INTRODUCTION

Observations in the UV and EUV allow many diagnostics of the outer layers of the stars and the Sun so that more and more space telescopes are developed to operate in this fundamental spectral range. However, absorption by residual contaminants causes critical effects such as loss of signal, spectral shifts, stray light... Thus, a cleanliness and contamination control plan has to be defined to mitigate the risk of damage of sensitive surfaces. In order to specify acceptable cleanliness levels, it is paramount to improve our knowledge and understanding of contamination effects, especially in the UV/EUV range. Therefore, an experimental study has been carried out in collaboration between CNES and IAS, in the frame of the development of the Extreme UV Imager suite for the ESA Solar Orbiter mission (to be launched in 2020); this instrument consists of two High Resolution Imagers and one Full Sun Imager designed for narrow pass-band EUV imaging of the solar corona, at wavelengths 17.4 nm, 30.4 nm and 121.6 nm, all highly sensitive to contamination.

The purpose of this joint experimental study was to assess transmittance loss and scattering effect of different representative optical components used for EUV (metal filters, Lyman-α filters and multilayer mirrors), contaminated at CNES at different levels by the outgassing products of three polymer materials.

MATERIALS & OPTICS

- Contaminants (outgassing products from typical space materials)
  - EC2216 epoxy resin
  - RTV-566 Silicone elastomer
  - MSS/RS-3C Carbon fiber-polycyanate resin composite honeycomb
- EUV samples
  - MgF₂ substrates with one side coated
  - Mirrors (Al/Mo/SiC coating on SiO₂ substrate)
  - Filters (Al sheet on hexagonal grid)

MAIN MEASUREMENTS RESULTS

- Contaminated filters by outgassed products from EC2216
- Contaminated filters by outgassed products from silicone
- Contaminated filters by outgassed products from SiC

CONCLUSION

This paper reported on an overview of the last results of performance loss of different optical components before and after contamination. Furthermore, some of them have been analyzed after a long exposure to VUV-visible radiations to characterize the irreversible degradation due to photo-polymerization of the organic deposits. This experiment was a first exploration of yet poorly known effects: it confirmed how critical molecular contamination is for UV instruments. The results showed that filters transmittance can drop to a fraction of the initial one depending on the nature and the amount of contaminants. Besides, mirrors reflectance can decrease significantly by absorption of these contaminants and by scattering effect due to the large amount of droplets. Thus, the sensitivity and the measurement quality of the optical instrument may be highly affected by contamination. In particular, scatter can degrade the Point Spread Function (PSF) and reduce the contrast. However, it is too early for establishing a predictive model of performance loss vs. contamination levels. More extensive and exhaustive measurements campaigns with more different contaminants deposits levels are needed.

REFERENCES