

Product Information

Yttrium Fluoride Patinal®

GENERAL INFORMATION

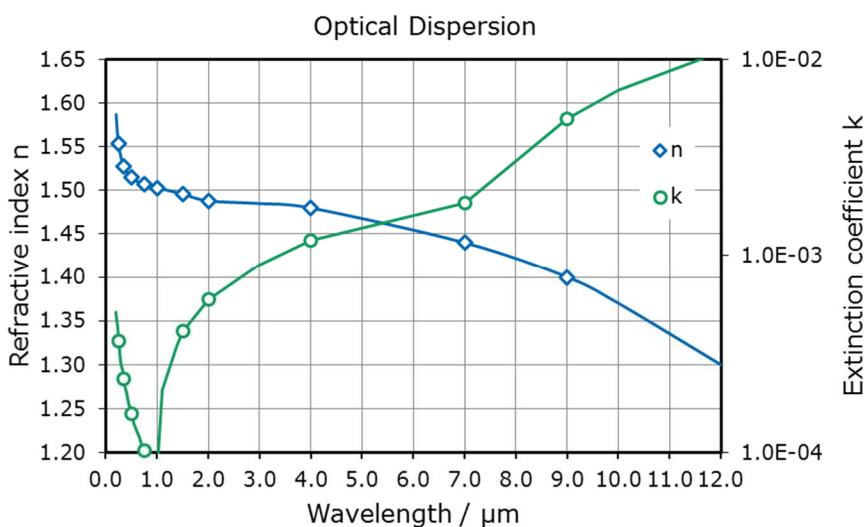
Thin films made from yttrium fluoride can be used for optical coatings from the UV to the MIR spectral range and show very good durability. They pass environmental tests of moderate abrasion, tape and adhesion even after 24 hours of humidity.

AREAS OF APPLICATION

- Multilayer coatings for UV, NIR and MIR spectral range
- Alternative to thorium fluoride for coatings in the IR spectral range

THIN FILM PROPERTIES

Range of transparency	200 – 12 μm
Refractive index	
• at 500 nm	~ 1.51
• at 10 μm	~ 1.37
Thin film stress	Tensile (low)



wavl / μm	0.25	0.35	0.50	0.75	1.000	2.00	7.00	9.00	12.00
n	1.55	1.53	1.51	1.51	1.50	1.49	1.44	1.40	1.30
k	3.7E-4	2.4E-4	1.5E-4	1.0E-4	8.5E-E	6.0E-4	1.8E-3	5.0E-3	1.1E-2

Contrary to MgF_2 which is limited to film thicknesses below $1 \mu\text{m}$ due to film stress and increasing porosity, YF_3 can be used for thicker layers of $2 \mu\text{m}$ and more because of its low tensile film stress and the density of the formed layer, which results in very low water absorption at $3 \mu\text{m}$ and $6 \mu\text{m}$.

NOTES FOR EVAPORATION

Evaporator source	Resistance heated evaporator Electron beam evaporator
Boat / liner	Mo and Ta boat W and Mo liner
Evaporation temperature	$\sim 1200 - 1400 \text{ }^\circ\text{C}$
Deposition rate	$0.8 - 1.5 \text{ nm/s}$
Substrate temperature	$100 - 175 \text{ }^\circ\text{C}$ preferably $\sim 150 \text{ }^\circ\text{C}$
Ion energy	300 eV
Ion current density	$30-50 \mu\text{A/cm}^2$
QCR-settings	Density 4.01 g/cm^3 , z-ratio 1.0

E-beam evaporation requires well optimized e-beam settings with low energy density to avoid decomposition. At substrate temperatures above $150 \text{ }^\circ\text{C}$ distinct crystalline layers are formed which cause an increase in light scattering.

YF_3 passes moderate abrasion requirements. But YF_3 and fluorides in general tend to form soft layers compared to oxides. If severe abrasion requirements have to be fulfilled a hard coating material has to be applied as a scratch resistant layer (e.g. ZnS , Y_2O_3 , DLC) on top.

Ion-assisted deposition (IAD) of YF_3 is possible. This method allows the manufacture of durable and adherent films with a thickness of $> 1.5 \mu\text{m}$ on various substrate materials (glass, fused silica, silicon, germanium). The coatings are stable in humid atmosphere and the optical properties remain unchanged after 24 hours at $50 \text{ }^\circ\text{C}$ und 95 \% rel. humidity. IAD allows to further suppress IR absorption from the water band.



PRODUCTS

Yttrium Fluoride Patinal® is available as granules.

Product Code	Description	Purity*	Dimensions
1.08707	Yttrium Fluoride Granules Patinal®	≥ 99.99 % (4N)	Granules, less than 1.0 mm

* The purity values are based on the specified trace metals.

Appearance

1.08707	Light grey crystalline granules
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SPECIFICATION

Cobalt (Co)	≤ 0.001 %	Sizes	
Copper (Cu)	≤ 0.001 %	1.08707	granules < 1 mm ≥ 90 %
Chromium (Cu)	≤ 0.001 %		
Iron (Fe)	≤ 0.002 %	Application test	
Manganese (Mn)	≤ 0.001 %	Each batch has to pass a specific application test assessing its evaporation behaviour.	
Oxygen (O)	≤ 0.2 %		

RoHS information

The RoHS compliance information is part of the Certificate of Analysis (CoA) for each batch of Patinal® material.



Quality assurance

Research, production and sales of our Patinal® evaporation materials take place under a certified DIN EN ISO 9001 quality management system and DIN EN ISO 14001 environmental management system. The quality of the materials is assured by our manufacturing processes, in-process controls and quality tests. Each batch is released only after passing our chemical analysis and application tests designed to confirm the suitability of the material for the evaporation process.

Handling precautions

Product safety information required for safe use is not included in this document. Before handling, read product and safety sheets and container labels for safe use, physical and health hazard information. The material safety data sheet is available online at www.patinal.com, from your EMD representative or distributor, or by calling your global Merck KGaA, Darmstadt, Germany, contact.

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