

Pioneering New Horizons in Science

TOYAMA

*Soft X-ray Monochromator
VLSPGM*



www.toyama-en.com

VLSPGM Soft X-ray Monochromator

Variable Line Spacing Plane Grating Monochromators

Toyama's state of the art grating monochromators are based on more than 30 years experience in the design and manufacture of soft x-ray systems. We have designed, manufactured and commissioned more than 20 VLSPGM instruments in the last 10 years, many on state-of-the-art beamlines.

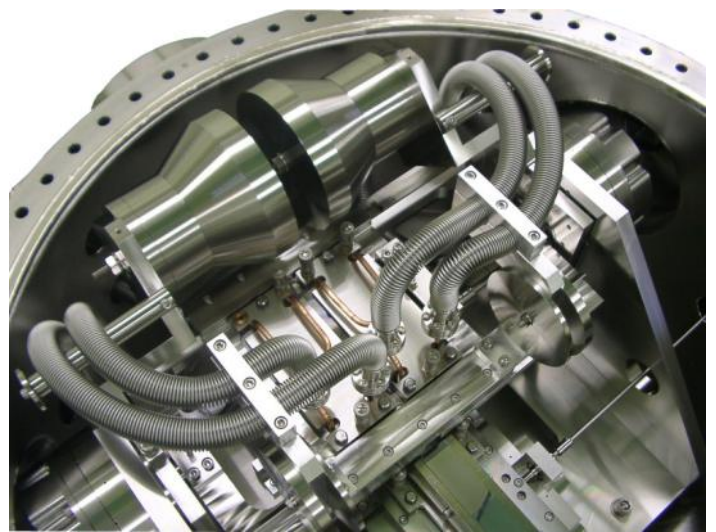
Working together with leading scientists and engineers, we continue to refine and develop all aspects of our monochromator systems. Our in-house staff include experts with extensive backgrounds in mechanical and thermal engineering, and we have all the latest software tools for optical design, thermal and vibration analysis.

We take pride in the fact that we are a *manufacturing* company, and our products benefit from the high level of quality control that this gives us.

Toyama's skills in ultra-precision mechanism technology, precision machining and UHV engineering ensure that our monochromator systems meet the very stringent requirements of the latest generation of soft x-ray beamlines.



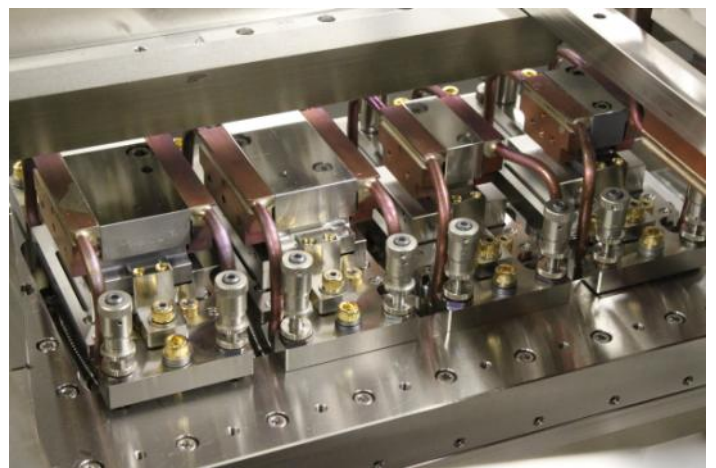
VLSPGM monochromator installed on the Metrology and Tests beamline at the SOLEIL synchrotron



Internal view of VLSPGM installed at KEK in Japan showing the water cooling system – the full monochromator is shown on the front cover

Features

- Extensive range of existing designs can be optimised for your specific requirements
- Ultra-high resolution over a wide range of wavelengths
- Precise in-vacuum rotary encoders allow direct angle reading
- Dual encoder systems for high resolution and stability
- Proven, reliable mechanisms for mirrors and gratings
- High heat load compatible by using high efficiency and low vibration double tubing water cooling system
- Incoming and outgoing beam angles horizontally fixed
- True UHV engineering for excellent vacuum performance
- Precision entrance and exit slits available



Grating holders, showing side cooling, installed in the DEIMOS monochromator at SOLEIL synchrotron

VLSPGM Soft X-ray Monochromator

Specification for VLSPGM at the BOREAS beamline, ALBA

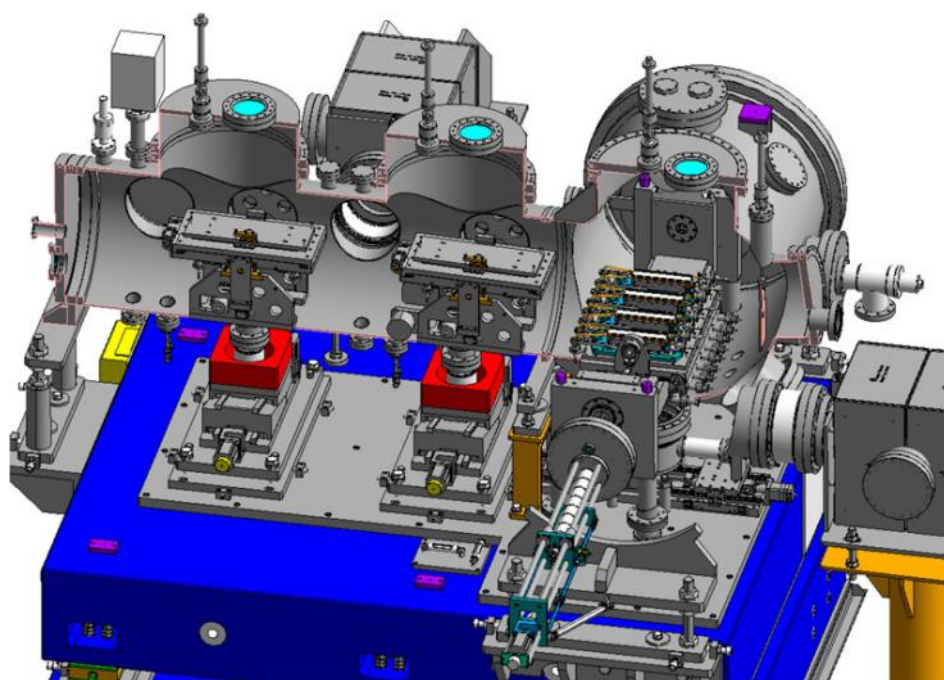
The monochromator for the BOREAS beamline at ALBA is based on the Variable Line Spacing, Plane Grating (VLS-PG) design. It can work at fixed included angles of either 175° or 177° in combination with either of the two spherical mirrors that are installed. There are positions for 3 gratings giving an energy range from 80eV to more than 3000eV; a fourth grating position is available. The two fixed angle mirrors (SM1 and SM2) are independently mounted and are water cooled. The mirror height and pitch angle are motorised and encoded. The gratings are mounted on an in-vacuum translation stage; they are also water cooled. The grating rotation mechanism uses an external sine bar drive with the grating rotation measured internally using an averaging dual read head encoder system. Other fine adjustments (roll and yaw) can be made with the system under vacuum using magnetically-coupled vacuum “screwdrivers” to operate differential micrometers on the optics holders.

The mirror and grating mechanisms are mounted on a common granite base to ensure maximum stability and low vibration performance. Careful attention is given to the design of the mirror and grating water cooling system and its interface to the holders for the optical elements. This ensures efficient cooling whilst minimising distortions of the optical elements; the double piping cooling system has been shown to significantly reduce vibrations associated with coolant flow.

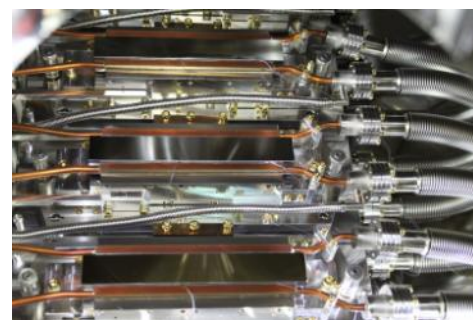
Photon energy range: 80 to >3500eV
Maximum resolving power: 5000 for E >1500eV
Beam size at sample: 100µm horizontal x 20 µm vertical to > 1mm x 1mm
Base pressure: <5 x 10⁻¹⁰ mbar
SM1/2 spherical mirrors: 250 mm (L) x 50 mm (W) x 40 mm (T)
Gratings: Low energy: 200 L/mm holographic, Medium energy: 800 L/mm ruled, High energy: 1200 L/mm ruled
25 mm (W) x 170 mm (L) x 30 mm (T)

VLSPGM Monochromator for BOREAS: Main Motorised Axes

Axis	Range	Resolution	Encoder Resolution	Drive Method
SM1/SM2 Height	-5 mm to +25 mm	<1.25 µm	0.1 µm	External stepper motor with encoder
SM1/SM2 Pitch	±1.0°	<1 µrad	0.1 µrad	In-vacuum stepper motor with in-vacuum encoder
Grating Translation	±190 mm	<100 µm	1.8 µm (angle encoder)	External stepper motor with angle encoder
Grating Pitch	-1.0° to +3.5°	< 120 nrad	50 nrad	External stepper motor with in-vacuum dual angle encoder



3D model of VLSPGM installed on the BOREAS beamline at ALBA—this has two mirrors and three gratings. The monochromator is shown installed on the beamline in the picture on the right.



Three interchangeable gratings installed in the BOREAS monochromator at ALBA synchrotron



Other areas of Toyama expertise

Synchrotron Applications

Toyama has developed an extensive range of components and systems for synchrotron beamlines and front ends including:

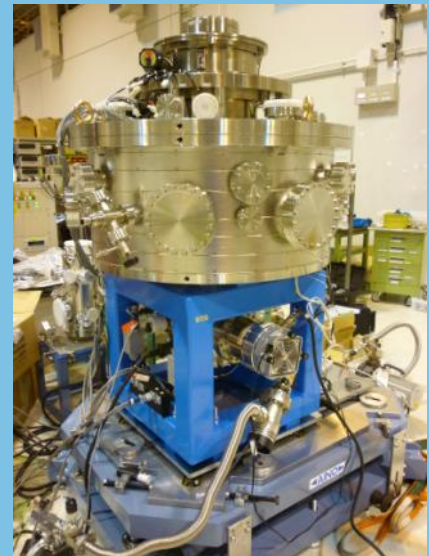
- Hard X-ray Monochromators
- Mirror systems
- Slits
- High heat load front ends
- Beam Monitors
- End stations such as Ellipsometers, Reflectometers and Diffractometers



Liquid nitrogen cooled mirror system



Crystal stage in the hard X-ray DCM



Diffractometer



XFEL Monochromator



Cooled slit



Screen Monitor

XFEL Components

Toyama has developed components for XFEL accelerators and beamlines:

- XFEL Monochromator
- XFEL Mirror Systems
- XFEL Beam Monitors for beam position, beam profile and beam current
- Energy Slits for XFEL accelerator

ISO 9001 and 14001 certification



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