

Pioneering New Horizons in Science

TOYAMA

Mirror Systems



www.toyama-en.com

Mirror Systems

Mirror Systems

Toyama's mirror systems are all individually customised to meet the requirements of the beamline where they are to be installed. Bendable designs are based on the highly successful mirror bending system (FMP-1000A) with the design evolving all the time to meet the requirements of the third generation synchrotrons and XFEL beamlines.

More than fifty mirror systems have been installed at SPring-8 and KEK synchrotrons in Japan. Mirror systems are also installed in many other countries worldwide.

Features

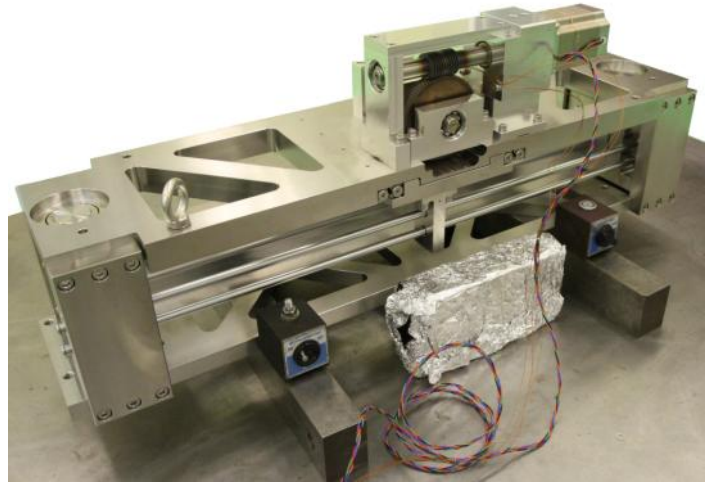
- High precision positioning in each axis independently (X , Z , θ_x , θ_z) whilst maintaining the bend
- High precision, reliable bending
- Completely UHV-compatible mechanism
- Flexible customisation of the design to use different materials, shape and size of mirror and the direction of the beam
- Water or LN2 cooling systems
- KB systems with fixed or bendable mirrors

Cooling System

Mirrors can be fitted with either water or liquid nitrogen cooling systems for high heat load situations.

Latest developments have allowed for temperatures to be controlled very precisely at a set point. This increases the precision of the mirror system as temperature fluctuations are reduced to a minimum.

Cryogenic cooling is achieved by end-cooling of the mirror. This is the only practical way to apply cryo-cooling without seriously affecting the figure of the mirror.

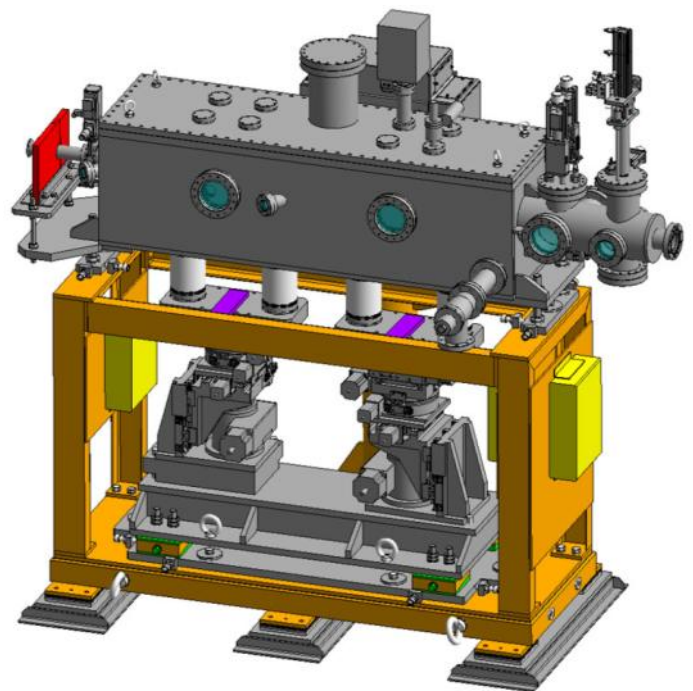


Mirror bender system utilising single actuator bender design for cylindrical bending. Twin activator benders can be used to generate elliptical mirror shapes.

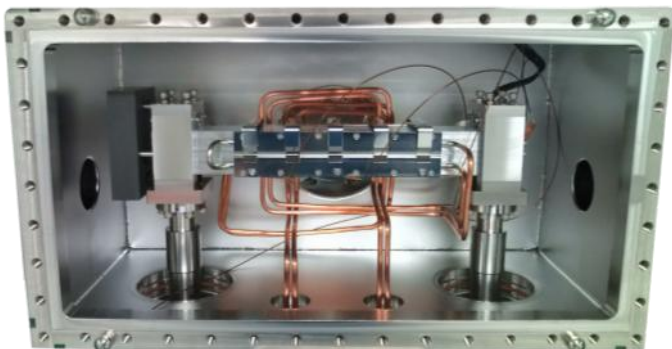
Bending System

Toyama's FMP-1000A bending system is based on a 4-point bending scheme. The high precision bender pivot points are linked by torsion bars to a high resolution linear drive mechanism which applies the bending force.

Single torsion bars allow for cylindrical bending; separating the two pivot points, and using two sets of torsion bars allows elliptical bends to be introduced.



3D model of a twin mirror system delivered to the BOREAS beamline at ALBA, Barcelona



Mirror chamber with liquid nitrogen cooling system delivered to SPring-8. Cooling is applied at the ends of the mirror

Specifications

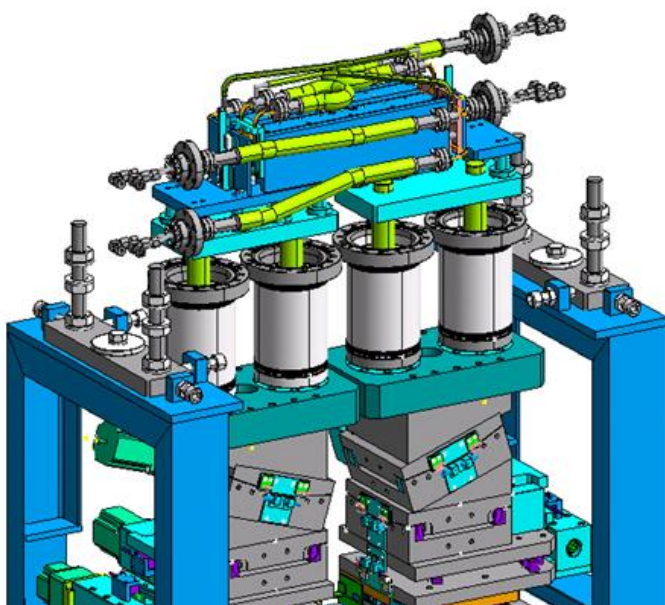
Every mirror system is individually designed to fit the requirements of the beamline. Toyama has a wide range of standard designs for mirror manipulation systems that can easily be customised to meet specific requirements.

We work with the beamline scientists to optimise and confirm the optics layout and to calculate the predicted optical performance of the mirror system. Every new system design will be modelled and subjected to finite element analysis in order to optimise stability and minimise unwanted vibrations. Thermal modelling can also be used to optimise the cooling arrangement, if required.

Typical specifications for a mirror system at SPring-8 are:

Adjustable range of chamber	X ± 15 mm, Y ± 15 mm, Z ± 25 mm
Adjustable range of mirror system mount	X ± 15 mm, Y ± 15 mm, Z ± 6 mm + shim 18mm
Adjustable range of mirror system (translation Y)	Max movement ± 30 mm Min resolution 0.4 μ m/pulse
Adjustable range of mirror system (horizontal Z)	Max movement ± 30 mm Min resolution 0.2 μ m/pulse
Adjustable range of angle θ_x	$\pm 1.2^\circ$ by displacement of Z1, Z2 axes
Adjustable range of angle θ_z	$\pm 1.2^\circ$ by displacement of X1, X2 axes
Vacuum Performance	$< 1 \times 10^{-8}$ Pa
Leak rate	$\leq 1.33 \times 10^{-11}$ Pa m ³ /sec

Bending System				
Radius of Curvature Km	100	80	70	60
Sag μ m	1.01	1.27	1.45	1.69
Axial displacement of bend mm	2.1826	2.7285	3.1180	3.6380



3D model of twin cooled mirror system for VESPERS beamline delivered to the Canadian Light Source

KB Mirror Systems

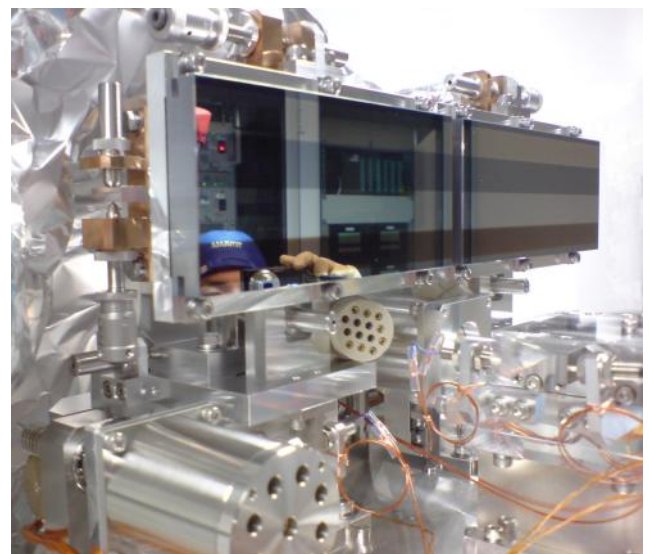
The KB Mirror chamber is designed to hold a Kirkpatrick-Baez mirror pair for focusing the beam to very small spot sizes. The mirrors are mounted one vertical and one horizontal to allow focusing of the beam in both axes.



Toyama's KB systems can accommodate fixed radius or bendable mirror designs. Careful design of the supporting mechanisms ensures optimum position and vibration stability. Standard designs can be customised to accommodate large (1000mm+) mirror and bender mechanisms.

Harmonic Rejection Mirror System

Harmonic rejection mirrors are required to improve the spectral quality of the monochromated beam for many experiments. Toyama can supply harmonic rejection mirror systems based on 1, 2 or 3 reflection geometries.



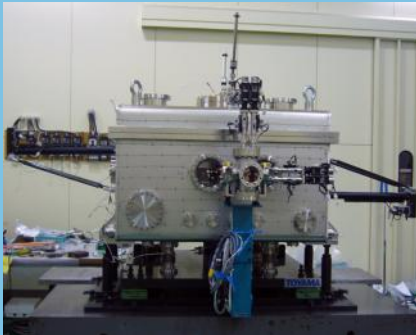
A harmonic rejection mirror system during installation, showing the stripes of different coatings on the mirror surfaces (third mirror removed). Delivered to the Metrologie beamline at Soleil

Other areas of Toyama expertise

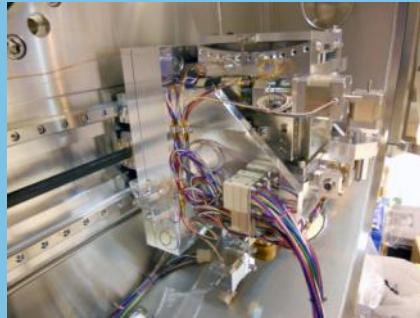
Synchrotron Applications

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

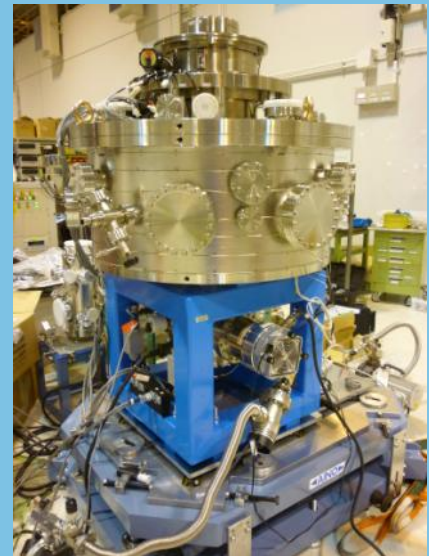
- Soft X-ray Monochromators
- Hard X-ray Monochromators
- Slits
- High heat load front ends
- Beam Monitors
- End stations such as Ellipsometers, Reflectometers and Diffractometers



Soft X-ray VLSPGM



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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