

Proposal of Hypereutectic AlSi- based Multilayer Mirrors for Wavelength between 20 nm and 25 nm

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Abstracts: A high-thermal stable extreme ultraviolet (XUV) multilayer mirror (MLM) for wavelength region of 20–25 nm has been proposed. Calculated reflectivity of hypereutectic Al-Si based MLM have almost 40-55% in this wavelength region and they have possibility of high-thermal stabilities comparing with that of the conventional pure-Al based MLMs. These new MLMs can be used for variety of applications such as high order harmonics, XUV microscopy, and XUV spectroscopy.

A multilayer mirror (MLM) is one of typical optical device in extreme ultraviolet (XUV) region as a focusing, steering, polarization control, and spectroscopy device. It is well known that a reflectivity of MLM at XUV region is limited to 70% due to the absorption of materials. The absorption coefficient shows a local minimum at the absorption edge. Therefore, absorption edges of lower-materials are taken into account for designing a high-reflectivity MLM, such as Si (k-edge at 12.5 nm) based MLMs for wavelength region around 13-20 nm, and Mg (k edge at 25 nm) for 27–50 nm, respectively [1]. On the other hand, there are limited reports around 20–25 nm, in spite of light flux increasing at HH light source, although Al (K-edge at 15 nm) based MLMs will become the solution in this wavelength region considering the optical constants [2]. However, because of the thermal properties of Al such as crystallization and internal-diffusion, it is difficult to be practically applied for high-flux field.

Hypereutectic Al-Si alloys are one of well-known Al-based alloys on mechanical engineering field, which have high thermal conductivity, wear resistance, and good strength [3]. These properties are important not only for aerospace and electric industries requirements but also for XUV optical devices requirements. In addition, there is a possibility for high-reflectivity MLMs observation considering the absorption coefficient at wavelength region of 20–30 -nm. Figure 1 shows several calculated reflective profiles of MLMs assuming ideal conditions at wavelength around 20–25 nm, Zr/AlSi, Mo/AlSi, Y/AlSi, and C/AlSi, respectively. In the calculations, Al-30wt.%Si was assumed, which is much higher than eutectic value (12.6wt.%). These new high-reflectivity MLMs have possibility to be applied for several practical uses because of its expected higher stability comparing with that of the pure-Al based MLMs.

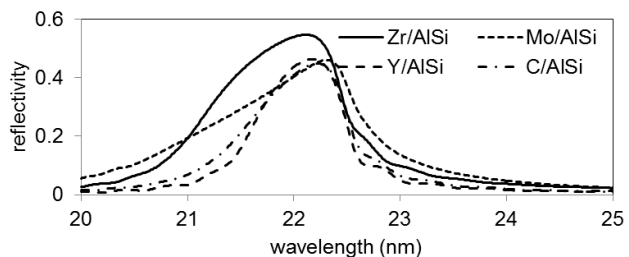


Fig. 1 Calculated reflective profiles of Zr/AlSi, Mo/AlSi, Y/AlSi, and C/AlSi, respectively. Assuming multilayer period is 11.5 nm.

- [1] X-ray Multilayer Results (<http://henke.lbl.gov/multilayer/survey.html>)
- [2] Q. Chang et. al., Opt. Express **21** 14399 (2013).
- [3] H. Ye, J. Mater. Eng. Perf. **12**, 288 (2003).