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 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 ion beam sputtering deposition system with a moving deposition shutter (MDS) to control the period thickness distribution, as well as the deposition rate stabilization technique [1-5]. In this paper, we report the results of Mo/Si multilayer deposition on the four mirrors.

Figure 1 shows period thickness distributions on the spherical substrates used for TXM^3. The vertical axis is the period thickness difference from the value at the center. Dash-dot curves show the distributions without the MDS control. Solid curves show those determined by the optical design, which should be targets of the MDS control. Especially, the convex mirror (#1) of the Schwarzschild optics needs steep gradient.

Figure 2 shows the result of the Mo/Si multilayer depositions measured at-wavelength normal incidence reflectometry using synchrotron radiation. The vertical axis is the period thickness difference from the design. All the errors are controlled within ±0.6% that implies 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. Improvement of deposition technique on convex substrates is needed in this region.

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Reference:

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[2] T. Hatano, *et al.*, PXRMS **5** (2001) 5.6. [3] T. Hatano, *et al.*, PXRMS **6** (2003) 24.
[4] Y. Adachi, *et al.*, PXRMS **7** (2005) P2-17. [5] T. Harada, *et al.*, PXRMS **8** (2007) P25, P26.

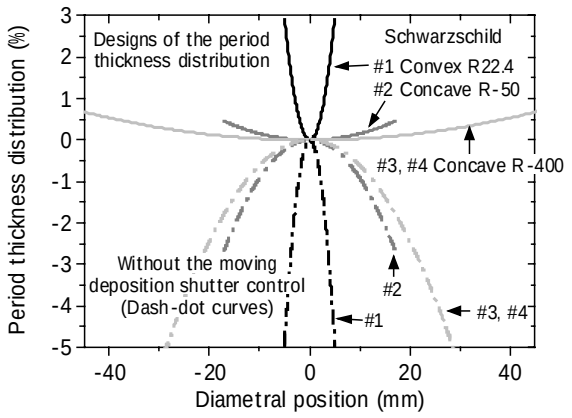

Figure 1: Period thickness distributions of the design (solid curves) and those without the MDS control (dash-dot curves) on the #1 – #4 mirrors of the TXM^3.

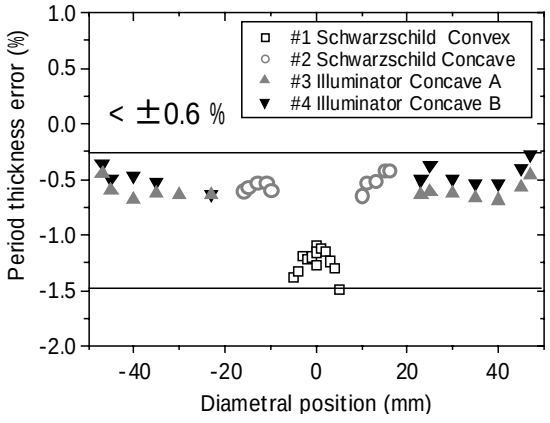

Figure 2: The period thickness distributions of the four Mo/Si multilayer mirrors.