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Experimental techniques

Nanoscale soft X-ray absorption spectroscopy (nano SX-XAS)

NanoTerasu JASRI

BL13U (180-3000 eV)

Microscopic researches on physical and magnetic properties for inorganic/organic materials with versatile polarized soft X-ray

Beamline features

- Soft and tender X-ray absorption spectroscopy (180–3000 eV).
- Left and right circular and linear polarization in arbitrary directions is produced by four APPLE-II type IDs. A 10 Hz polarization switching system is under construction. At present, ~0.1 Hz switching is available at a fixed X-ray energy. For use of polarization switching, advance consultation is required before proposal submission.
- X-ray beam focused to micrometer size using two types of focusing mirrors (Wolter and toroidal mirrors). Non-focused beam is also available, but advance consultation is required before proposal submission.
- Operando spectroscopy under magnetic and/or electric fields, and/or high pressure (planned for the future).
- Transmission X-ray microscope (TXM) with a focused X-ray beam of less than 10 nm (currently under construction; scheduled to be available from FY2026 onwards).

Note: As of October 1, 2025. The information in this document may be updated during beamtime. If you require important performance parameters, please contact the staff in charge in advance.

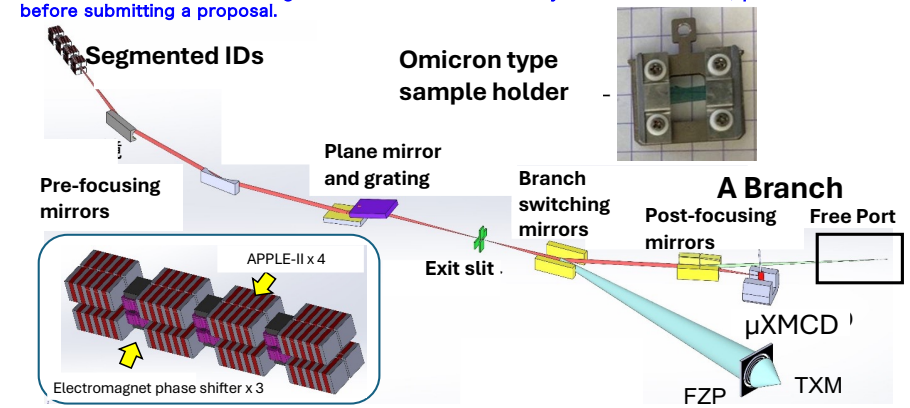
Methods

1. Soft X-raSoft X-ray absorption spectroscopy (XAS)
2. Soft magnetic circular dichroism (XMCD)
3. Soft X-ray magnetic linear dichroism (XMLD)

Beamline information

polarization (energy range)	single ID	left and right circular (185-1450 eV) horizontal linear (180-3000 eV) vertical linear (260-3000 eV)
	four IDs ※	arbitrary directional linear (185-1450 eV) left and right circular polarization plus 45°/135° linear (260-3000 eV)
energy resolution ($E/\Delta E$)	>10,000@400 and 870 eV measured at N_2 and Ne absorption edges (For all energy range, ~10,000 is expected)	
beam flux on a sample	~ 10^{11} photons/sec. (estimated)	

※Four IDs can be used in segmented undulators mode. if you need this mode, please contact us before submitting a proposal.



Schematic picture of Segmented IDs

Endstation information

A branch	μXMCD[1]		The X-ray beam can be focused using a Wolter mirror. XMCD measurements can be performed under an arbitrarily oriented horizontal magnetic field.
	Free Port A	Versatile XAS[2]	The X-ray beam can be focused using a toroidal mirror. Advance consultation is required before proposal submission for the use of a non-focused beam. The apparatus is equipped with a differential pumping system.
		Users' own chambers	If you wish to bring your own chamber, advance consultation is required before submitting a proposal. Both focused and non-focused beams are available.
B branch	Free Port B		If you wish to bring your own chamber, advance consultation is required before submitting a proposal. The non-focused beam is available.

[1] μXMCD

Pressure	UHV (<10^{-6} Pa)
Beam size	< 3 μm (V) × 3 μm (H)
method	Total electron yield (TEY), partial and total fluorescence yields (PFY & TFY), X-ray excited optical luminescence (XEOL), Transmission method
Sample holder	Omicron type sample holder. Transport of samples using a specific mobile chamber is also available. Advance consultation is required.
heating	< 770 K (tentative)
cooling	> 160 K (LN_2)
misc	➢ The apparatus is equipped with an evaporation source. ➢ An arbitrarily oriented horizontal magnetic field (< 160 mT) generated by a permanent magnet is available.

[2] Versatile XAS

Pressure	HV (10^{-4}~10^{-5} Pa)
Beam size	10– 100 μm (V) × 17– 100 μm (H)
method	Total electron yield (TEY), partial fluorescence yield (PFY) Transmission method
Sample holder	Omicron type sample holder. Transport of samples using a specific mobile chamber is also available. Advance consultation is required.
Temperature	Room temperature
misc	➢ This system is applicable to samples unsuitable for ultra-high vacuum conditions, such as natural and biological samples.