Polyimide Film Window Installed to Defend a SR Beam Line for Radioactive Materials from an Accidental Vacuum-break

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The beamline for radioactive (RI) materials sciences in SPring-8 should be protected from the RI pollution as well as vacuum-break. In the energy region around 2 keV, conventional Be windows can not be used because of large attenuation. We developed a new window of polyimide film (PIFW) to defend the vacuum apparatus from the RI contamination due to an accidental vacuum-break.

The window assembly is shown in Fig 1. A sheet of polyimide film of 7.9 μm thickness was attached w ith epoxy-resin to a stainless steel flange with an aperture of 10 mm (H)×40 mm (W). A stainless steel mesh of 20 mm (wire diameter) and 70 mm (inter-wire distance) supports the film on the upstream side. For use adopted is the window assembly which withstood static pressure over 2×10^5 Pa at off-line tests. The transmittance of the beams through the film was measured to be more than 0.6 in the energy region over 2 keV.

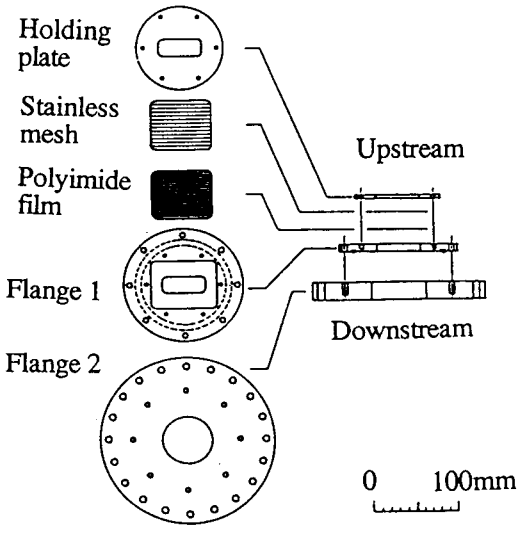

Fig. 1. Mechanical assembly of the polyimide window.

Endurance tests of the PIFW were carried out on the actual SR beamline, BL-27, at the Photon Factory. On taking off a blank-off flange (φ25mm) at the downstream terminal of the beamline, the pressure change was measured at 100 mm upstream of the PIFW with a cold cathode-gauge as shown in Fig. 2. No breakage was observed, although the pressure was detected to increase. The volume of the accumulated air in the chambers was $4.0\times10\text{-}^5$ Pa•m^3, which was calculated from a product of the pressure change and the total volume of vacuum chambers and ducts. This very slow leak of air is thought to as air percolation through the polyimide film and/or the epoxy-resin, but not as pinholes or micro-breakage.

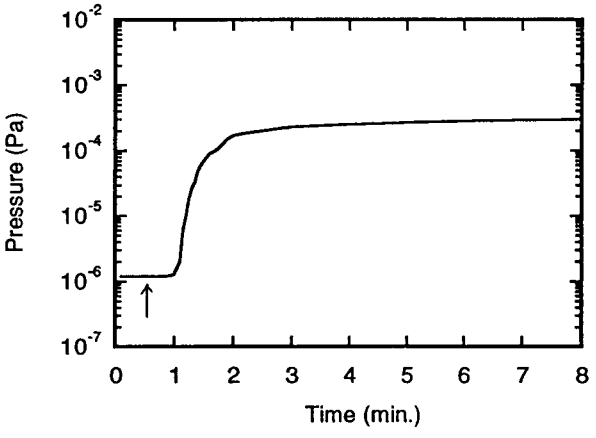

Fig. 2. Pressure change at 100 mm upstream of the polyimide window. The arrow shows the time when the blank-off flange was taken off.

The result indicates that the PIFW can endure the shock wave caused by an accidental vacuum-break. We are planning to simulate the mechanism of transportation of the RI sample materials through the PIFW accompanying the percolating air.