Multilayer Gratings for the Extreme Ultraviolet Region: Experimental Measurements and Computational Modeling

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ABSTRACT

The efficiencies of diffraction gratings with Mo/Si multilayer coatings were measured using synchrotron radiation and were compared to computational modeling. Initial validation of the computer code was performed by comparing the measured and calculated efficiencies of a 2400 groove/mm master grating and a replica grating in the 100-350 Å wavelength range. As a result of the replication process, the replica grating had an aluminum surface with an oxide layer. An additional thin SiO_2 coating was applied to the oxidized aluminum surface for the purpose of reducing the microroughness. The efficiency of the replica grating as a function of wavelength had an oscillatory behavior that resulted from a thin-film interference effect associated with the SiO_2 coating. The measured efficiencies were compared to the efficiencies calculated by a computer program, running on a desktop PC computer, that is based on the modified integral approach (Leonid I. Goray, International Intellectual Group Inc., 2070 Five Mile Road, P. O. Box 335, Penfield NY 14526 USA). The calculation accounts for the groove profile as determined from atomic force microscopy (AFM), the optical properties of the grating surface and the layers, and the polarization of the incident radiation. The measured and calculated efficiencies were in good overall agreement. Using the same computer code, the efficiencies of Mo/Si multilayer coated gratings were calculated and compared to the experimental efficiencies for the cases of near normal incidence angles, for angles 30-40^o from normal, and for S and P polarized incident radiation.