



Surface materials engineering

Conductive Anti-Reflected coatings for shielding in harsh environments

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«To be an actor of progress by transforming science into industry in a free and pioneering company.»

HEF in figures

Since 1953,

70 years of surface
materials engineering
expertise

3200 employees (worldwide)

650 in France

€317 M

turnover in 2022

66%

of capital is owned by employees
and 34% by the founder's
family

200

patents

90

industrial sites

in **21** countries

€55 M

in investments in 2023

6500

customers



3 areas of surface materials engineering expertise



TRIBOLOGY

Studying phenomena related to dynamically interacting solids. Understanding and managing the mechanics of friction and wear.



PHOTONICS

Studying phenomena related to the interaction between light and matter.

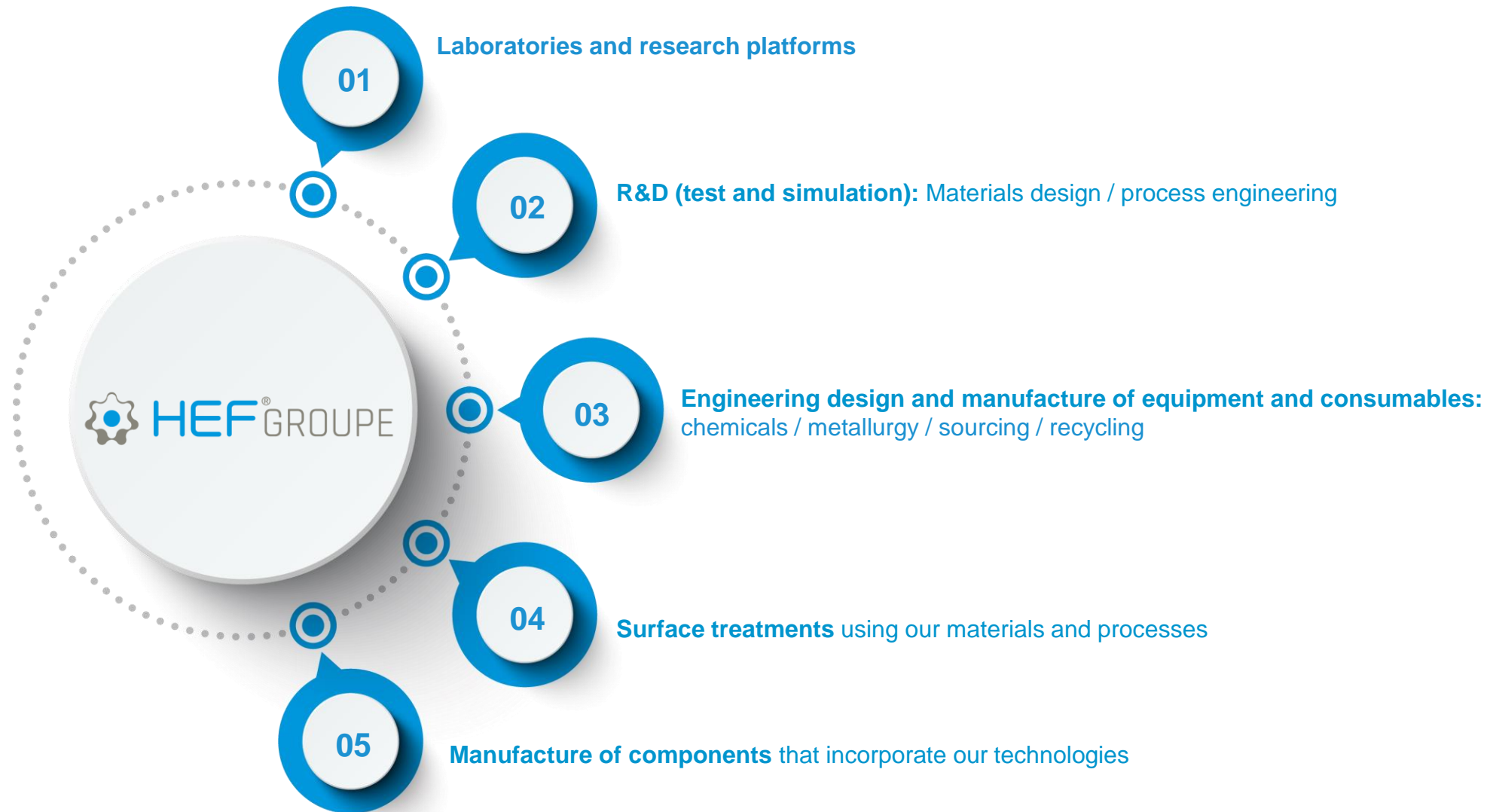
Understanding and managing surfaces and optical interfaces.



HYDROGEN TECHNOLOGIES

Manufacturing, transporting, storing and using hydrogen: electrolysis / compression / fuel cells and hydrogen engines.

From research to industry, a proven integration model



HEF's ambition: to be a major global player in photonics

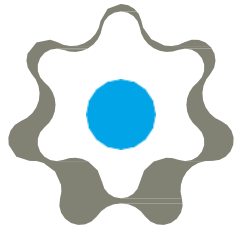
- **The Group's industrial contribution:**
 - Vertical approach: Integrated key elements (Materials & Equipment)
 - Industrial activity structured in France and deployed worldwide; possibility of setting up resources for large quantities
 - Financial resources for strategic acquisitions in various countries
- **Combined with a medium- and long-term R&D drive:**
 - Maintaining industrial leadership through strong R&D in materials and processes
 - A collaborative upstream R&D unit in Saint-Etienne with national and regional expertise
 - Some examples of subjects: laser cutting and structuring, structuring for IR and visible applications, precise filters, high resistance to laser flux, etc.



HEF works in close proximity to its customers worldwide

Our teams are ready to provide prompt responses, service, and close proximity to the group's customers. Technologies and expertise available at consistent quality standards worldwide.





HEF[®]
PHOTONICS

Photonics Business Unit (240 personnes)

KERDRY
Lannion
Côtes-d'Armor
(22)
25 personnes

NEYCO
Vanves
Hauts de Seine
(92)
20 personnes

FICHOU
Fresnes
Val-de-
Marne (94)
37
personnes

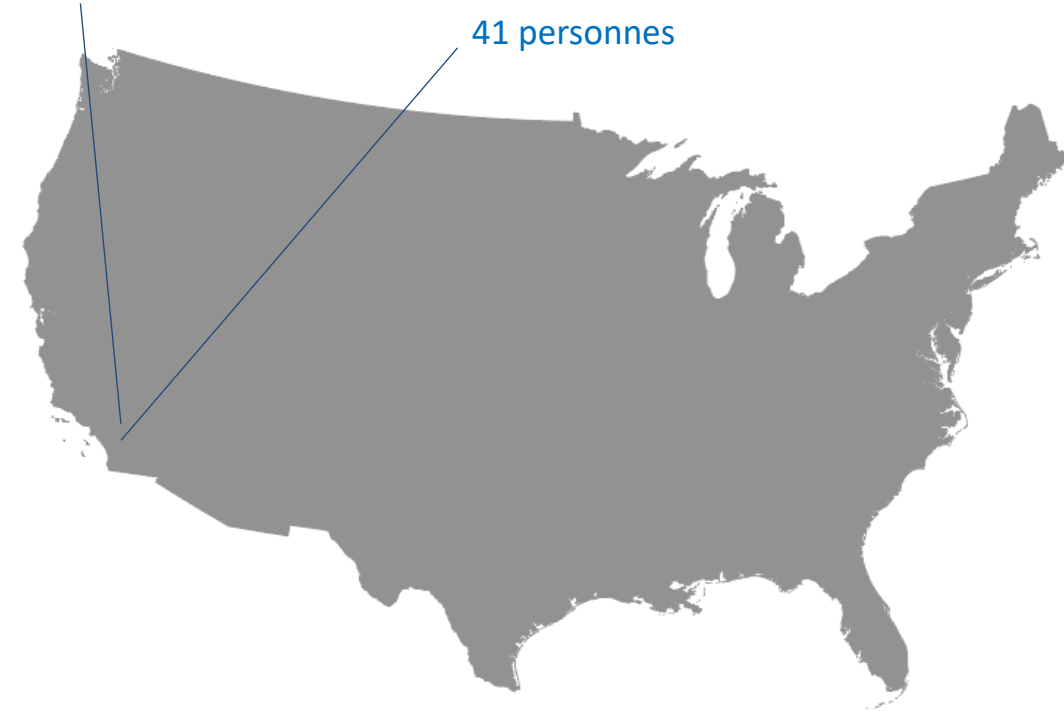
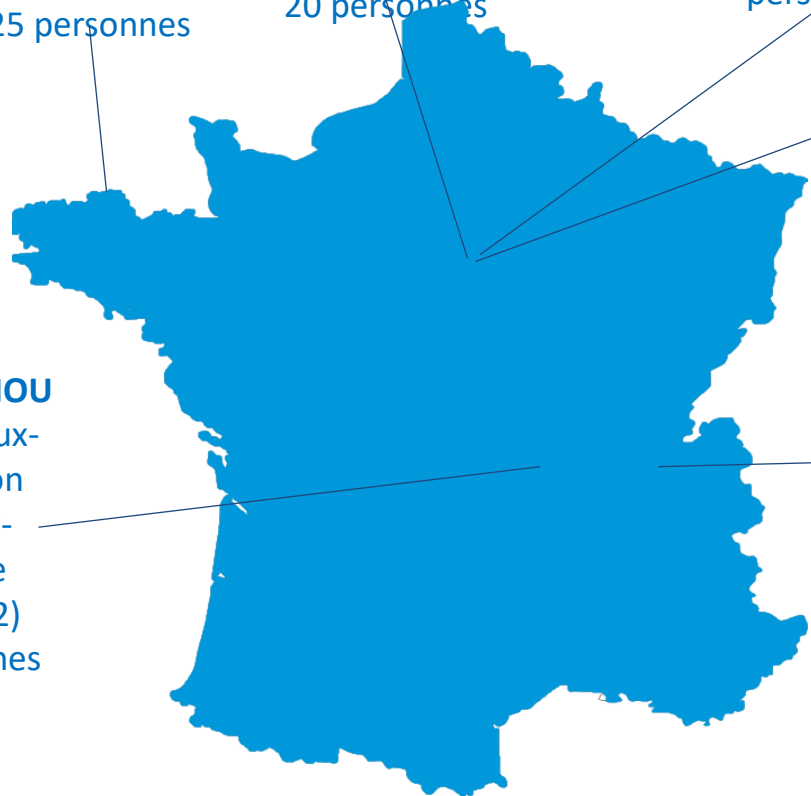
**ABRISA
TECHNOLOGIES**
200 S. Hallock Drive
Santa Paula,
Californie 93060
77 personnes

**ABRISA
TECHNOLOGIES**
1401 Abalone
Avenue
Torrance, Californie
90501
41 personnes

OPTIMASK
Morangis
Essone (91)
18 personnes

HEF - FICHOU
Andrézieux-
Bouthéon
et Saint-
Etienne
Loire (42)
5 personnes

ACERDE
Sainte Hélène du Lac
Savoie (73)
14 Personnes



KERDRY at a glance: Optical thin films “know how”

For 40 years, the individual companies from HEF Photonics have developed a recognized expertise in optical and metallic treatments by thin film deposition under high vacuum and in controlled environment.

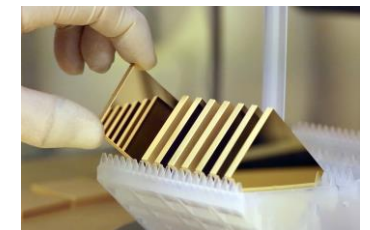
HEF Photonics integrated these entities to create a powerful tool adapted to industrial needs.

More than 35 coating machines are installed in more than 2500 m² of clean rooms (ISO 5 to 7).

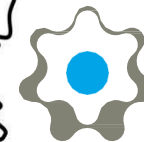
End of 2023, HEF will provide to internal subsidiaries their first coating chamber (73 inches, e beam, ion assistance).

Wide range of capabilities : optical treatments from UV to IR (anti-reflection, mirror, intense black, dichroic, filter...)

Capacity up-to 1.40 m (55”) substrate diameter



KERDRY
HEF[®]PHOTONICS

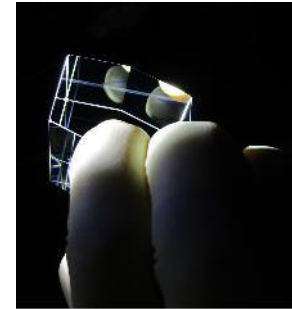
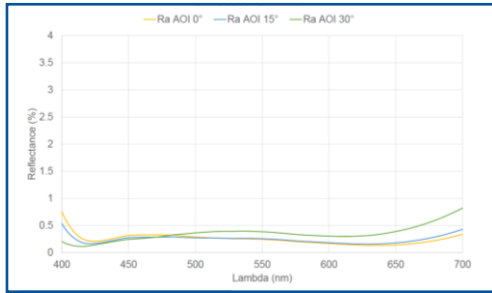


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PHOTONICS

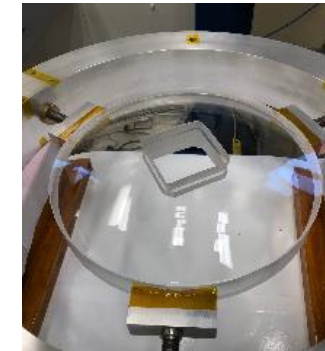
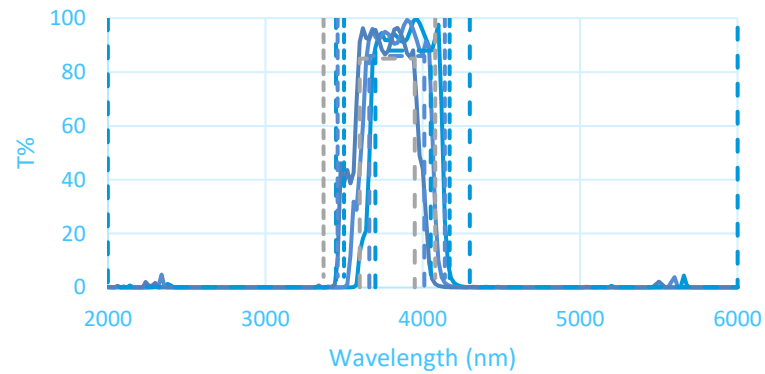
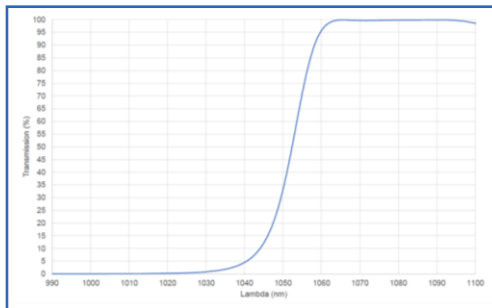
SURFACE MATERIALS ENGINEERING

Optical thin films (continued)

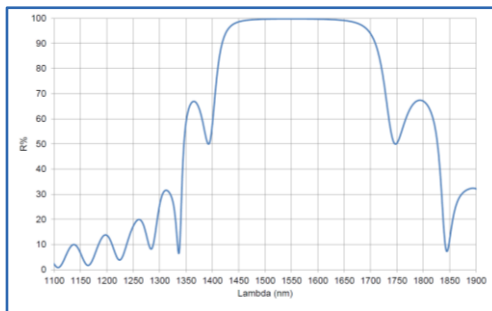
- Antireflective coatings (V-coating, W-coating, wide band BBAR...)



- Custom Filters

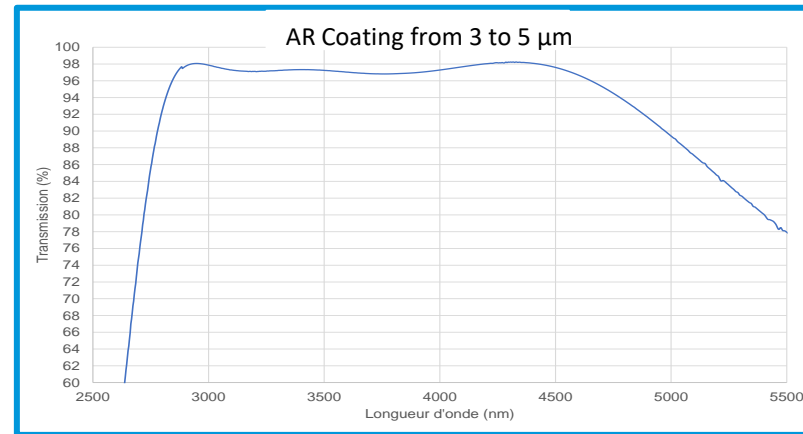
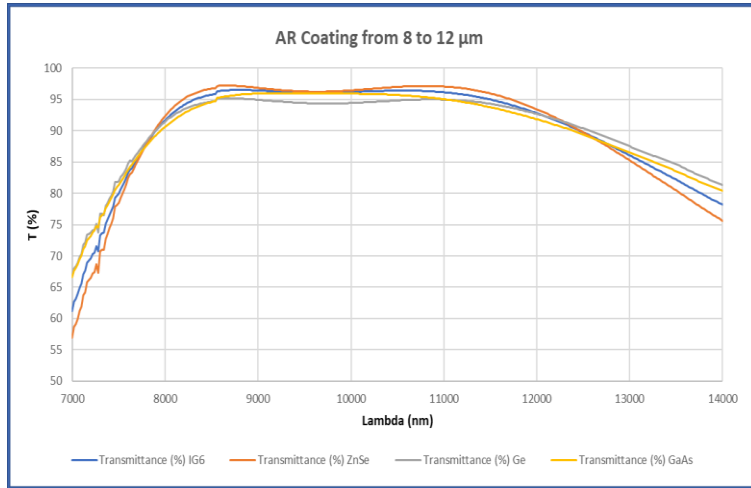


- Bragg Mirrors



Optical thin films (continued)

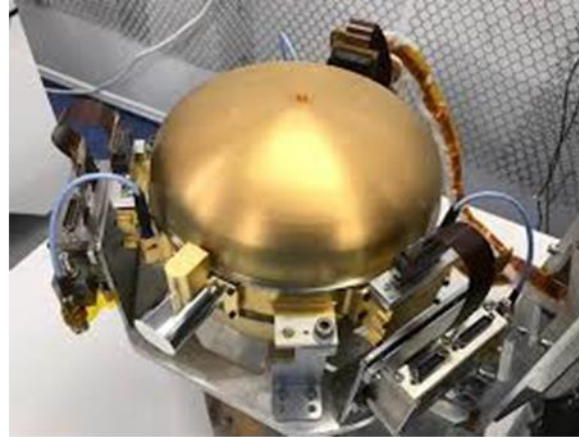
- AR Coating on Si, Ge, ZnSe
- up to 300mm optics



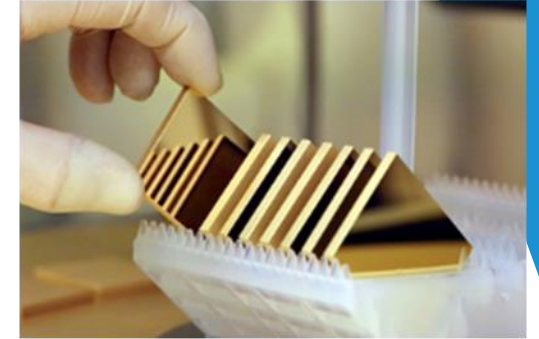
- DLC coating for IR application, up to 50 mm, need development to coat larger parts

Optical thin films (continued)

- Metallic & Dielectric Mirrors
 - Silver, Aluminum, Gold Mirror
 - Dielectric Mirror : $R > 99,5\%$
- Up to 1,4m diameter



SEIS – Mars InSight Program



*CTA Project
(more than 150
mirrors done)*

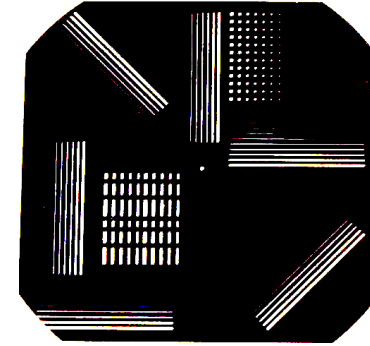


JUICE Program

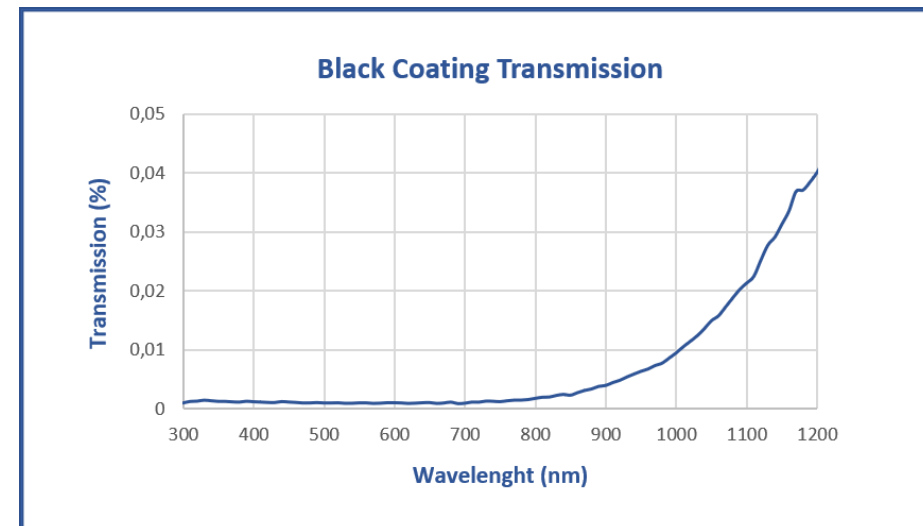
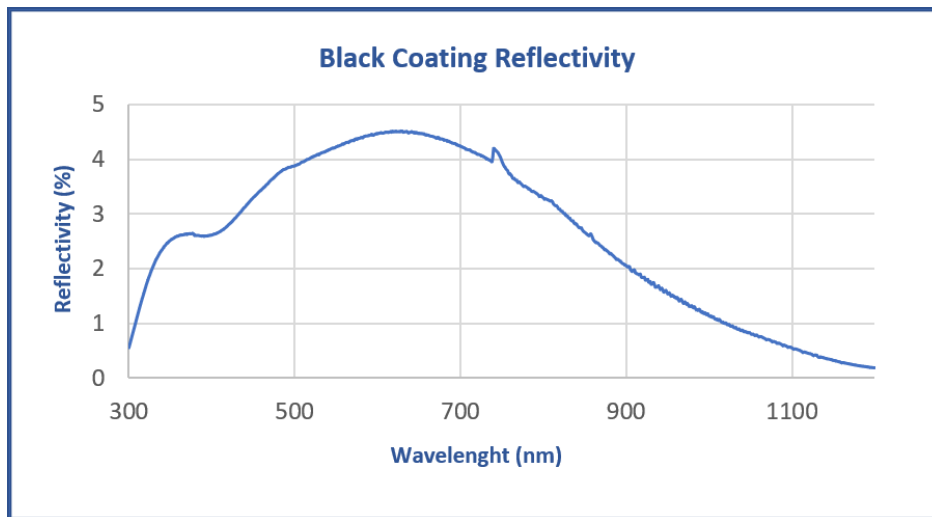


Optical thin films (continued)

- Black Coating:
 - Low Transmittance ($T < 0.01\%$)
 - Low Reflectance
 - Spectral band adapted to customer specifications from $0.3 \mu\text{m}$ to $3 \mu\text{m}$
- On flat surfaces (200 mm diameter)

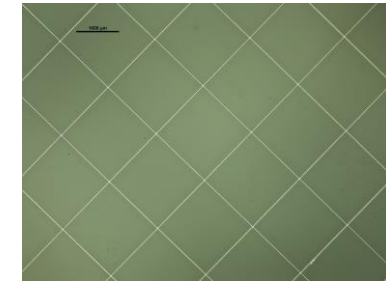
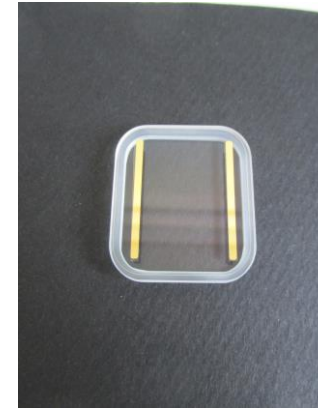


Sentinel-5 Component



ITO. Concept and applicabilities

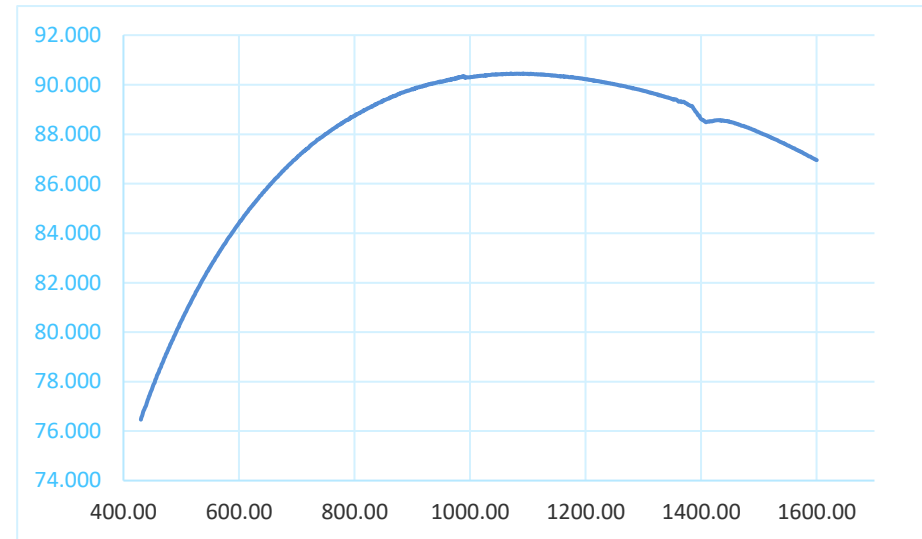
- ❖ **ITO (Indium Tin Oxide) coatings** can be applied on a variety of substrates, including glass (and even plastics)
- ❖ Mainly applications are:
 - EMI/RFI shielding**
 - ESD** (protection against electro static discharge)
 - heated optical filters for displays**
 - Active components for touch-screens
 - High performance electrodes for photovoltaic cells
- ❖ **Light transmission, absorption and reflection** are determined by the properties of the coated layer (PVD-based). Standard coatings are chosen for optimum light transmission (>80%). Generally they lie in VIS up to 1,5 micr. Range.
- ❖ **High conductive busbar** to create a contact area from the coating to the surface of the substrate as an option.



Kerdry ITO figures of merit

- ❖ Transmission ($T > 80\%$) in VIS/NIR range.
- ❖ Resistivity = $f(\text{grain density, film thickness})$

Thickness (nm)	Ohm/sq.
221	20
346	14
430	12
518	10
682	9
947	< 7,5



- ❖ Grain density depends not only on PVD technology used, but also in post growths treatments used.
- ❖ Competitive technologies -as “metal grids”- more expensive and undoubtedly not convenient for “small f”



Kerdry ITO..... coming up soon

- ❖ **ITO/flash metal/ITO** to further optimise shielding beyond 1s of GHz range & high power RF sources (RADAR)
- ❖ **Index-Matched Indium Tin Oxide (IMITO)** (medium long term) for telecom. C & L bands.
- ❖ Integration with other coatings résistant to high energy fluxes and ATOX résistances
- ❖ Markets:

Defence and Sec: C4ISR systems (even for long f)

Space: VLEO satellites and high accurately metrology in general.



Delighted to listen your requirements and propose the best shielding solution for your optical systems

Masking, lithography

- Engraving using different types of technology (**photolithography, lift-off, wet etching, laser**)
 - Resolution of up to $1\ \mu\text{m}$ in width and $0.15\ \mu\text{m}$ in thickness
 - Different types of substrates and etched materials (Al, Ag, Cr, Cu, Ni, Au, etc.)
 - Assembling optics, gluing (special processes, visible, UV)



POSITION ENCODERS



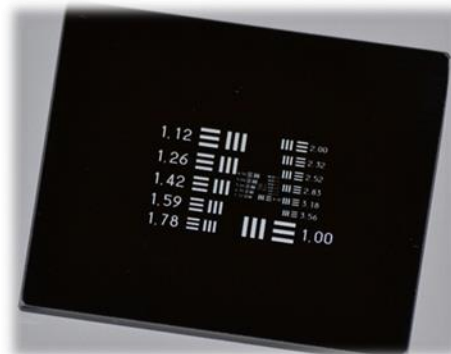
RETICLES



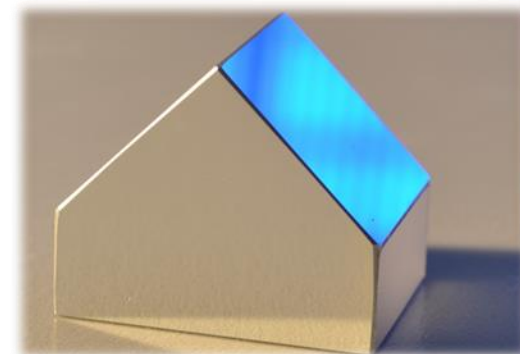
RANDOM GRIDS



GAUGES



MIRES

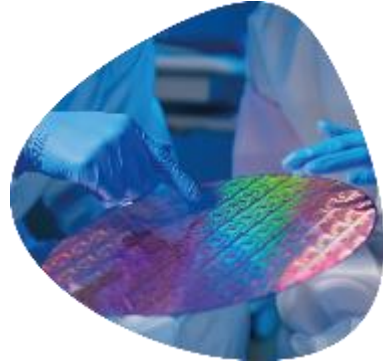
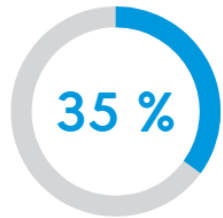


METALIZATION

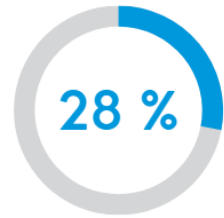
HEF PHOTONICS – key areas of activity



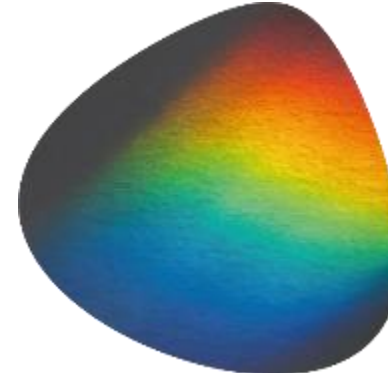
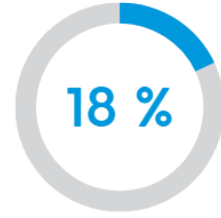
DEFENCE



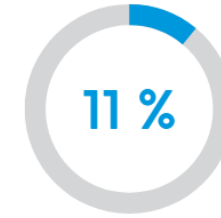
INDUSTRY



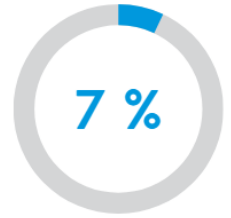
MEDICAL



INSTRUMENTATION



RESEARCH



Turnover >20 M€ (2022) **2-digit EBITDA**
CAGR >100% (2023-2028)

Breakdown as a % of 2022 turnover

Customers



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ISO 9001:2015 & ISO 14001



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