Ultra-precision Fabrication Process for Neutron Focusing Device

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High-performance proton accelerator facilities, such as J-PARC in Japan, ISIS-TS2 in UK, and SNS in USA, are operated for various neutron applied measurement. Even in these latest powerful neutron sources, high-performance neutron focusing devices are required to realize practical measurements because neutron intensity is very low compared with that of X-ray in synchrotron orbital radiation facilities. To meet the requirement, we have been developed fabrication process to make neutron focusing devises, which combines the figuring technique utilizing wet chemical etching and an ion beam sputter deposition technique. This fabrication process enabled us to make 400 mm-long elliptical neutron focusing supermirror with a focusing gain of greater than 50 and 1-dimensional focusing width of 0.128 mm [1], and also to make high-precision thin elliptical supermirror substrate with a thickness of 1.5 mm for multiple neutron focusing device [2].

We have been developed numerically controlled plasma chemical vaporization machining (NC-PCVM) technique, which is utilizing atmospheric-pressure plasma, to fabricate aspherical mirror shape with a form accuracy of sub-micrometer order on a synthesized quartz glass substrate [3]. Furthermore, numerically controlled electrochemical machining (NC-ECM) technique to make mirror shape efficiently on a low-cost metal substrate is under developing [4]. These two techniques are very promising for cost effective fabrication process of neutron focusing devises because these are harmless and highly-efficient compare to our previous wet etching fabrication process utilizing hydrofluoric acid. In my talk, recent achievements on fabrication of elliptical neutron focusing mirror substrate will be introduced.

References

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