Product Information

Niobium(V) Oxide Patinal®

GENERAL INFORMATION

Niobium pentoxide is especially suited for IAD processes and a suitable alternative to TiO_2 with its high refractive index and low absorption. However the layers may show some absorption when deposited by conventional thermal evaporation. Similar to tantalum pentoxide, niobium pentoxide emits oxygen during melting and evaporation, requiring reactive evaporation. Due to the similarities in the process for those two materials, Nb_2O_5 is a close alternative to Ta_2O_5 and, in contrary to tantalum, not included on the list of "conflict minerals" mentioned in the Dodd-Franck Wall Street Reform and Consumer Protection Act.

AREAS OF APPLICATION

- Multi-layer coatings for laser mirrors and beam splitters
- Anti-reflection coatings on glass in VIS and NIR

THIN FILM PROPERTIES

Chemical Formula	Nb_2O_5
Range of Transparency	380 nm – 7 µm
Refractive index at 500 nm	
• conventional T_s = 300 °C / no IAD	~ 2.25 – 2.30
• IAD – T_s = RT	~ 2.30 – 2.35
Thin film stress	Compressive

The 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	375	450	550	700	900	1200
n - IAD	2.495	2.341	2.266	2.220	2.196	2.181
k - IAD	2.5E-03	4.6E-04	2.0E-04	1.1E-04	6.9E-05	4.6E-05

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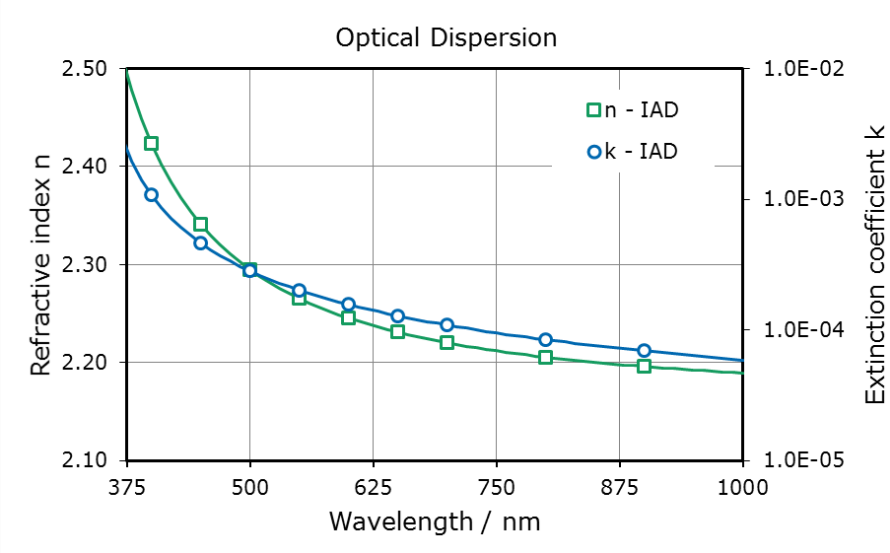
* EMD Performance Materials is a business of Merck KGaA, Darmstadt, Germany



NOTES FOR EVAPORATION

Evaporator source	Resistance heater thermal evaporator Electron beam evaporator
Boat / Liner	Ta or W boat Copper crucible or Mo liner
Melting temperature	1512 °C
Deposition rate	0.2 – 0.5 nm/s
Oxygen partial pressure	$1\text{-}3 \cdot 10^{-4}$ mbar
Substrate temperature	Conventional (without IAD): 150 to 300 °C IAD: RT – 150°C
IAD settings (Leybold APS)	80 – 130 V Bias, 30 – 40 sccm O_2
QCR-settings	Density 4.26 g/cm³, z-ratio 0.4

Nb_2O_5 shows a high suitability for IAD processes and a good evaporation behavior resulting in homogeneous layers and low absorption values for IAD processes with oxygen assistance. For IAD processes with a Leybold APS source, the maximum index of refraction can be achieved at a bias voltage of 100 V. At an APS bias voltage of 80 V, almost stress free Nb_2O_5 coatings can be produced.

With optimized conditions layers without optical absorption in the visible can be obtained. However, in some cases, e.g. at higher substrate temperature or after several consecutive evaporations from one crucible without replenishment of material, Nb_2O_5 layers do show some absorption. The removal of this absorption is done by heat-treatment, e.g. baking the coatings for one hour at 400 °C in air.

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PRODUCTS

Niobium(V) Oxide Patinal® is available as granules.

Product Code	Description	Purity*	Dimensions
1.01759	Niobium(V) Oxide Granules Patinal®	≥ 99.95 % (3N5)	Granules, about 1 – 4 mm

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

Appearance	
1.01759	White granules

SPECIFICATION

Cobalt (Co)	≤ 0.001 %
Copper (Cu)	≤ 0.001 %
Chromium (Cu)	≤ 0.002 %
Iron (Fe)	≤ 0.005 %
Vanadium (V)	≤ 0.005 %

RoHS information

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

Sizes	
1.01759	Granules 1 - 4 mm ≥ 80 %

Application test

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

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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.

Disclaimer

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