High Confidence Mo/Si Multilayer Deposition for the Transmission X-Ray Multilayer Mirror Microscope TXM^3

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We have developed multilayer imaging mirrors for a transmission X-ray multilayer mirror microscope (TXM^3) equipped with an LPP light source. The optics of TXM^3 is composed of four spherical multilayer mirrors, two for the Schwarzschild optics, and the other for illuminator optics. The throughput depends on a single multilayer reflectivity and reflection wavelength matching of the four multilayers. We have reported about our IBS deposition system with a moving deposition shutter (MDS) to control the period thickness distribution, as well as the deposition rate stabilization technique [1]. In this paper, we report the results of Mo/Si multilayer deposition on the four mirrors.

Figure 1(a) shows the period-thickness distributions of the spherical substrates used for TXM^3. The dash-dot curves show the distributions without MDS control. Solid curves show those determined by the optical design, which should be targets of MDS control. In particular, the convex mirror (#1) in Schwarzschild optics requires a steep gradient. Figure 1(b) shows the period-thickness distribution of the deposited Mo/Si multilayer, which were measured by a reflectometer at Photon Factory BL-12A. The vertical axis is the period thickness difference from the design. All the errors were well controlled within ±0.6% that indicates the total throughput should be no less than 86% of the perfectly matched multilayers. The matching accuracy of #2-#4 is ±0.2%, enough to be applied to shorter wavelength multilayers such as carbon- and water-windows multilayers.

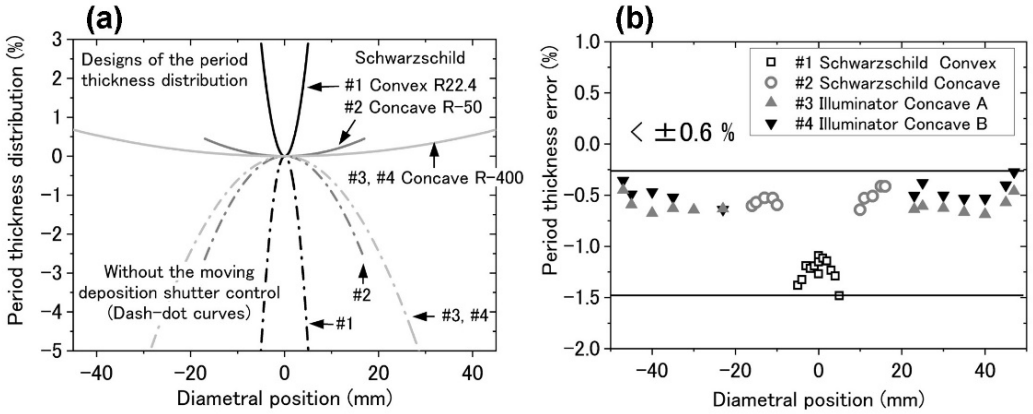

Figure 1. Period thickness distributions of (a) the design (solid curves) and those without the MDS control (dash-dot curves), and (b) experimental result of the four Mo/Si multilayer mirrors of TXM^3.

References

[1] T. Hatano, H. Umetsu and M. Yamamoto, JSPE Publication Series, **3** (1999) 292.