Mo/Si-multilayers for EUV applications prepared by Pulsed Laser Deposition (PLD)

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In the past the successful application of PLD for X-ray multilayer synthesis has already been demonstrated for C-spacer systems. Recently the method has been tested also for Mo/Si layer stacks. An UHV-coating machine has been used to prepare X-ray mirrors on 4“ substrates. The ablation of both, Mo and Si targets, was carried out by Nd:YAG laser radiation using the third harmonic (λ=355nm) with a pulse energy E_P= 550mJ and a pulse width τ=4...6ns. Multilayers of 10...50 periods have been synthesized.

SX-measurements in the EUV-range at near normal incidence show reflectivities R_s of typically 60%. From HR-TEM a high stack regularity and minimum interface roughness can be deduced. In contrast to conventional technologies (coating by sputtering or e^--beam evaporation) the formation of a $MoSi_x$-interface layer happens only for deposition of Mo on Si. Extremely sharp interface transitions from one individual layer to the other are observed and the total period is represented by a three-layer system. From TEM results a structure model for PLD-prepared Mo/Si-multilayers has been deduced. The optical parameters of the layers were adapted by reflectivity curve fitting, so that the measurements in the EUV-range can be explained. Using this model predictions of the ratio of the number of atoms N_{Si}/N_{Mo} for the total stack were made and are in good agreement with results of RBS measurements.

The use of the multilayers as X-ray optics requires an excellent homogeneity of the layer thickness across the entire mirror. It can be shown, that the PLD technique is able to realize film uniformities with a standard deviation of the period thickness of less then 0.5%. This was confirmed by Cu-K_α-reflectometry and by near normal incidence measurements in the EUV range on 4“ samples.