# Al-based multilayer coatings for space applications

**E. Meltchakov [1] F. Delmotte [1] R. Mercier [1] S. de Rossi [1] Ch. Bourassin-Bouchet [1] C. Burcklen [1] M. Dehlinger [1] M. Roulliay [1] A. Jérome [1] F. Varnière [1] F. Auchère [2] X. Zhang [2]**

[1] Laboratoire Charles Fabry, Institut d'Optique Graduate School, 91127 Palaiseau, France
[2] Institut d'Astrophysique Spatiale, 91400 Orsay, France

A further progress in astrophysics and in studying of ultrafast dynamics requires new optical functions of multilayer optics: not only higher reflectivity, but also a better control of the spectral shape (narrowband or broadband mirrors, enhanced spectral purity) and of the phase and polarization characteristics of reflected pulses.

Laboratoire Charles Fabry (LCF) has been involved in development of multilayer mirrors (substrates and coatings) for the Extreme ultraviolet Imaging Telescope (EIT) of the first satellite solar mission SOHO (Solar and Heliospheric Observatory) launched in 1995, then for the EUV telescopes of STEREO mission, launched in 2006 and, more recently, for the EUV telescopes of Solar Orbiter mission to be launched in 2018 [1].

In the field of attosecond science, starting from first measurements of the duration of an attosecond pulse reflected by a broadband multilayer mirror in 2005, LCF reported recently on the first experimental demonstration of XUV pulse compression by a factor 2 with a multilayer mirror and produced multilayer mirrors able to compress pulses down to record sub-50 as pulses [2].

Here we will present recent advances in the development and fabrication of multilayer coatings for XUV applications. Highly efficient narrowband, dual-band and broadband mirrors have been realized of periodic and aperiodic multilayer systems with a use of aluminium as a low absorbing material in the spectral range between 17 and 40 nm. We will discuss the design of various multilayer structures which is performed by using the IMD simulation software and/or a home-made Matlab code with optimization algorithms. A significant increase of the measured reflectance of periodic multilayers was obtained by applying a three-material design for the multilayer structure [3]. We will describe how more complex multilayer systems can be designed for specific applications in the XUV range and we will show optical parameters of multilayer mirrors that we have realized for the EUV imaging instrument of Solar Orbiter (Fig. 1).

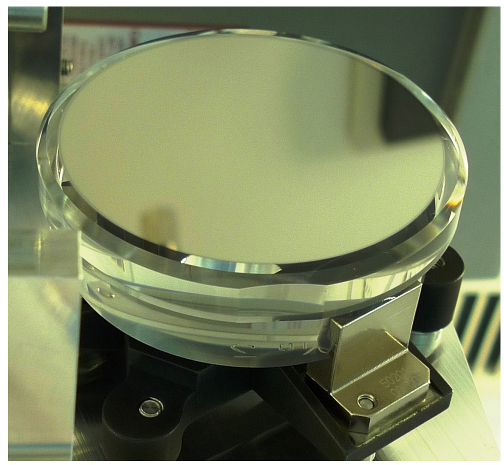

**Fig. 1**: Al/Mo/SiC coated primary mirror of High Resolution Imager of EUV telescope of Solar Orbiter.

Most of the multilayer mirrors were deposited by magnetron sputtering and characterized by grazing incidence X-ray reflectivity (GIXR). The XUV reflectivity measurements were performed at the BEAR beamline of ELETTRA Sincrotrone Trieste and at the metrology beamline of Soleil synchrotron.

The optimization of the single band and dual band coatings for Solar Orbiter mission in terms of efficiency, spectral purity, lateral uniformity and stability to space environment will be presented at the conference.

**References**

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