Deposition and In Situ Reflectance Measurements of Y/Mo XUV Multilayer Mirrors

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Preliminary studies of new material pairs for XUV multilayer mirrors have shown that Y/Mo multilayers can theoretically have high reflectances in the 8 to 15 nm wavelength region with reflectances between 25 and 35% being achieved around l=11.5 nm.[1,2] These results were nearly a factor of two lower than expected even after taking into account the interface roughness estimated from the low-angle XRD studies. Possible explanations for these apparently low XUV reflectances include contamination during deposition or oxidation of the surface layers prior to measurement. Alternatively, the theoretical reflectance could have been overestimated if the optical constants derived from atomic scattering factors were not accurate because the assumed film density was incorrect.

To distinguish between the above different possible causes of the lower than expected XUV reflectances, Y/Mo multilayer mirrors were fabricated using a newly constructed UHV deposition/reflectometer system. This system can be attached directly to a synchrotron beamline and multilayer samples can be characterized directly after deposition and before exposure to ambient air. With this system, we were able to confirm that both layer contamination during deposition and surface oxidation after deposition were responsible for the lower than expected reflectances. The best Y/Mo multilayers were fabricated with base pressures below the 10-8 Torr range and had in situ near- normal incidence reflectances of 46%, 35% and 21% at wavelengths of 11.4, 9.7 and 7.9 nm, respectively. After several days of exposure to ambient air these samples typically had a relative reflectance loss of ~10% as a result of the Mo surface layer oxidizing.[3]

In this presentation, the construction of the deposition/reflectometer system and the optimization of the deposition parameters of the Y/Mo multilayer mirrors will be described along with the in situ reflectance measurements.

1. C. Montcalm, P. Kearney, J.M. Slaughter, B.T. Sullivan, M. Chaker, H. Pepin, and C.M. Falco, Survey of Ti-, B- and Y-based soft x-ray/extreme ultraviolet multilayer mirrors for the 2 to 12 nm wavelength region, submitted to Appl. Opt., November 1996.

2. C. Montcalm, B.T. Sullivan, M. Ranger, J.M. Slaughter, P.A. Kearney, C.M. Falco, and M. Chaker, Mo/Y multilayer mirrors for the 8-12-nm wavelength region, Opt. Lett. 19, 1173-1175 (1994).

3. C. Montcalm, B.T. Sullivan, S. Duguay, M. Ranger, W. Steffens, H. Pepin, and M. Chaker, In-situ reflectances measurements of soft x-ray/extreme- ultraviolet Mo/Y multilayer mirrors, Opt. Let. 20, 1450-1452 (1995).