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Highly efficient SiC/Mo/Al multilayer gratings for EUV applications

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Multilayer interference coatings can be used to improve the efficiency of reflective diffraction grating in the soft x-ray [1-2] and in the extreme-ultraviolet (EUV) [3] spectral domains. By matching multilayer Bragg interference and grating diffraction conditions, one can achieve high spectral resolution ($\lambda/\Delta\lambda > 1000$) with efficiencies similar to the one of the multilayer coating. Such multilayer gratings are of particular interest to develop high efficiency and high resolution EUV spectro-imager instruments.

In this work, we optimized and studied SiC/Mo/Al periodic multilayer on fused silica gratings with trapezoidal shape in order to reach a maximum 1st order efficiency at wavelengths ranging from 25 nm to 29 nm, a region of particular interest for solar corona spectro-imaging. Multilayers with a different number of periods have been deposited by magnetron sputtering on 3600l/mm grating substrates.

All grating samples have been characterized by Atomic Force Microscopy (AFM) to determine the initial profile before deposition and the change of profile after deposition. We have also characterized the grating samples before and after deposition by using grazing incidence x-ray reflectometry at 8.05 keV to get further information on grating and multilayer structural parameters.

Moreover, the 0 and 1st order efficiencies of the multilayer grating have been measured by monochromatic synchrotron radiation on the XUV Metrology beamline at Soleil synchrotron. The results are in good agreement with the simulations made with a homemade Matlab code based on Rigorous coupled-wave Analysis (RCWA) and using structural parameters determined by AFM. The measured first-order efficiency reaches a maximum of about 9.3% at λ=27 nm, which exceeds previously published results by Seely *et al*. [3].

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