Installation of a prototype of focusing-type small-angle neutron scattering instrument with an ellipsoidal supermirror

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SANS is a very powerful and popular technique to study nano-scale structure in matters. Every neutron facilities all over the world have at least one or two such instruments, but very often, they are oversubscribed and not so easy to obtained machine time on these machines. We, therefore, decided to develop a prototype sans instrument, that is compact and low cost, hence can be easily installed at any neutron beam line.

Using a compact ellipsoidal mirror as a focusing device and high positional-resolution detectors, which have been developed in the last decade, we can now construct very compact and versatile focusing-type SANS instruments. We are now developing such instruments, and named it "Mini-focusing small-angle neutron scattering instrument (mfSANS)".

At first, we have conducted mock-up test experiments of a time-of-flight type mfSANS at a small pulsed cold-neutron source facility at Hokkaido University. The results looked very promising: from the preliminary results showed that we could measure minimum momentum transfer Q of the order of 2 $\times$ 10-2 nm-1 if the sample is a strong scatterer.

We have just finished a first phase construction of another prototype mfSANS instrument at the JRR-3 reactor at C1-3 position in October as shown in the figure. We put a new monochromator at just downstream of the ULS (ultra low-angle scattering) instrument in the same monochromator shielding. The total length of the instrument, from the monochromator to the detector, is only about 2.8 m. It is installed not horizontally, but installed above the beamline at the angle of 135 ° (45 °) from the horizontal line. Aperture size of 1 to 10 mm can be selected remotely. A focusing mirror of 900 mm in length was used, that has a curved surface of a part of an ellipsoid of 2.5 m major and 20 mm minor axes, coated with 2.5 Qc supermirror. It is divided into three parts, each with 300 mm in length. Sample position is just after the mirror. A detector of 5 inch effective diameter that consists of a resistive-wire type photomultiplier with a ZnS scintillation plate is used. The position resolution of it is less than 1 mm.

Several very preliminary data were obtained with the instrument. Unfortunately, slight miss-alignments in the focusing mirrors were found. Even though, the miss-alignments were not so large, the direct beam focusing position was displaced by about 300 mm and it was blurred by almost a factor of 2. Even with such a geometry, we could measure fairly good small-angle scattering patterns and minimum Q of about 0.05 nm-1 using 2 mm aperture. Because of the long shutdown of the JRR-3 reactor, we will resume commissioning from July, 2008.

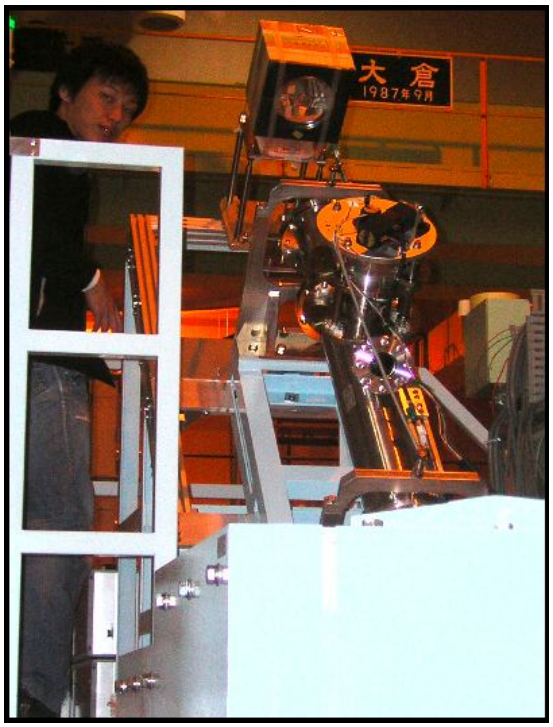

Fig. 1. Mini-focusing small-angle neutron scattering instrument (mfSANS) just installed above the ULS monochromator shielding.