Cryogenic mirror for a-high-heat-load X-ray beamline at SPring-8

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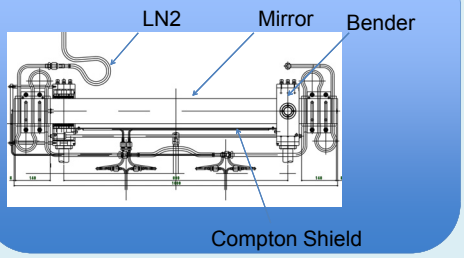
Introduction

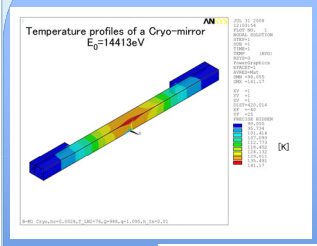
A liquid-nitrogen-cooled (LN) X-ray mirror has been designed and built for the high power loads of a 15m in-vacuum undulator beamline of the SPring-8. It is designed to operate for beam energy of 14 to 25 keV and is vertically deflecting. It was designed as the first mirror to reduce the heat load of the first crystal of DCM. The maximum beam power load to the mirror was estimated to be a max 1.8 kW, and 1 kW absorbed (0.3 kW scattered).

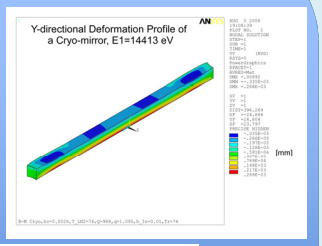
Cryogenic mirror design

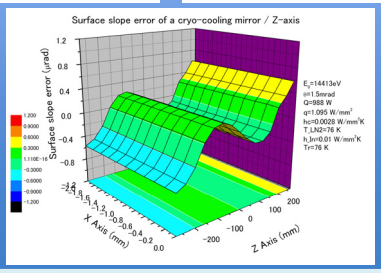
LN2 cooling holder & bender



FEA simulation/half model

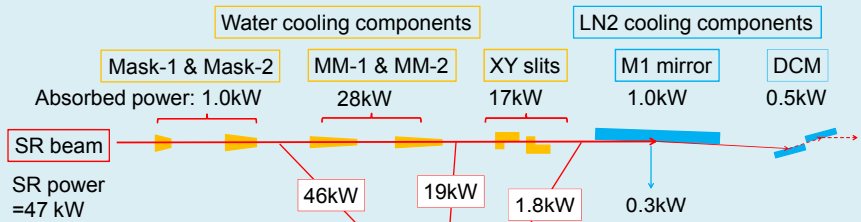






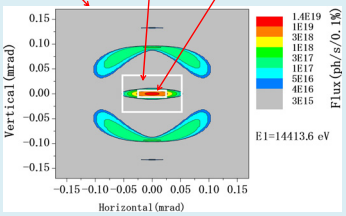
Heat load management

The heat load of the monochromator crystal is reduce to 0.5 kW, which is the design heat load of the standard SPring-8 DCM. The design heat load of 0.5kW is achieved by aperture defining components and mirror, which are illustrated below.



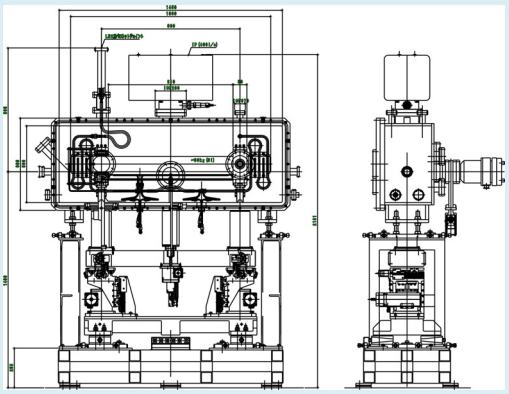
Source parameter
Period=20mm
Kmax= 1.4

SR Max. power
=57 kW



Flux density (ph/s/0.1%)

SPring-8 BL43LXU Cryogenic mirror



Toyama fabricated and installed two another cryogenic mirrors without bender in the SPring-8 beamlines.

At maximum power load, the foot print on the mirror is 367mm in length in 2.46 mm in width at a grazing incidence angle of 1.5 mrad.
The absorbed power is 988 W and the average power density is 1.1 W/mm2.
The active area is 800mm x 20 mm and the total length is 1300 mm. This mirror is indirectly cooled by circulating liquid nitrogen and provided with mechanical bender. The bender mechanism is used for gravity force compensation mechanism and it is also used to collimate the beam. The mirror system was installed at a beamline of BL43LXU (http://user.spring8.or.jp/sp8info/?p=3138) of SPring-8 in 2011.