Patinal®

Evaporation Materials

PRODUCT INFORMATION

Niobium(V) oxide Patinal®

EMD Chemicals Inc.
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NOTES AND EXPLANATIONS

We advise our customers regarding technical applications to the best of our knowledge within the scope of the possibilities open to us, but without obligation. Current laws and regulations must be observed at all times. This also applies in respect to any protected rights of third parties. Our suggestions do not relieve our customers of the necessity to test our products, on their own responsibility, for suitability for the purpose envisaged. Quotations from our literature are only permitted with our written authority, and the source must be stated.

The products information sheet is based on our own investigations and on literature data. The properties of the materials in thin coatings are affected by the choice of deposition conditions. For this reason, coating properties quoted are to be understood as being typical values and cannot be guaranteed. As far as possible, the conditions under which the coating properties were achieved are indicated.

QUALITY CONTROL

During quality control of the products analyses were performed with the aim to measure those properties of the products which are of major importance for the applicability of the products and the properties of the coatings. Chemical analysis is performed to determine the specified impurities. Furthermore application testing is performed to analyze the behavior of the product during melting and evaporation. Also thin coatings are made to analyze transmittance and refractive index. The values listed in the specification are guaranteed impurity limits determined on representative samples of each production batch.

SAFETY NOTE

Working safety requires that products which are formed during evaporation to be kept in the closed system. If fine dust develops during cleaning of evaporation equipment suitable respiratory protection must be provided (approved respirators).

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GENERAL

Niobium pentoxide is especially suited for IAD processes. With conventional thermal evaporation, absorption of the layers may occur. Similar to Tantalum pentoxide, Niobium pentoxide emits oxygen during melting and evaporation, requiring reactive evaporation.

ITEMS

1.01759.0100	Niobium(V) oxide granules about 1-4 mm Patinal® 100 g package
1.01759.1000	Niobium(V) oxide granules about 1-4 mm Patinal® 1 kg package

SPECIFICATION

Cobalt (Co)	≤ 0.001 %
Chromium (Cr)	≤ 0.002 %
Copper (Cu)	≤ 0.001 %
Iron (Fe)	≤ 0.005 %
Vanadium (V)	≤ 0.005 %
Particle size 1-4 mm	≥ 80 %
Application test	conforms
RoHS information:	
Cd (Cadmium)	≤ 0,01 %
Hg (Mercury)	≤ 0,1 %
Pb (Lead)	≤ 0,1 %
PBB (polybrominated biphenyls)	≤ 0,1 %
PBDE (polybrominated diphenyl ethers)	≤ 0,1 %

The Chromium(VI) concentration (RoHS requirements: ≤ 0.1 %) is always smaller than or equal to the total chromium concentration.

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EVAPORATION PROCEDURE

Usually Nb_2O_5 is melted under a shutter and after that is evaporated reactively with addition of oxygen through a needle valve. During melting and at the beginning of evaporation of Nb_2O_5 oxygen is developed which causes a temporary increase of the chamber pressure.

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

RECOMMENDED COATING CONDITIONS

Evaporation source	**electron beam**
Crucible	copper, water cooled
Chamber pressure before evaporation	about 10^{-5} mbar
Oxygen partial pressure	about 10^{-4} mbar
Deposition rate	0.2 – 0.4 nm/sec
Substrate temperature	150 – 300 °C

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EXAMPLE

The following results are obtained with a Nb2O5 coating after evaporation, without thermal after-treatment.

The optical properties refractive index n and absorption index k were calculated using KS Film software. The geometrical layer thickness is about 256.7 nm. The coating shows a negative inhomogeneity of -4 % (decreasing refractive index).

Wavelength [nm]	**Refractive index n**	**Absorption index k**
400	2.155	$1.1 * 10^{-3}$
500	2.070	$7 * 10^{-4}$
600	2.029	$6 * 10^{-4}$
700	2.006	$5 * 10^{-4}$
800	1.992	$4 * 10^{-4}$

Transmittance and reflectance are measured with a Cary 3E and VW equipment. The transmission range is from 360 to 9000 nm.

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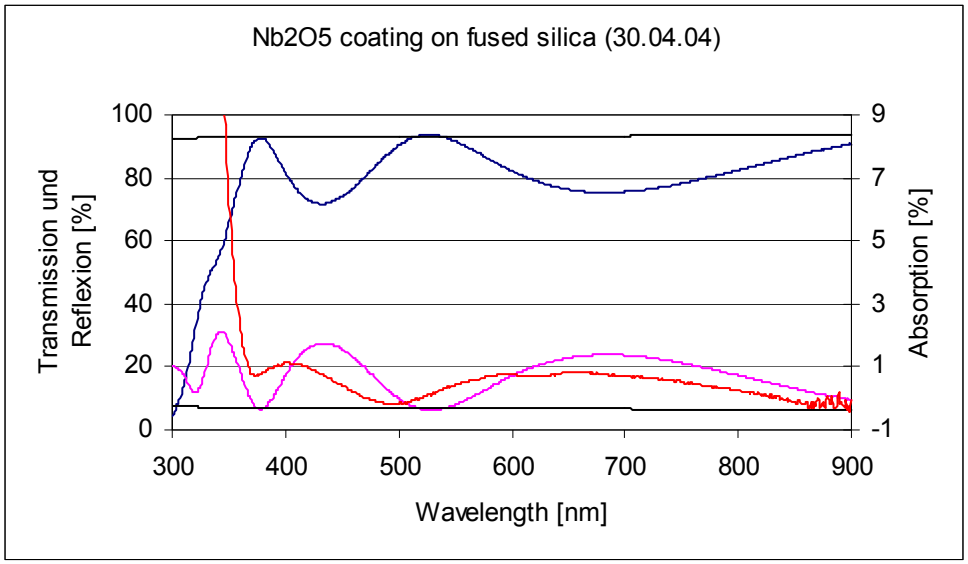
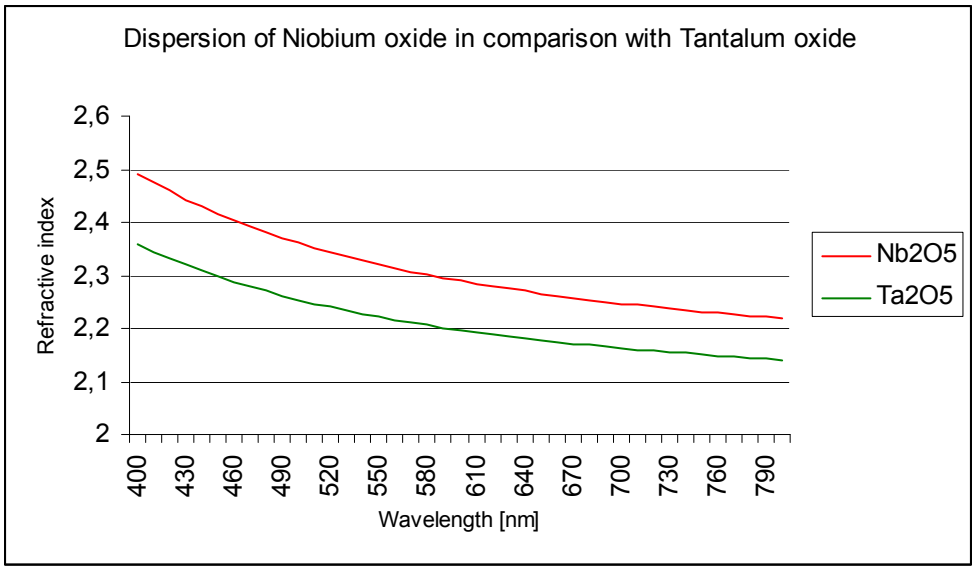
Transmittance and reflectance spectra of Nb_2O_5 layer on fused silica:



Dlispersion



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