Optics Balzers Jena GmbH

UV coatings by IAD and PARMS technology for Sentinel-5 mission

T. Weber[a], M. Lappschies[a], S. Jakobs[a], R. Jansen[b], J. Day[b], L. van der Laan, B. de Goeij[b], T. Luijkx[b], J. Mekking[b]

[a]Optics Balzers Jena GmbH, Otto-Eppenstein-Straße 2, 07745 Jena, Germany

[b]TNO, Stieltjesweg 1, 2600 AD Delft, The Netherlands

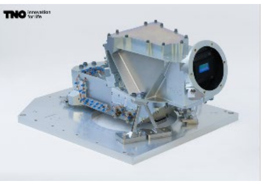
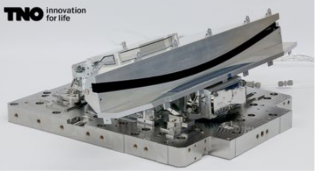
thomas.weber@opticsbalzers.com – Phone: +49 3641 3529-411 – Fax: +49 3641 3529-35

Abstract:

Within the Copernicus program, the Sentinel-5/UVNS instrument is dedicated to the monitoring of air quality, trace gases and aerosols. The instrument consists of five co-aligned spectrometers in the spectral channels named UV1, UV2VIS, NIR, SWIR1, and SWIR3. The spectral band of UV1 spectrometer is defined from 270 nm to 310 nm. To distribute incoming light into the channels and within the UV1 channel dedicated coatings for UV spectral range are needed. OBJ was selected for development and application of these coatings.

1. Introduction

- This presentation will give an overview on different types of UV coatings developed by OBJ for Sentinel-5/UVNS instrument. Two different contributions of Optics Balzers Jena GmbH (OBJ) will be discussed. Firstly, coatings for the telescope beamsplitter optical assembly (TSBOA) and secondly coatings for UV1 spectrometer optics. Sentinel 5 is an ESA project with prime contractor Airbus DS. Manufacturing of TSBOA and UV1 Spectrometer was led by TNO [1,2]. A picture of manufactured PFM models can be found below (Picture credit TNO).

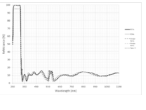
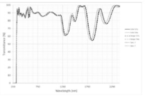



- For both telescope assemblies OBJ was in charge of coating of beam splitters and slit homogenizers inside beam splitter assemblies. Within UV1 spectrometer, OBJ has coated the mirrors and the gradient filter. Coatings were done by means of Plasma Assisted Reactive magnetron Sputtering (PARMS), Ion assisted deposition (IAD), and e-beam evaporation.

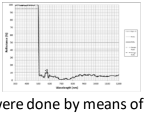
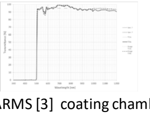
2. Design and manufacturing

2.1 TSBOA beam splitter coatings

For VN beam splitter a layer stack composed of Ta2O5 and SiO2 is used to split light efficiently into NIR and UV2VIS channel.

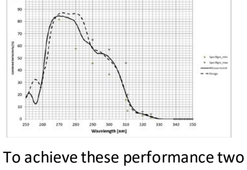
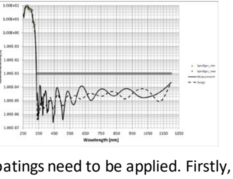
A third material (HfO2) needs to be added for US beam splitter to separate UV1, SWIR1, and SWIR3 channel.

Coatings were done by means of PARMS [3] coating chambers equipped with a broad band monitoring system to allow for a precise process control [4].

2.2 UV1 channel mirror coatings

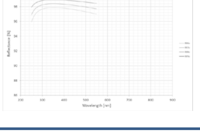
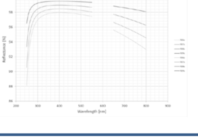
The UV1 spectrometer consists of five mirrors. Reflectance requirements are specified as combined reflectance for all five mirrors.

To achieve these performance two coatings need to be applied. Firstly, a black absorbing coating to generate low reflectance in the long wavelength range and secondly a dielectric mirror coating based on HfO2 to define the reflectance profile of each mirror.

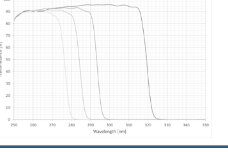
2.3 TSBOA homogenizer coatings

The protected aluminum mirror coating, Alflex™, was manufactured by means of e-beam evaporation. Measured reflectance for AOI of 86°-89° is shown.

2.4 UV1 channel linear variable filter coating

Specified coating performance is a short pass coating with transmittance level of above 90% in UV1 band (270-310 nm) with linear variation of band edge position and OD3 blocking level. The manufacturing was carried out at OBJ by means of Ion Assisted Deposition and the layer stack was composed of an SiO2/HfO2 multi-layer stack [6].



3. ACKNOWLEDGEMENTS

- The work presented was done in the framework of Sentinel mission of ESA Copernicus program funded by EU and ESA. OBJ thanks ESA, TNO, and AMOS for selection and cooperation during the development.

3. References

[1] Irizar, J., Melf, M., Bartsch, P., Koehler, J., Weiss, J., Greinacher, R., Erdmann, M., Kirschner, V., Perez Albinana, A., Martin, D., " Sentinel-5/UVNS," Proc. SPIE 11180, 1118004 (2019).

[2] Jansen, R., Day, J.P.R., Vink, R., de Vreugd, J., van Beekum, E.R.J., van der Laan, L.W., van't Hof, A.C.A., Gielesen, W.L.M., Koehlwer, J., "Design and first light of the Sentinel-5 UV1 spectrometer optics," Proc. SPIE 11151, 111510Q (2019).

[3] Scherer, M., Pistner, J., Lehnert, W., "Innovative production of high quality optical coatings for applications in optics and opto-electronics," 47th Annual Technical Conference Proceedings of the Society of Vacuum Coaters, 179, (2004).

[4] Ristau, D., Ehlers, H., Gross, T., Lappschies, M., "Optical broadband monitoring of conventional and ion processes," Applied Optics, 45, 1495–1501 (2006).

[5] Weber, T., Lappschies, M., Jakobs, S., "Manufacturing of high performance VIS-NIR beam splitters by plasma assisted thin film deposition technologies," Proc. SPIE 10691, 106911A, (2018).

[6] Weber, T., Lappschies, M., Jakobs, S., Meini, M., Gabrieli, R., Taccola, M., "Development of linear variable filters and black coatings by PARMS technology for FLORIS HR focal plane array of FLEX mission," Proc. SPIE 11180, 1118044 (2019).