Al/fluoride mirrors with enhanced far UV reflectance

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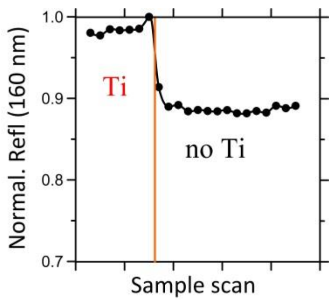
Al is a remarkable metal that extends its high reflectance to the far ultraviolet (FUV) and beyond. Its thin native oxide strongly degrades Al FUV reflectance, which is avoided by protecting the Al film with a FUV transparent material, among which MgF_2, AlF_3, and LiF extend this transparency deeper in the FUV.

The deposition conditions between Al and the fluoride are somewhat conflicting, since the fluoride grows less porous and less absorbing on a heated substrate, whereas Al deposited on a heated substrate grows rougher.

A significant FUV reflectance improvement was obtained by Quijada et al. [1] with the 3-step process: Al is deposited on a substrate at room temperature (RT) and it is immediately protected with an ultrathin fluoride film; then the mirror is heated in vacuum to complete the fluoride protective layer. The present team has investigated the optimum deposition temperature of MgF_2 [2] and AlF_3 [3] protective layers for largest Al reflectance. It has also been found that when the full Al/fluoride is deposited at RT and later heated in vacuum, a mirror reflectance close to the one of the 3-step process is achieved, and this procedure may be simpler to implement in practical cases.

Yet, protected Al has a feature centered at ~160 nm consisting in a reflectance dip; it is due to the resonant absorption of surface modes called surface plasmons. FUV light couples to these modes through surface roughness. It has been found that an ultrathin Ti buffer layer under the Al film results in a significant reduction of the reflectance dip [4], which is almost completely removed in the case of RT-deposited Al/fluoride mirror.



These advances on enhanced-reflectance Al/fluoride FUV mirrors will be presented at the conference.

[1] M. A. Quijada et al., Proc. SPIE **8450**, 84502H (2012), SPIE **9144**, 9144G (2014)
[2] L. V. Rodríguez-de Marcos et al., Opt. Express **26**, 9363 (2018)
[3] N. Gutiérrez-Luna et al., Coatings **9**, 428 (2019)
[4] J. I. Larruquert et al., Opt. Express **29**, 7706 (2021)