Experimental studies of the propagation of programmed buried defects into multilayer coatings

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Optics in the range of extreme ultraviolet (EUV, 5-100 nm) require advanced ultra-thin film multilayer mirrors. These multilayer systems ensure a high transmission/reflection efficiency. Surface roughness can reduce this efficiency. Furthermore, for imaging purposes, besides efficiency low defectivity is important. During fabrication of the mirror substrates and handling of the mirror blanks, scratches in the substrates and particles contamination can occur. Those defects will imprint into the multilayer, deform it locally and reduce the imaging power of the optical component. Our research work is focused on fabrication and inspection of particles buried under a multilayer structure. Those multilayer structures are commonly used in EUV lithography and space instruments optics.

The aim of the research is fabrication of buried defects, namely bumps and pits, with varied size and investigation of the deposition of multilayers to reduce the deformation of the defect onto the multilayer stack. Fabrication of defect arrays is done in Helmholtz Nanofacility, Forschungszentrum Jülich. The degree of the smoothing by a dedicated layer or multilayer system is determined with atomic force microscope, scanning electron microscope, white light interferometer and cross-section transmission electron microscopy. Variation of deposition parameters and deposition thickness allows smoothing of the small defects without loss of EUV reflectivity. The results may enable decreasing fabrication and handling efforts and therefore, reduction of the optics costs.

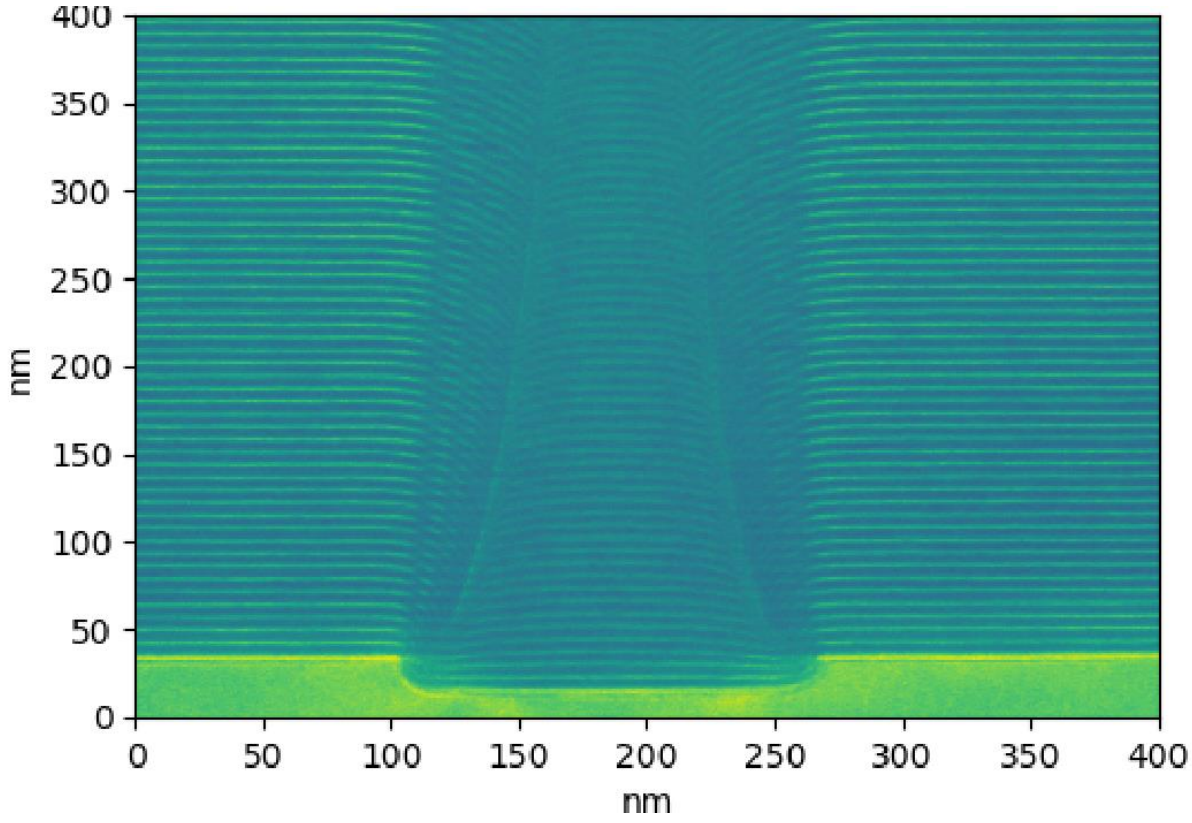

Fig. STEM image, 144 Si/Mo multilayer on top of 250 nm pit.