

Hard X-ray mirrors by multilayer replication: developments and application

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In order to extend the energy range of hard X-rays to handle, multilayer coatings have been introduced in many fields. For astrophysical observations, we have developed Pt/C multilayer, with graded density d-spacing, so called “Super mirrors”, which covers broad energy band up to 60 keV. Here broad band is essential, because line energies are sometimes red-shifted by Cosmological expansion of the Universe.

Another key element of mirrors of X-ray telescopes is high throughput to collect as many photons as possible within severe weight budget of the payload to be onboard a satellite. Since the incident angle of X-ray reflection ranges below 1 degree and should be smaller for higher energies. Therefore mirror substrate has to be much thinner than the pitch of the nested mirror shells, that is about 1 mm. It is impossible to polish such thin mirrors and then we introduced replica mirrors from mandrels of extremely smooth surfaces. On the mandrel, usually gold layer had been deposited as a separation agent. In these days, multilayers deposited on glass mandrel can be copied on thin substrate of 0.1-0.2 mm thick.

The combination of replication technique and multilayer coating allow us various possibility of application, such as hard X-ray microscopes. Though it might be almost impossible to deposit multilayers on the inner surfaces of narrow cones of microscopes, it is rather easier to deposit them on outer mandrel and then to replicate them on the substrate. There might be some technical issues to be solved but seems promising to enhance hard X-ray response of microscopes. In this paper, we intend to present current status of the hard X-ray multilayer replica mirrors being developed in our group and to exchange knowledge and requirements with expert of microscopes.