

Environmental stability of extra-narrowband mirrors for FUV instrumentation

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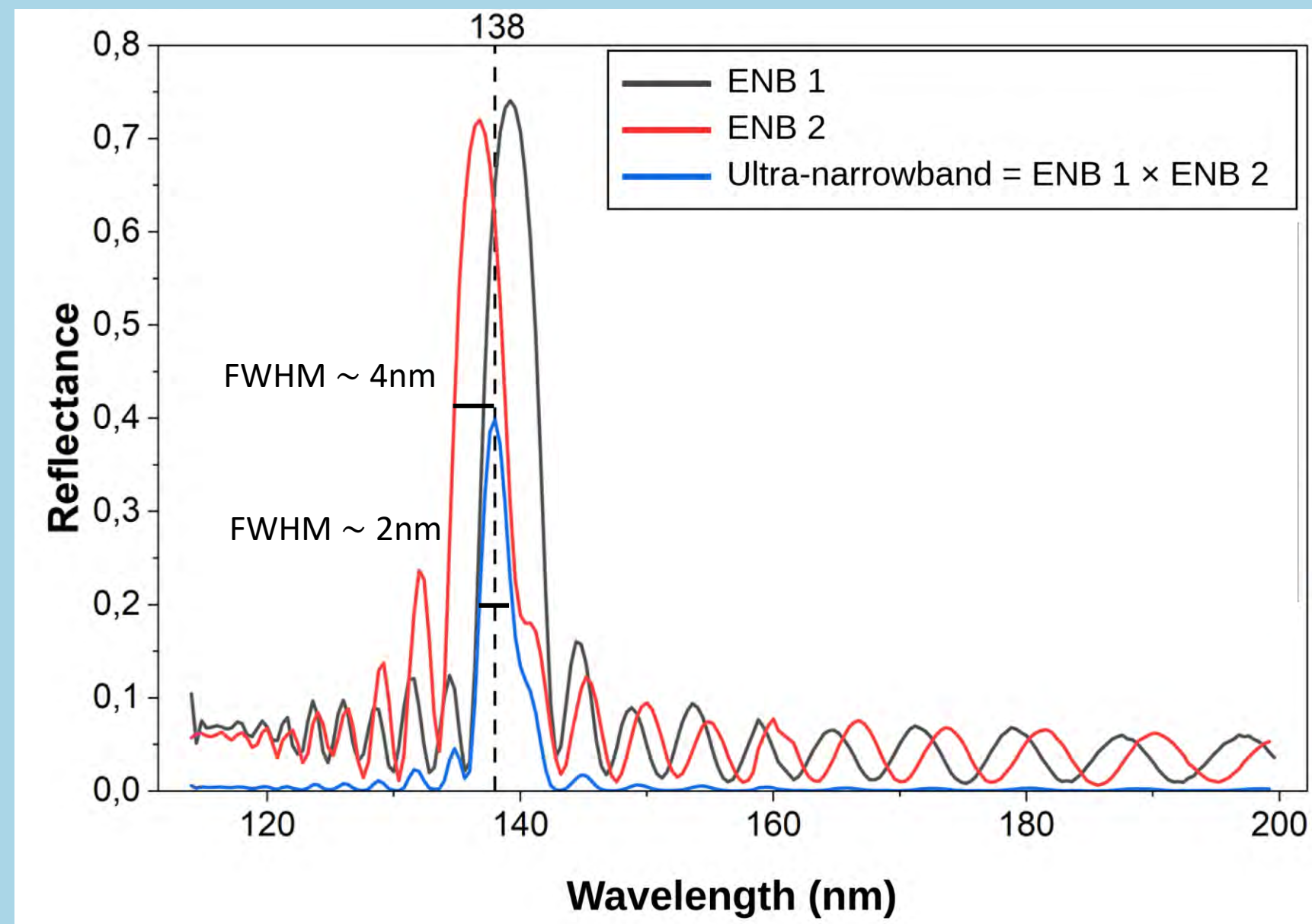
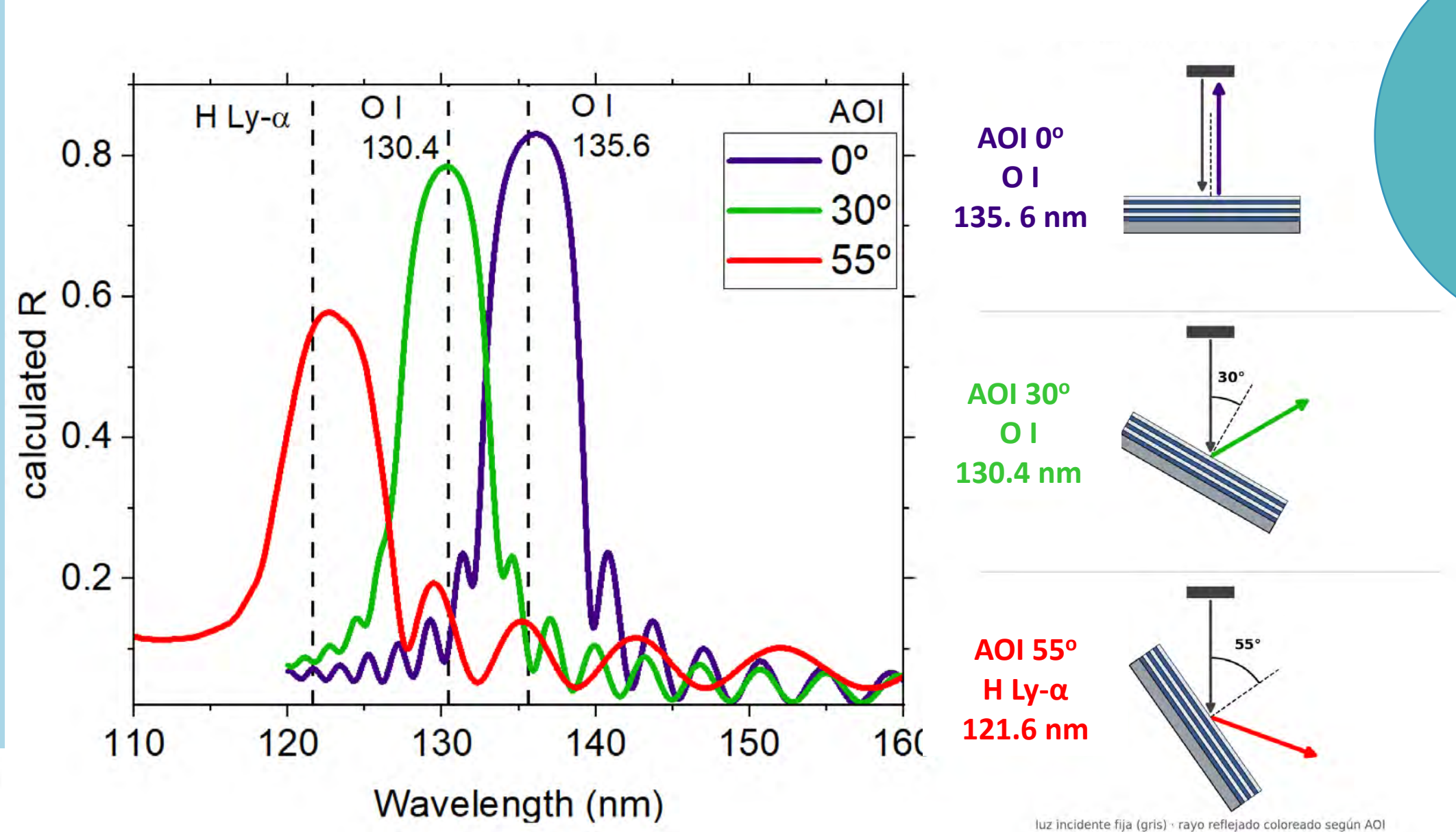
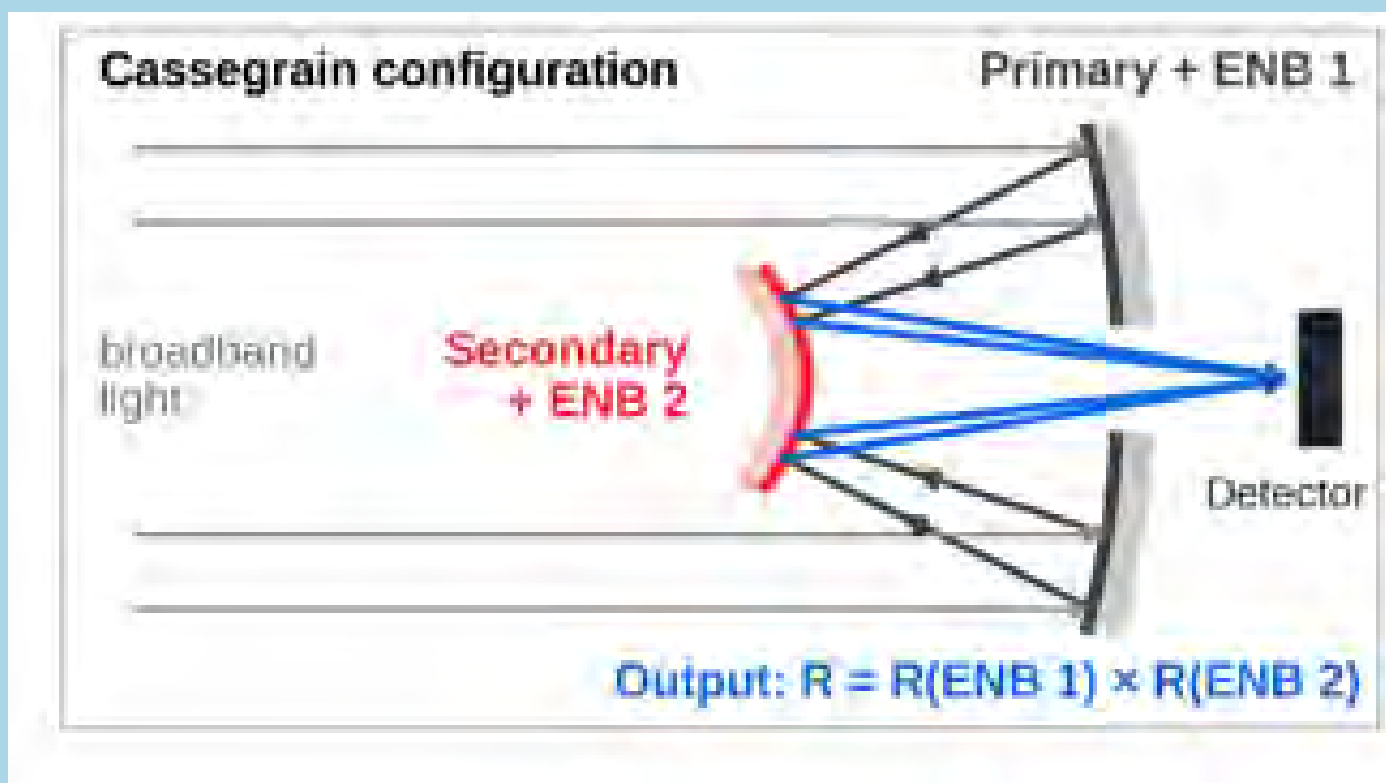


MOTIVATION

FUV region (100 – 200 nm) contains key spectral lines for astrophysics, solar and planetary physics (OUL). Imaging specific targets at a given spectral line requires optics with high spectral selectivity

Essential for diagnosing hot plasmas, semiconductor processing, and space-based atmospheric studies

- H I: 121.6 nm
- O I: 130.4/135.6 nm
- N I: 123.9 nm/124.3 nm
- He II: 164 nm
- C IV: 155nm

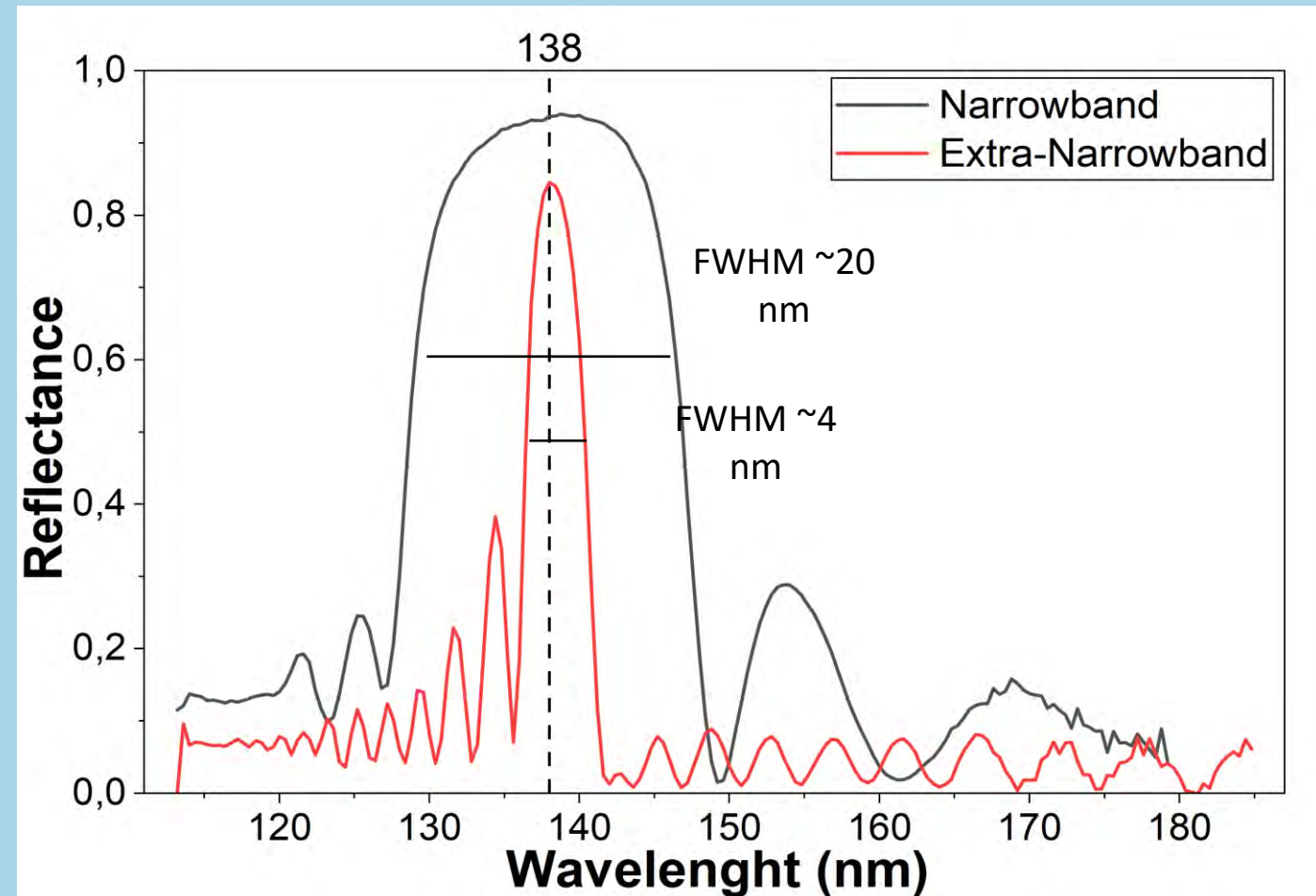


EXTRANARROWBANDS

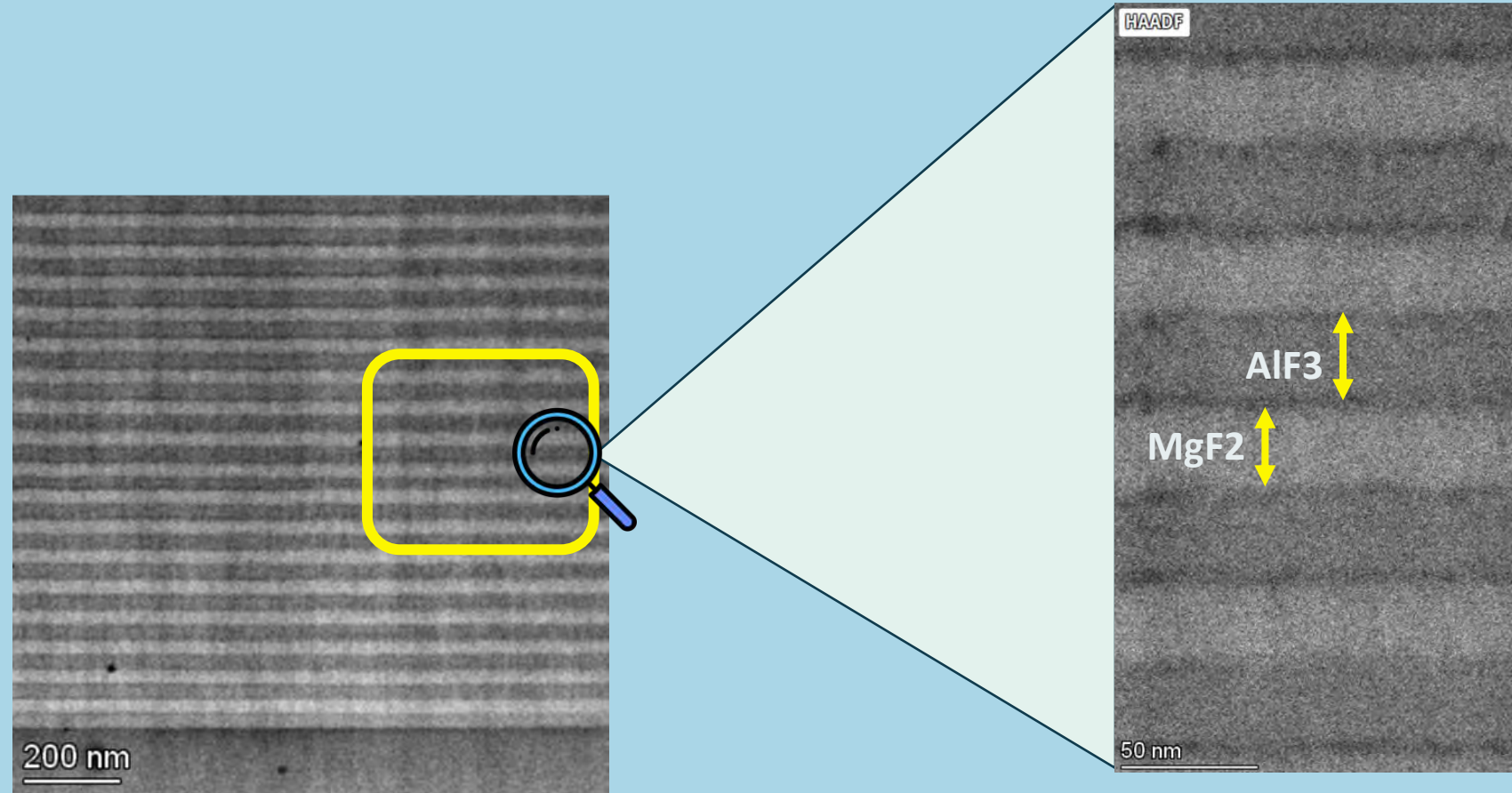
NEW TECHNOLOGY

Multilayers based on fluorides (AlF₃/MgF₂)_n

- Low contrast of index refraction
- Many Layers for high reflectivity
- Tunable range: 120 nm – 200 nm

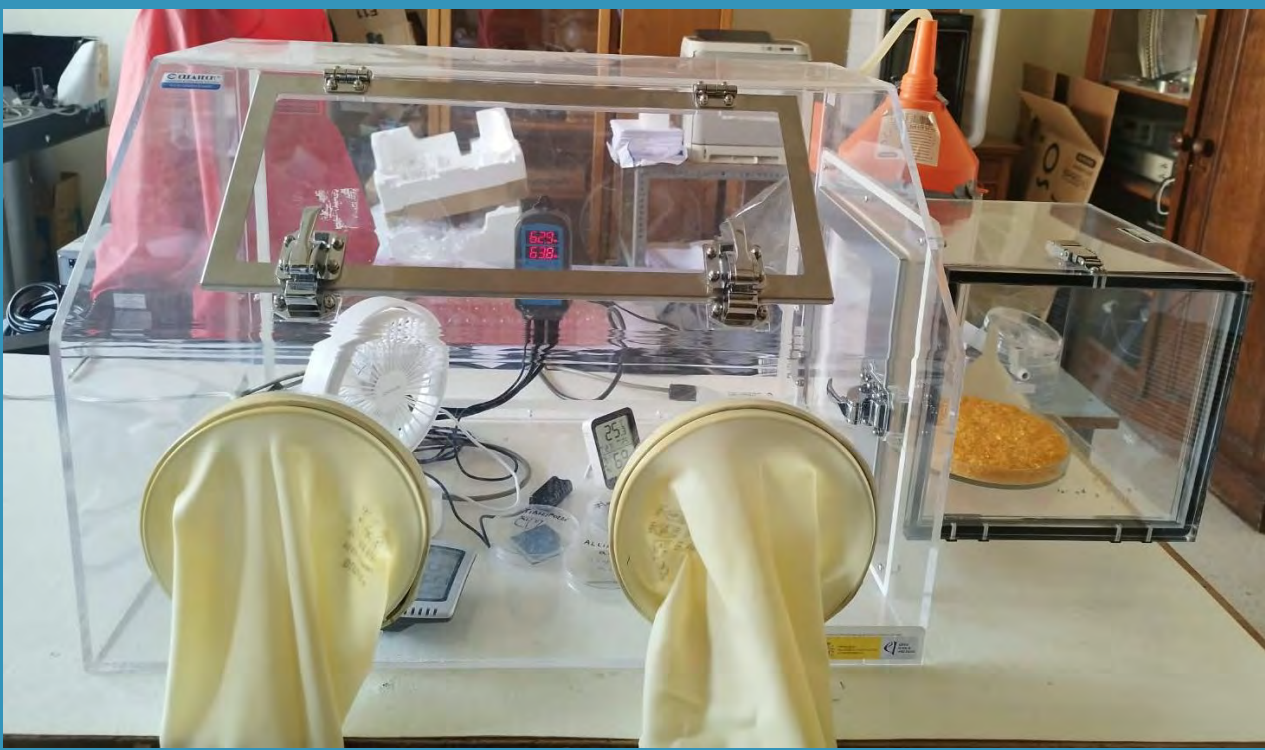


Same filter at different inclinations

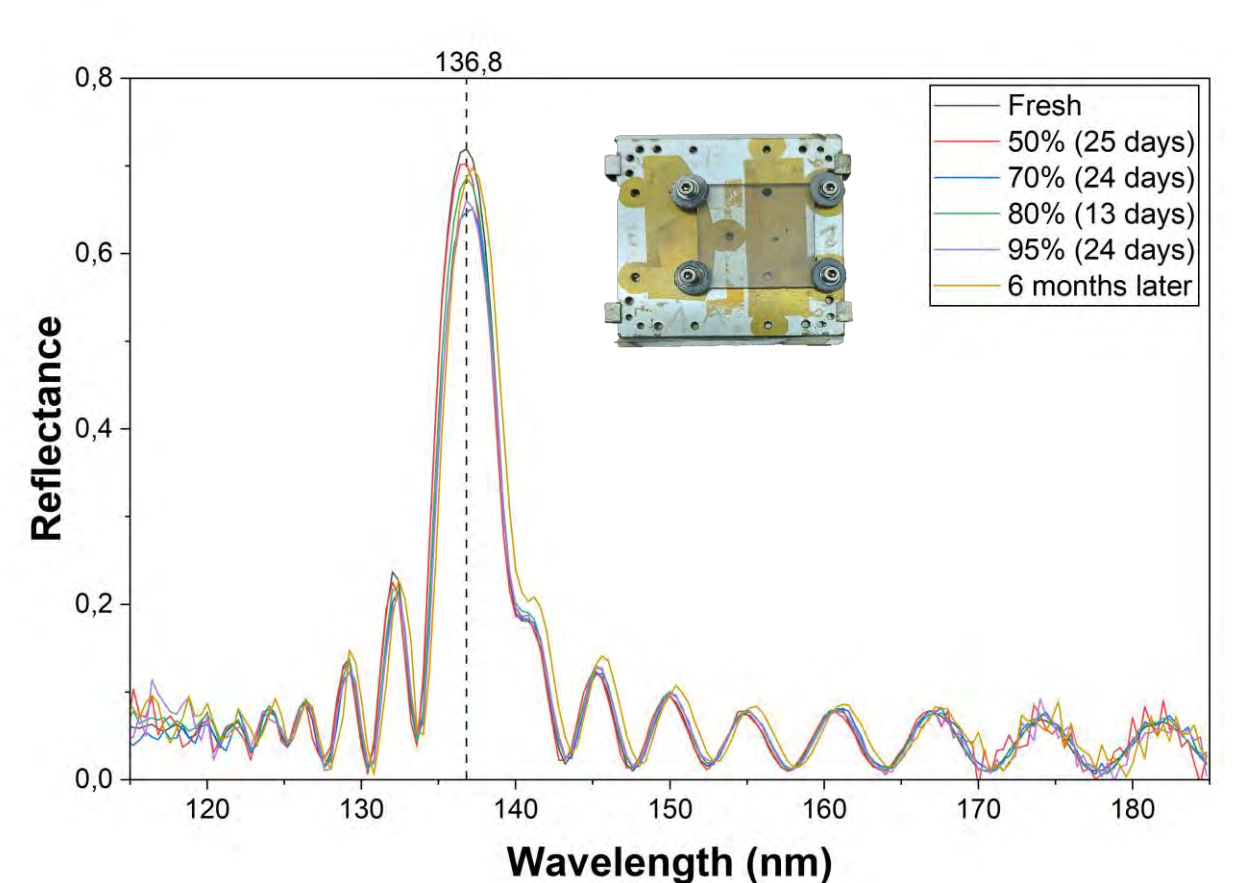
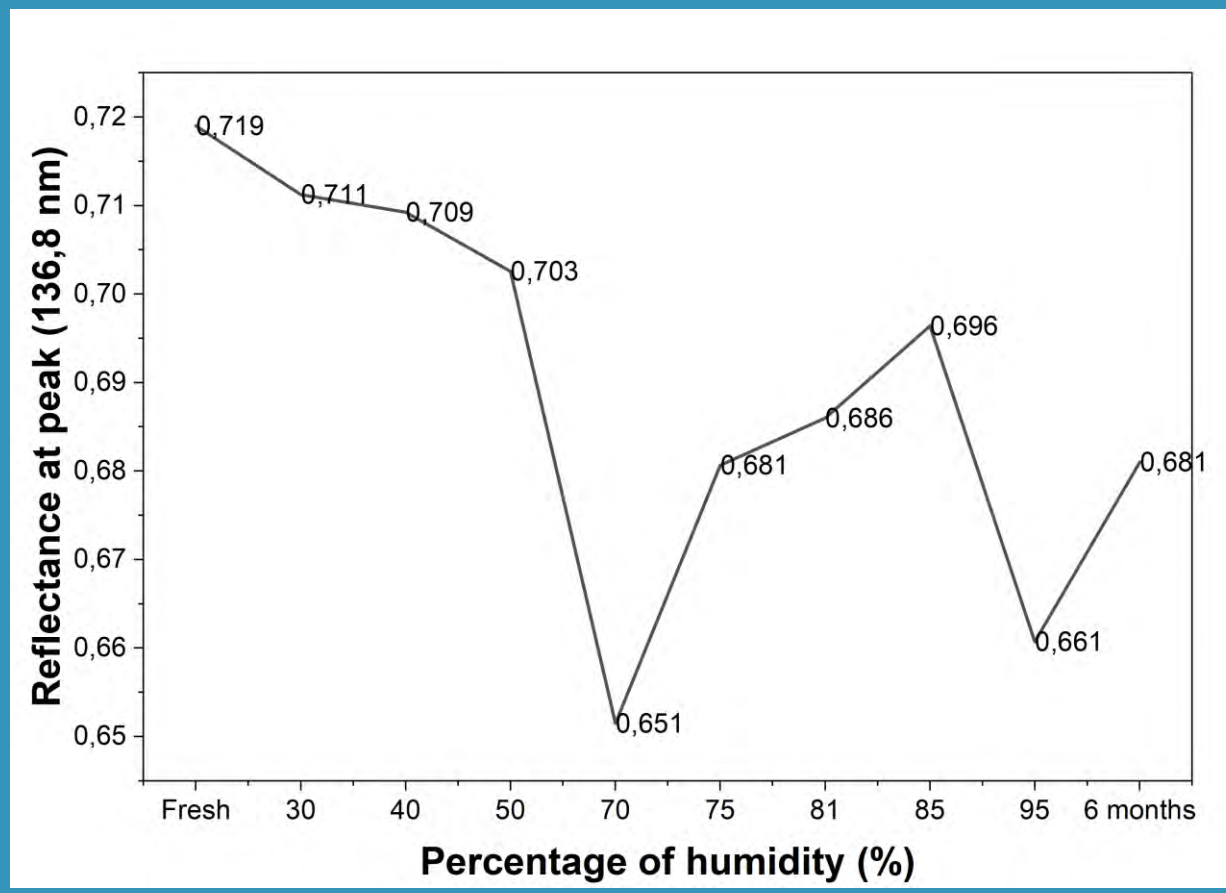


ENVIRONMENTAL TESTS

HUMIDITY



Exposures from 30% to 95%



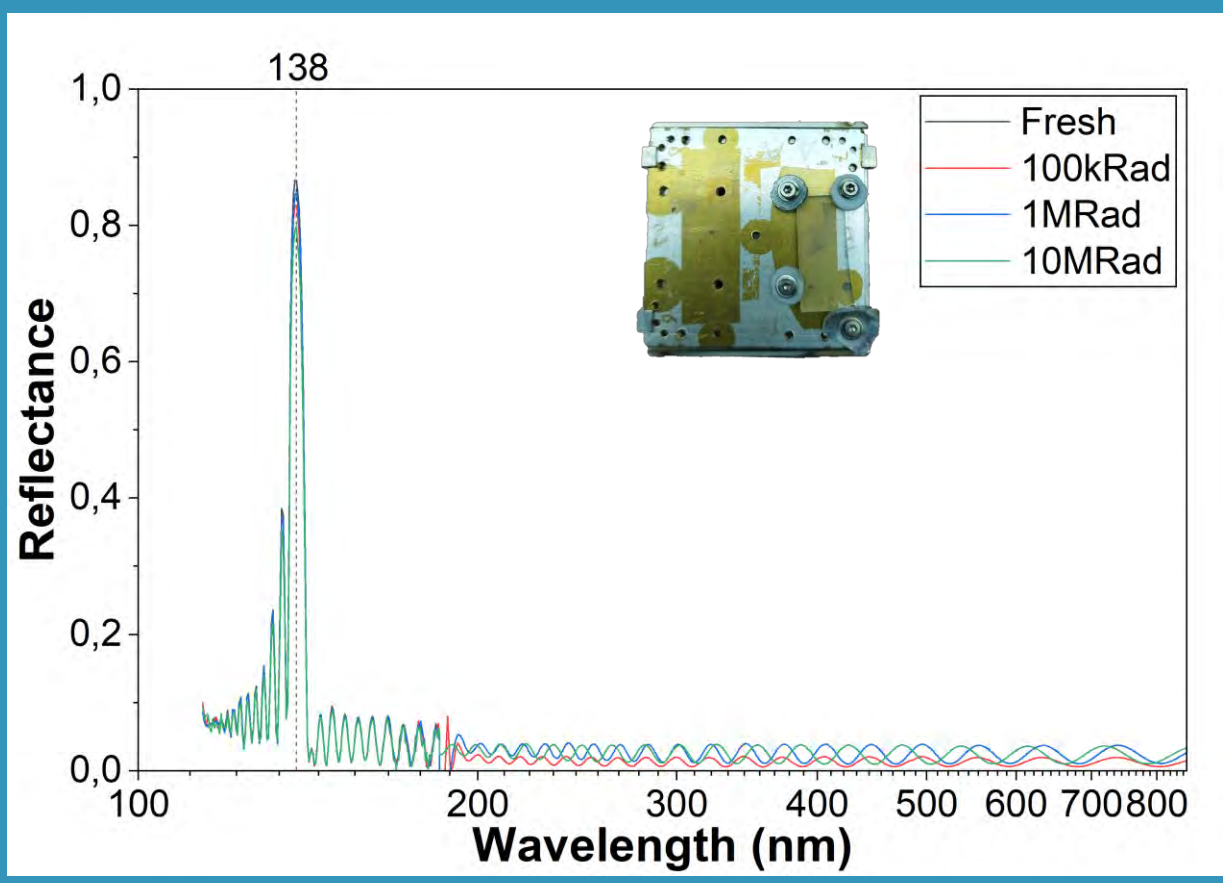
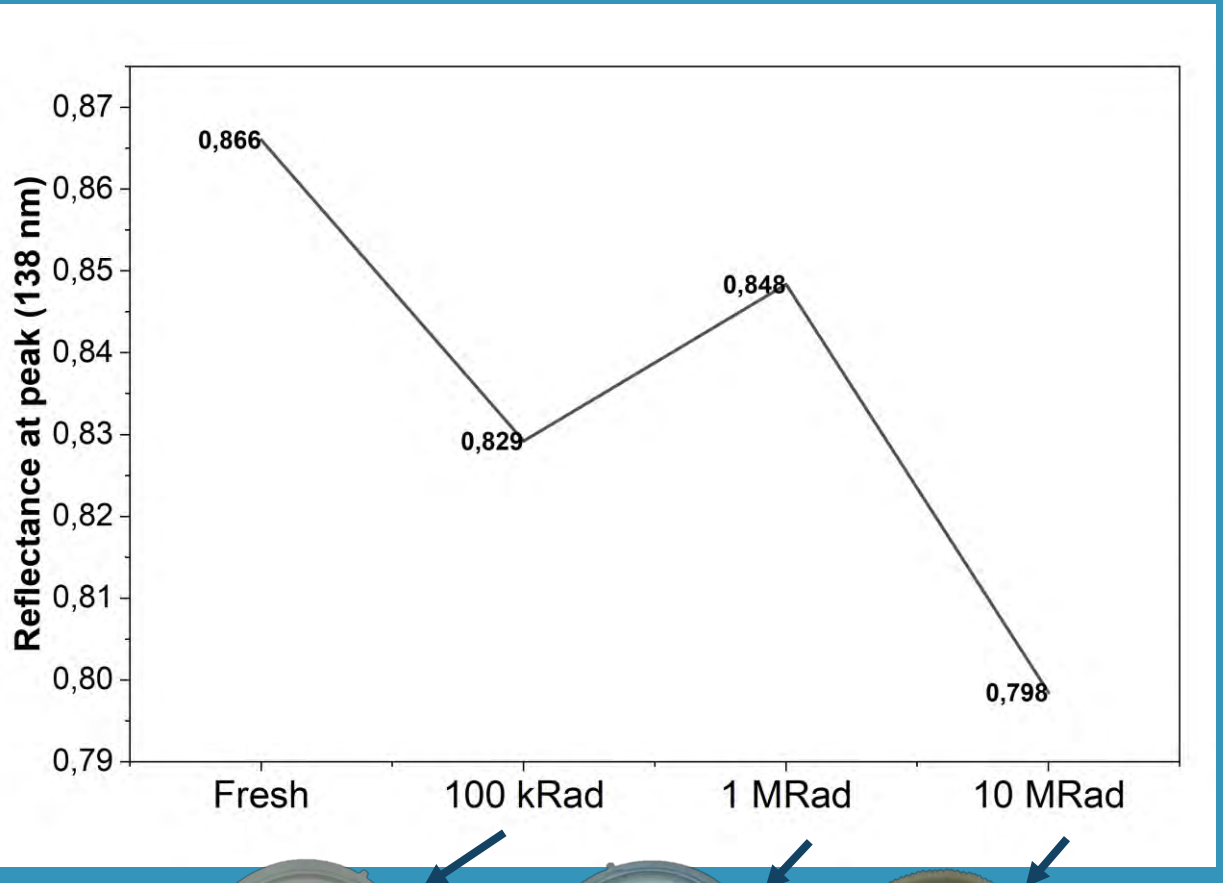
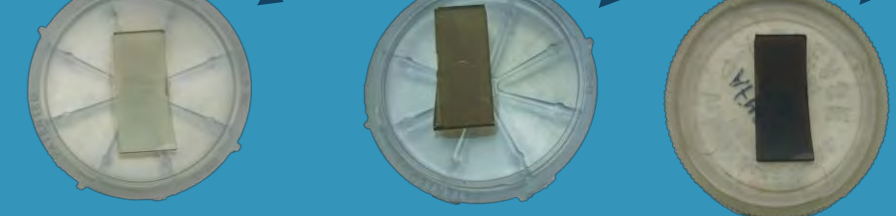
Water degradation is reversible

GAMMA IRRADIATION

Ciemat
Centro de Investigaciones
Energéticas, Medioambientales
y Tecnológicas

3 exposures at doses of 19.22 KGy/h

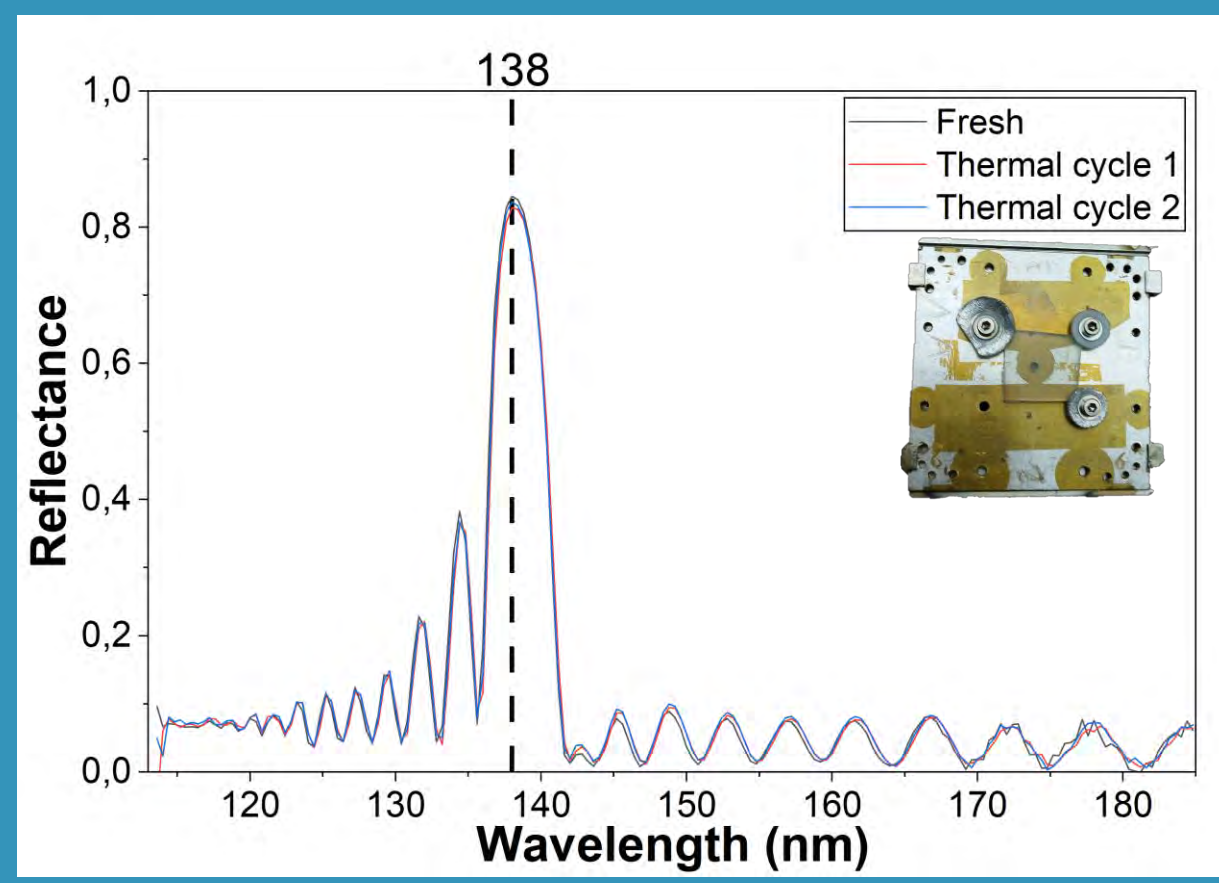
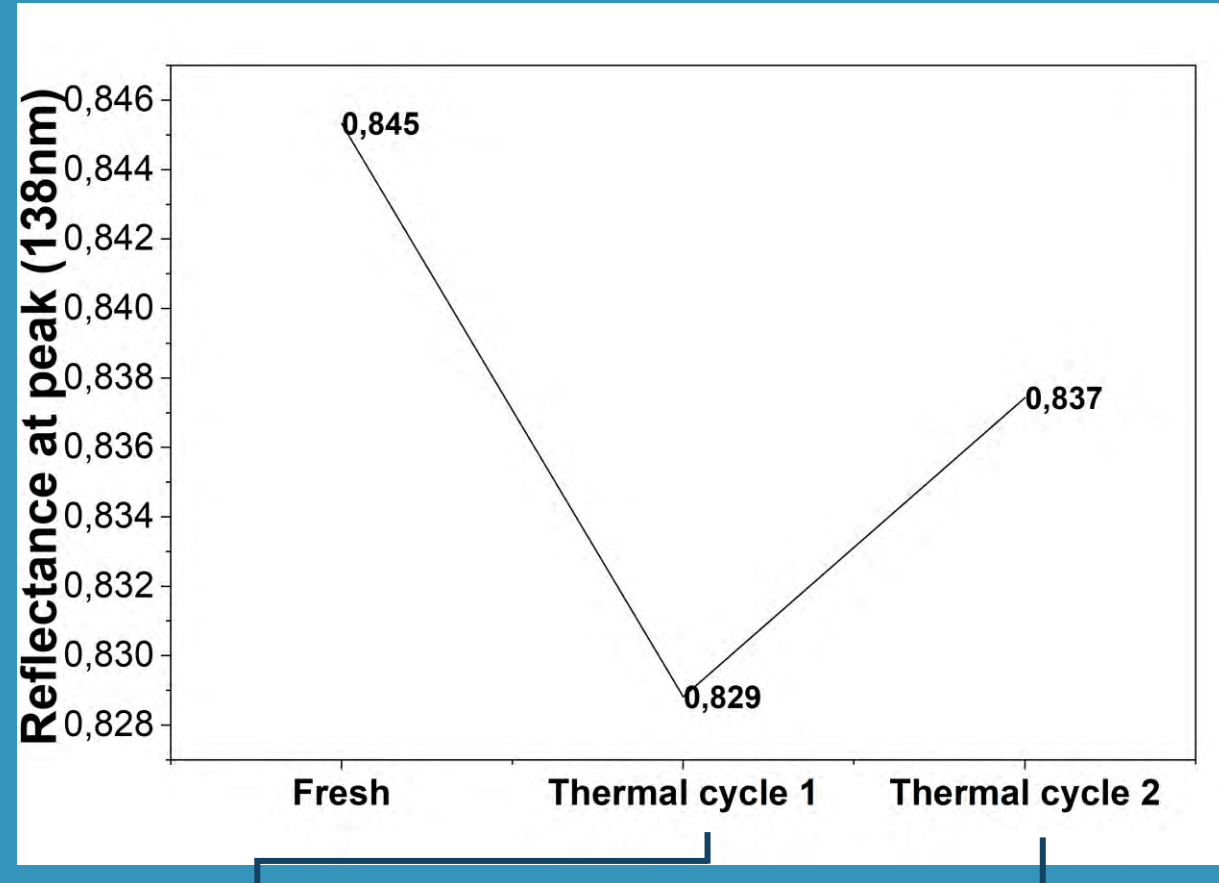
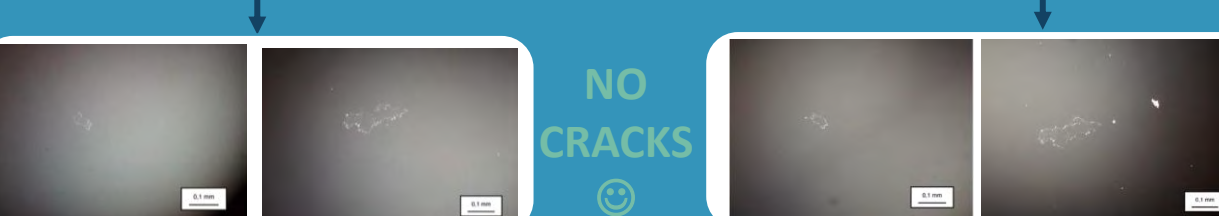
100 kRad → 1 MRad → 10 MRad
1.1 Mrad acumulated 11.1 Mrad acumulated



THERMAL CYCLING

Erica

2 thermal cycling in vacuum
1st: 5 cycles between -30°C and +70°C
2nd: 5 cycles between -70°C and +80°C



METHODS

DEPOSITION CHAMBER

- ISO 6 clean room
- Fulfills space requirements
- Thermal evaporation
- Ion-Beam Sputtering: not required for these multilayers
- 75cm diameter chamber



VUV reflectometer



- ISO 8 clean room
- FUV polarizers available
- Grazing Incidence monochromator
- 40 – 200 nm covered

CONCLUSIONS

Extra-narrowband FUV mirrors → **TRL 3**

- **Thermal stability:** stable reflectance after cycling, with no observable morphological changes.
- **Ionizing radiation:** limited degradation of the optical response in the FUV.
- **Humidity response:** moderate variations due to surface water adsorption in higher RH that seem reversible.

After environmental tests → **TRL 4+**

ACKNOWLEDGMENTS

This work has been funded by the national research grant CoatFuvEslon (PID2022-1424170B-I00) funded by MCIN/AEI/10.13039/501100011033 and the European Union NextGeneration EU/PRTR. We thank P. Valdivieso (CIEMAT) for the gamma irradiation, GIMRO – Instituto de Óptica (CSIC) for the visible-range measurements.