed a polarizing undulator-based optical system for natural circular dichroism (CD) measurement and succeeded in the observation of natural circular dichroism in the extreme vacuum ultraviolet (EUV) region.

CD has been utilized to analyze the structure of chiral molecules and polymers. The extension of the CD-measurable region to the EUV region has made a significant increase in the number of the CD-applicable molecules such as sugars. However, in the EUV region, no continuous transparent-type optics is currently available. Therefore, the EUV-CD measurement system without transmission-type optics has been developed at the beam line BL-5B in the storage ring TERAS at AIST in Japan, which has adopted a polarizing undulator as a circularly polarized light source. The intensity of CD is generally weak, approximately 0.1-1 % of absorption intensity. Such a weak CD signal was successfully acquired by an appreciable improvement in our undulator-based CD system and calibration method.

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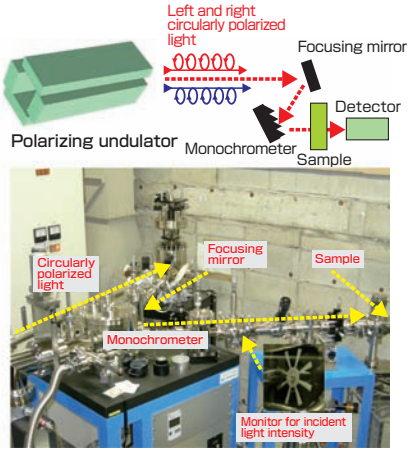

Schematic view and photograph of natural circular dichroism measurement system using the polarizing undulator