EFFECT OF TIN BOMBARDMENT AND DEPOSITION ON COLLECTOR MIRROR REFLECTIVITY IN DPP EUV SOURCES

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The effect of Sn exposure on Extreme Ultraviolet (EUV) reflective properties of candidate mirror materials is a critical issue for the commercial development of EUV lithography. Studies have been carried out at the Interaction of Materials with Particles And Components Testing (IMPACT), a facility dedicated to the study of interactions of materials with energetic ions. Equipped with multiple *in-situ* diagnostics for interrogating the surface, information can be obtained from the sample being treated in real time, capturing dynamic effects that can not be observed with *ex-situ* measurements. The effect of Xe bombardment on the EUV reflectivity response of both single layer and multilayer mirrors has been studied in this facility [1, 2], giving important insights regarding optics lifetime during EUV source operation. Two types of Sn exposures were performed in IMPACT: exposure to a thermal source and to an energetic source. The thermal source simulates the effect expected due to vapor condensation, while the energetic source simulates bombardment due to energetic ions coming from the pinch. The results obtained for the case of deposited Sn have confirmed previous knowledge about the behavior of EUV optics with Sn overlayers, which lead to a significant reflectivity loss. The case of energetic Sn bombardment has not been studied extensively. It is inherently different from Xe bombardment, since Sn can be assimilated by the sample, while Xe simply escapes provided the fluence is low. Mirrors subject to bombardment at different energies and angles show a saturation effect, also predicted by dynamic Monte Carlo computer simulations of the implantation. This saturation is a consequence of both Sn-induced mixing and sputtering. In-situ surface diagnostics include low-energy ion scattering spectroscopy (LEISS) and X-ray photoelectron spectroscopy (XPS) conducted in real time during Sn-ion irradiation. In addition, a new in-situ EUV real-time reflectometer that uses a Si target-based photon source at 15 degrees incident with respect to the mirror surface has been installed in IMPACT. Ex-situ diagnosis includes: X-ray reflectivity, electron microscopy and atomic force microscopy.

1. B. Heuser, J. P. Allain et al. *Nuc. Inst. Meth. Phys. Res. B,* **242**, p. 520 (2006).

2. M. Nieto, J. P. Allain, submitted for publication.