

Product Information

Indium – Tin Oxide (84/16) Patinal®

GENERAL INFORMATION

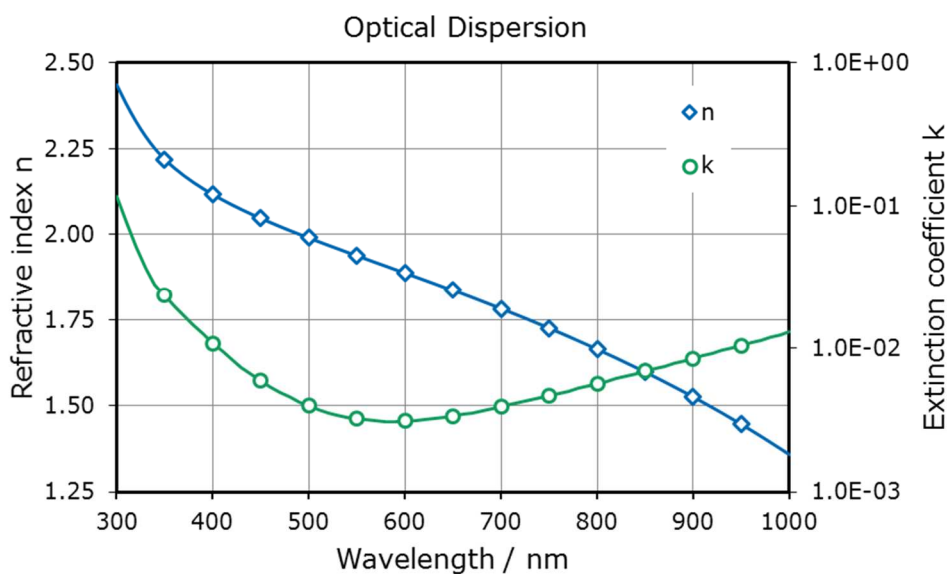
Indium – Tin Oxide Patinal® ("ITO") can be used in a vacuum deposition process for electronic or antistatic applications to make transparent optical coatings with good electrical conductivity. Indium – Tin Oxide Patinal® has an $\text{In}_2\text{O}_3/\text{Sn}_2\text{O}_3$ ratio of 84/16.

AREAS OF APPLICATION

- Transparent, electrically conductive films on glass and plastic substrates for electronic applications
- Antistatic coatings
- Adhesion promoter on polymers and metal coatings

THIN FILM PROPERTIES

Range of transparency	400 nm – 7 μm
Refractive index at 500 nm	~ 2.0
Thin film stress	Compressive



Sheet resistance, transmittance in the VIS, and reflectance in the IR region depend on the thickness of the film and the deposition conditions, such as evaporation temperature, deposition rate, oxygen pressure and ion assist parameters. The electrical conductivity of ITO films depends especially strongly on the oxygen pressure during deposition.

wavl / nm	350	450	550	700	850	1000
n	2.22	2.05	1.94	1.78	1.60	1.36
k	2.3E-02	6.0E-03	3.2E-03	3.9E-03	6.9E-03	1.3E-02

Layers of greater thickness, for example of 500 nm thickness, corresponding to $4 \lambda/2$ for 500 nm, have a relatively high reflectance in the infrared. They can be used as selective layers, for example for solar technology.

The films are hard, adhere well and are durable. No damage to the layers is observed over a 24 hour period at 95 % humidity at 35 °C or in 4 % sodium chloride solution at 25 °C.

NOTES FOR EVAPORATION

Evaporator source	Resistance heated thermal evaporator Electron beam evaporator
Boat / liner	Copper crucible, Mo-liner Mo-boat
Evaporation temperature	2000 – 2200 °C
Deposition rate	0.15 – 0.35 nm/s
Oxygen partial pressure	$2 \cdot 10^{-4}$ - $5 \cdot 10^{-4}$ mbar
Substrate temperature	Standard process: 100 to 300 °C IAD: RT – 200 °C
QCR-settings	Density 7.0 – 7.1 g/cm ³ , z-ratio 1.0

Preconditioning of the sublimating Indium – Tin Oxide Patinal® should be carried out with a sweeping e-beam to carefully fuse the surface of the material in the pocket before increasing the e-beam power to the level needed for the required deposition rate.

Deposition at substrate temperatures exceeding 100 °C can result in increased surface roughness with high optical scattering. The ITO layers formed tend to be brown to brown-grey in color. By post deposition thermal annealing in an oxygen atmosphere transmittance and sheet resistance can be enhanced after evaporation. Typical annealing temperatures would be in the range of 350 °C to 450 °C for about 2 hours. This will result in the oxidization of residual metal components and a change in thin film structure. Low sheet resistance needs to be balanced against high transmission in the VIS wavelength region.

Prior to annealing it is possible to etch ITO layers with diluted hydrochloric acid.



PRODUCTS

Indium – Tin oxide 84/16 Patinal® is available as tablets.

Product Code	Description	Purity*	Dimensions
1.11706	Indium – Tin oxide 84/16 Patinal®	≥ 99.95 % (3N5)	Tablets, about 0.6 g

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

Appearance

1.11706	Yellow-green tablets
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SPECIFICATION

Cobalt (Co)	≤ 0.0005 %
Copper (Cu)	≤ 0.003 %
Chromium (Cr)	≤ 0.001 %
Iron (Fe)	≤ 0.02 %
Vanadium (V)	≤ 0.005 %

Sizes

1.11706	h = 4.5 – 5.5 mm Ø = 6.7 – 7.3 mm
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Application test

Each batch has to pass a specific application test assessing its evaporation behaviour.

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 9001:2000 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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