Al-based multilayers for space applications in EUV

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Extreme ultra-violet (EUV) is the range of increasing interest for various applications, such as synchrotron radiation, high-order harmonic generation and, particularly, space research running an analysis of numerous emission lines of the solar plasma. In the choice of reflecting coatings for the wavelengths range between 15 and 40 nm, the preference is often given to Mo/Si multilayers as the most technologically advanced. In principle, other material combinations would provide a higher reflectance and, sometimes, a narrower bandwidth.

We will report here on the development of multilayers made with the use of aluminum as a low absorbing material beyond 17 nm. We will discuss the optical performance of Al-based multilayers with regard to promising reflectivity and selectivity characteristics and the problems of stability and large interfacial roughness [1]. We will present and compare the results obtained with two- and three-component Al-based multilayer mirrors designed for use at three wavelengths: 17.1, 19.5 and 30.4 nm corresponding to emission lines of Fe IX-X, Fe XI-XII and He II.

A certain improvement of the optical performance of the two-component multilayers was achieved via optimization of the deposition process. We will demonstrate a further possibility to reduce the average roughness by introducing a third material into the multilayer structure rather than depositing a buffer layer at each interface [2]. The idea is twofold since a correct choice of additional material would also provide for a higher theoretical peak reflectance. According to the EUV reflectivity simulations, we have selected refractory metals W or Mo as a high absorbing material to introduce in the multilayer structure along with Al and SiC or B_4C. The order of deposition, layer thicknesses and the number of periods were optimized for maximum theoretical reflectance of the three-component multilayers in the wavelength range from 15 to 40 nm. The multilayer mirrors Al/W/SiC, Al/Mo/SiC and Al/Mo/B_4C of various periods have been fabricated and tested. The EUV and X-ray reflectivity measurements confirm significantly improved performance and rather good stability of optical characteristics of these new systems compared with the two-component Al-base multilayers of the same period.

References

[1] D. Windt and J. Bellotti: Appl. Opt. **48**, 4932 (2009)

[2] E. Meltchakov, C. Hecquet, M. Roulliay, S. De Rossi, Y. Menesguen, A. Jérome, F. Bridou, F. Varniere, M.-F. Ravet-Krill and F. Delmotte: Appl. Phys. A. DOI 10.1007/s00339-009-5445-2 (2009)

The work was supported by French space agency *CNES* (*Centre National d'Études Spatiales*).