In-depth and surface characterization of Al/Mo/SiC multilayers

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We present the characterization of Al/Mo/SiC periodic multilayers, designed for optics applications in the extreme ultra-violet range (EUV). With respect to the Al/SiC system, the addition of a thin Mo layer at the SiC-on-Al interfaces decreases the roughness at both SiC-on-Al and Al-on-SiC interfaces. The reflectivity measurements performed near normal incidence with synchrotron radiation around 17 nm prove that the introduction of the Mo layers leads to reflectance values higher than 50% [1]. Time-of-flight secondary ion mass spectrometry (ToF-SIMS) and the x-ray photoelectron spectroscopy (XPS) measurements are performed to analyze the buried layers and the superficial zone of Al/Mo/SiC system.

The ToF-SIMS has already been successfully applied to the study of periodic Al/SiC multilayers [2]. The results obtained on the Al/Mo/SiC system clearly give evidence of the succession of the various layers and show that the Mo atoms are present at both Al-on-SiC and SiC-on-Al interfaces. This explains why roughness decreases at all the interfaces while the Mo atoms are added at only one interface. The combination of the SIMS and XPS results show that the first SiC layer is partially oxidized, but the oxygen atoms do not reach to first Mo and Al layers. An equivalent SiO_2 layer, 1.6 nm-thick, is revealed at the top of the multilayer. It explains the difference obtained between the optics simulation and the EUV reflectivity measurements.

[1] E. Meltchakov, C. Hecquet, M. Rouillay, S. de Rossi, Y. Menesguen, A. Jérome, F. Bridou, F. vernière, M.-F. Ravet-Krill, F. Delmotte, Appl. Phys. A**98**, 111 (2010)
[2] P. Jonnard, K. Le Guen, M.-H. Hu, J.-M. André, E. Meltchakov, C. Hecquet, F. Delmotte, A. Galtayries, Proc. SPIE **7360**, 7360O (2009)

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