Development of a neutron focusing device with an ellipsoidal supermirror

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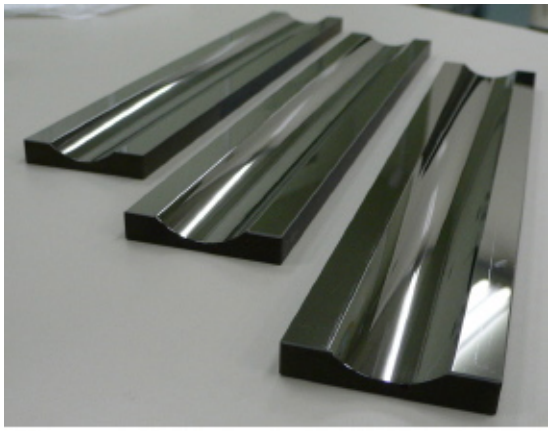
We are developing an ellipsoidal focusing mirror. An ellipsoidal surface mirror can guide neutrons those leave a small area to another small area. That kind of mirrors works as a neutron focusing device and makes it possible to build an experimental setup of high-resolution focusing small-angle neutron scattering (focusing-SANS). When higher Qc supermirror will be deposited on the ellipsoidal surface of the mirror, the two of small area where neutrons leave or arrive at approach nearer without reducing the amount of neutrons to be focused. That means the focusing-SANS system becomes compact by high-Qc supermirrors.

The original ellipsoid of the curved surface shaped on the substrate had the distance of 4000mm between two focal points on the major-axis and the semi-minor axis was 20mm. Some part of the original ellipsoid was ground on the borosilicate glass of 900mm × 50mm × 9mm by the Electrolytic In-process Dressing (ELID) method. Here, the length of 900mm was achieved by three pieces of 300mm substrates.

Figure 1 (top) shows three pieces of an ellipsoidal focusing mirror coated by Ni monolayer. The Ni monolayer of 2000Å in thickness was successfully deposited on the ellipsoidal surface, while 2Qc Ni/Ti supermirror of 13400Å was peeled off the curved surface. The reason of the peeling off seems to be due to using the detergent and scouring powder and insufficient washing by water and alcohol. The 2Qc supermirror was successfully deposited on the flat surface of the borosilicate glass cleaned by one-hour supersonic washing in the hot water. This cleaning method will be applied to the substrate with the curved surface ground by ELID method. We are also trying to uniform the layer thickness of supermirror all over the curved surface, because an excess of layer thickness increases the stress in the layers and results in peeling the layer off the substrate.

Figure 1 (bottom) shows the reflectivity of 2Qc supermirror deposited on Si substrate with the flat surface. The same amount of reflectivity will be realized on the 2Qc supermirror successfully deposited on the curved surface.



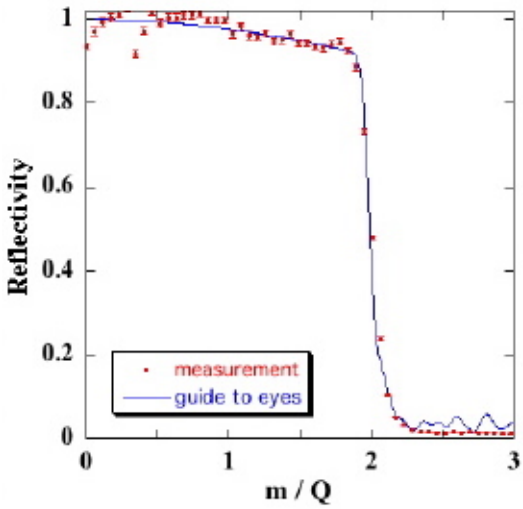


Fig. 1. An ellipsoidal focusing mirror coated by Ni monolayer (top), the reflectivity of 2Qc supermirror deposited on Si substrate with the flat surface (bottom).