Product Information

Substance WR4 Patinal®

GENERAL INFORMATION

Substance WR4 Patinal® was developed for the deposition of hydrophobic layers by vacuum evaporation. Compared to other hydrophobic layers, Substance WR4 Patinal® has the following advantages:

- In addition to its excellent hydrophobic properties, Substance WR4 Patinal® is also oleophobic which eases the removal from e.g. fingerprints.
- Substance WR4 Patinal® forms very durable and well adhering coatings on silicate and oxide layers.
- Substrates made from both mineral glass and plastics can be coated with Substance WR4 Patinal®.

The low reflection of an AR-coated surface increases the visibility of fingerprints and other contaminations due to a larger contrast between clean and dirty surface areas. The excellent hydrophobic and oleophobic properties of Substance WR4 Patinal® protect these surfaces from becoming contaminated and not being fully functional any more. Additionally, a WR4-coated layer is easier to clean.

Substance WR4 Patinal® is delivered as tablets made from a metallic carrier doped with the hydrophobic substance. Substance WR4 Patinal® must be stored in a cool and dry location in the originally sealed package as described on the following page.

AREAS OF APPLICATION

- Hydrophobic & oleophobic topcoat for ophthalmic lenses
- Topcoat for camera lenses, binoclular lenses & automotive cameras
- Topcoat for optical filters, spectroscopic windows & other sensitive optical components

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THIN FILM PROPERTIES

Substance WR4 Patinal®	Static θ_s	Sliding angle	Boiling test	Acidic resistance	Salt water	Abrasion test (4000 cycles)
Water	116°	30°	116°	112°	112°	~ 105°
Ethylene Glycol	102°	23°	102°			
Hexadecane	70°	8°	70°			

Typical contact angles for Substance WR4 Patinal® measured with a Krüss DSA 100

The sliding angle is a good indicator for the smoothness of a coating. This measurement is performed with a tilting table on a Krüss DSA 100. A 15 µl droplet of water is applied to the coated surface, then the angle of the table is slowly increased to determine the angle at which the droplet starts to slide off. Substance WR4 Patinal® shows a sliding angle of about 28°.

The boiling test was performed by immersion of the coating in boiling hot water for a period of 30 min. The contact angle was measured before and after the test.

Acidic resistance was tested by immersion of the coating in a 5% wt HCl(aq) solution for a period of 72 hours. The contact angle was measured before and after the test.

The salt water test was performed by immersion of the coating in a 4.6% wt NaCl(aq) solution for a period of 72 hours. The contact angle was measured before and after the test.

Substance WR4 Patinal® shows highest mechanical durability and resistance to wiping and abrasion. The stability of the coating is judged by comparing the water contact angle on Substances WR4 Patinal® before and after performing an abrasion test with steel wool.

Test conditions:

- Cycles: up to 8000, 1 cycle = 2 hubs of 50 mm
- Hub length: 50 mm
- Speed: 60 cycles/min
- Load: 10 N/cm²
- Abrasion material: Steel wool #0000

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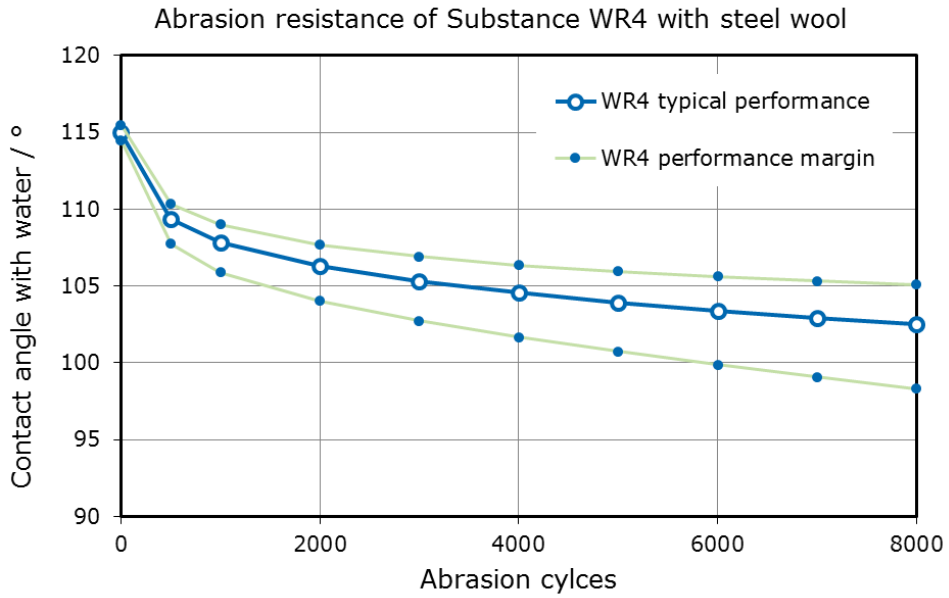

NOTES FOR EVAPORATION

Evaporator source	Resistance heated thermal evaporator Electron beam evaporator (indirect)
Boat / liner	Box type Ta or W boat Mo or Ta-Liner with perforated cover
Boat temperature	400 – 800 °C recommended 600 – 800°C
Chamber pressure	< $4 \cdot 10^{-5}$ mbar
Substrate temperature	From RT up to < 300 °C recommended < 150 °C
QCR-settings	Density 1.5 g/cm³, z-ratio 1.0
Thickness (QCR)	15 – 20 nm (depending on tooling factor)

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For proper application of Substance WR4 Patinal® we suggest to follow these steps:

1. Substrate cleaning
2. Tablet placement
   Open the original package just before closing the vacuum chamber and pump down. Take the tablet without touching by hand, place it in the evaporator and pump down without delay
3. Plasma pretreatment
   - Process gas: Ar or Ar/O_2 mixture (80% / 20%)
   - Process time: ≥ 3 min
4. Adhesion layer deposition
   - Material: SiO_2 (preferred), Al_2O_3, ZrO_2 etc.
   - Deposition rate: 0.15 – 0.3 nm/s
   - Thickness: 5 - 30 nm
5. Deposition of Substance WR4 Patinal®
   - Evaporation type: thermal (e.g. Mo-Boat) or e-beam (indirect by covered liner)
   - Process power: constant power (no rate control), low power setting depending on equipment used
   - Substrate temperature: RT – 150 °C
   - Boat temperature: 600 °C – 800 °C
   - Process time: 60 s – 90 s till rate starts, additionally up to 300 s for depletion of tablet
   - Chamber pressure: < $4*10^{-5}$ mbar
   - Density setting: 1.5 g/cm^3, Z-Ratio: 1.0, Tooling-factor: 100%
   - Thickness (quartz crystal reading): 15 nm – 20 nm (depends on tooling)
6. Post deposition ripening (optional)
   - Chemical ripening will also be achieved during normal storage, without acceleration.
   - Optional: Store in a warm and humid environment (e.g. > 50 °C @ 80% RH) for > 2 h
   - Optional: Curing in air for ca. 1 h at higher temperatures (up to 150 °C)
   - Optional: Wet processing in water at temperatures of > 60 °C

The evaporated substance forms a thin layer on the substrate. Optimum properties can be obtained for films of ca. 20 nm with full depletion of the tablet. Durable films with good adhesion can be deposited onto oxidic surfaces, especially on SiO_2 films. Substance WR4 Patinal® can also be deposited directly onto MgF_2 layers on mineral glass with acceptable performance. Predeposition of a few nm of SiO_2 on MgF_2 is suggested for even better durability.

The refractive index of Substance WR4 Patinal® is about 1.3 in the visible spectral range. For optimum results on AR-coatings, the final AR-Layer should be reduced in optical thickness to compensate the added Substance WR4-Layer.

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PRODUCTS

Substance WR4 Patinal® is available as doped metallic tablets.

Product Code	Description	Dimensions
1.01822	Substance WR4 Tablets Patinal®	Ø 11 mm x h 7 mm

Storage conditions

Store cool and dry in the originally sealed package at a temperature range between +2 and +8°C, lower temperatures are allowed. ***Allow full accommodation to room temperature*** before opening the package in order to prevent condensation of humidity from the environment onto the tablet.

Transportation conditions

Substance WR4 Patinal® in the original package can be transported without detrimental effect on shelf life.

SPECIFICATION

RoHS information

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

Contact angle	≥ 110°

Sizes

1.01822	h = 6.5 – 7.5 mm Ø = 10.5 – 11.5 mm

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.

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