A-periodic multilayers for EUV lithography

Michele Suman,[1,2] Maria-Guglielmina Pelizzo,[2] Piergiorgio Nicolosi,[1,2] G.Monaco[1,2] and David L. Windt[3]

[1]*Information Engineering Department, University of Padova, via Gradenigo 6B, Padova, 35131 Italy*
[2]*National Research Council- National Institute for the Physics of the Matter, LUXOR Laboratory, via Gradenigo 6B, Padova, 35131 Italy*
[3]*Reflective X-ray Optics LLC, 1361 Amsterdam Ave., Suite 3B, New York, NY 10027, USA*

High normal incidence reflectivity in the EUV and soft X-ray spectral range can be obtained only with multilayer structures designed so that the electric field components reflected at the various interfaces add in phase.
The multilayer structures used for EUV lithography (EUVL) typically consist of alternating layers of molybdenum (Mo) and amorphous silicon (a-Si). High reflectivity is crucial for photolithographic applications, since the throughput of the system depends critically on the intensity of the radiation beam used to project the image of a mask on the photo-resist-coated wafer.
We have designed and developed novel a-periodic multilayers, covered by capping layers that can offer superior performances both in term of flux and life-time [1]. We have designed these coatings using an optimization procedure based on an innovative algorithm. We show that the integrated intensity can be increased up to 2.18 times with respect to that one obtainable with standard periodic multilayers (see Fig. 1). The a-periodic structures are designed in order to have low EUV energy absorption in the top-most layers; this property makes them especially insensitive to both the choice of capping layer material, and to possible capping layer degradation. We have produced prototype capped a-periodic coatings and measured their performances.

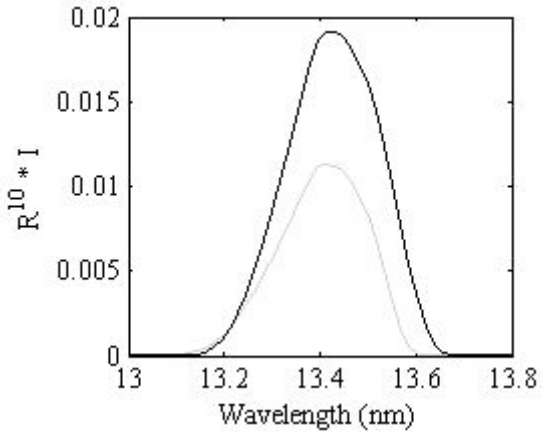

Fig. 1. Integrated intensity after ten reflections of Sn laser plasma spectrum; in black line, aperiodic multilayer; in gray line, periodic standard multilayer; both structures have a RuO2/Mo capping layer.

References

1. S. Bajt et al., "Design and performance of capping layers for extreme-ultraviolet multilayer mirrors," Appl. Opt. **42**(28), 5750–5758 (2003).