

Titanium Oxide X Patinal®

GENERAL INFORMATION

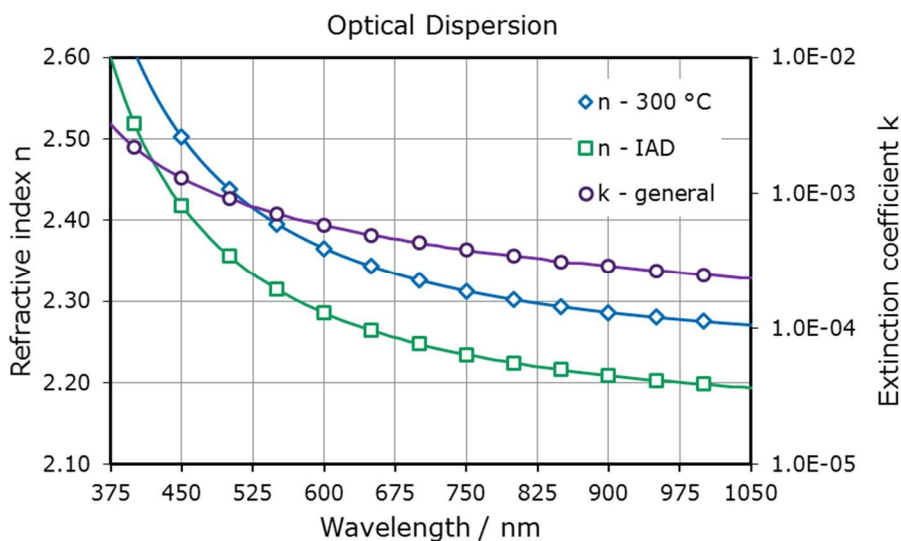
Titanium Oxide X Patinal® (chemical formula Ti_3O_5) is one of the preferred Ti-suboxides used to manufacture thin films of TiO_2 . For this purpose the material is evaporated reactively. The advantage of Titanium Oxide X Patinal® over TiO_2 is less outgassing during preparation of the melt due to the favorable oxygen-to-titanium ratio of 1.67. This results in a shorter preparation time to achieve stable conditions before the start of the evaporation process, and less risk of spattering.

AREAS OF APPLICATION

- AR and multilayer coatings on glass and plastic substrates
- UV protection for plastic substrates

THIN FILM PROPERTIES

Chemical formula	Ti_3O_5
Range of transparency	400 nm – 12 μm
Refractive index at 500 nm	~ 2.40
Absorption edge	~ 390 nm
Thin film stress	Tensile



Date of Issue: 12 / 2021, Page 1 of 5

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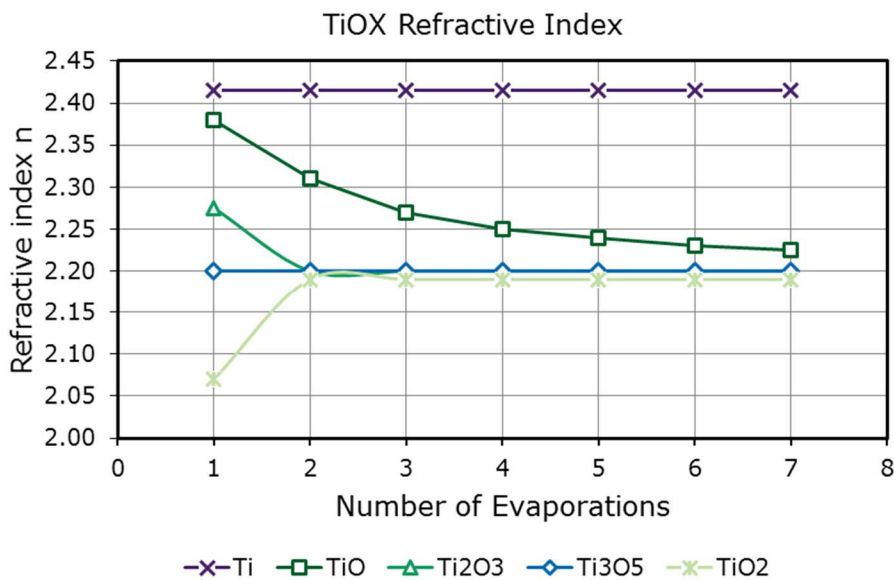
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The resulting optical properties of the thin film are strongly dependent on the deposition rate, substrate temperature and oxygen partial pressure. Strict control of these parameters allows excellent reproducibility.

wavl / nm	400	500	600	750	900	1050
n - IAD	2.60	2.44	2.37	2.31	2.29	2.27
n - 300 °C	2.52	2.36	2.29	2.23	2.21	2.20
k - general	2.0E-04	9.0E-04	5.8E-04	3.8E-04	2.8E-04	2.4E-04

Titanium Oxide X Patinal® allows for an improved reproducibility of the refractive index due to its stable oxygen/titanium ratio of 1.67. Differing ratios of oxygen to titanium require prolonged preparation time of the melt to reach stable and reproducible process conditions.



Refractive index of TiOx films as a function of the number of evaporations for various titanium starting materials, (Appl. Opt. 1976 Dec 1;15(12):2986-91, Pulker et al.)



NOTES FOR EVAPORATION

Evaporator source	Resistance heated thermal evaporator Electron beam evaporator
Boat / liner	Ta or W boat Copper crucible or Mo liner
Melting temperature	1770 °C
Deposition rate	~0.2 – 0.4 nm/s
Oxygen partial pressure	$1-2 \cdot 10^{-4}$ mbar
Substrate temperature	Conventional (without IAD): 250 to 350 °C
QCR-settings	Density 4.26 g/cm ³ , z-ratio 0.4

Evaporation conditions are similar to those for titanium(IV) oxide (TiO₂).

Titanium Oxide X Patinal[®] can be evaporated from a boat or with an electron beam evaporator. With a tungsten boat, Titanium Oxide X Patinal[®] melts without spattering and evaporates smoothly. In addition to directly cooled copper crucibles or exchangeable crucibles a molybdenum liner can be employed. The low thermal conductivity of this liner allows for easier melting of the material with less e-beam power before reaching evaporation temperature. The evaporation process can be completed easily without spattering. Titanium Oxide X Patinal[®] can be refilled without limitation.



Date of Issue: 12 / 2021, Page 3 of 5

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PRODUCTS

Titanium Oxide X Patinal® is available as granules.

Product Code	Description	Purity*	Dimensions
1.00097	Titanium Oxide X Granules Patinal®	≥ 99.95 % (3N5)	Granules, about 0.8 – 4 mm

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

Appearance

1.00097	Dark violet, glossy crystalline granules
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SPECIFICATION

Cobalt (Co)	≤ 0.0005 %	Sizes	
Copper (Cu)	≤ 0.001 %	1.00097	Granules 0.8 - 4 mm ≥ 80 %
Chromium (Cr)	≤ 0.005 %		
Iron (Fe)	≤ 0.02 %	Application test	
Vanadium (V)	≤ 0.01 %		

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 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.

Disclaimer

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Date of Issue: 12 / 2021, Page 5 of 5

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