

Product Information

Black A Patinal®

GENERAL INFORMATION

Black A Patinal® is a light grey powder consisting of SiO₂ & Cr suitable to produce dark-brown to black low reflectance layers on glass and plastics. These layers are always brown in transmission, not black. The name Black A originates from the original application in the 80's where it was used as an almost black reflecting material for sunglasses. The Black A layers are hard, adhesive and resistant against humid air (90 % humidity at 35 °C) and salt solutions (4 % NaCl in water at 25 °C). They are not affected by temperature (8 hours at 360 °C in air).

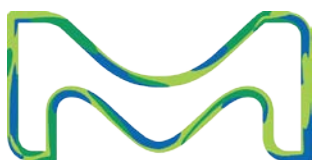
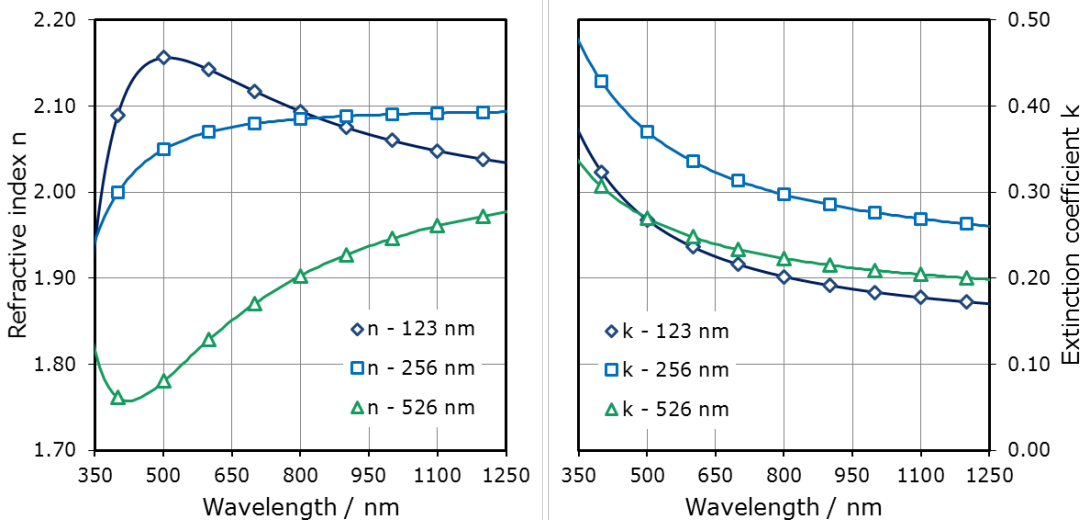
AREAS OF APPLICATION

- Light absorbing filters
- Sun glasses
- Scales or decorative coatings

THIN FILM PROPERTIES

Refractive index n and extinction coefficient k are correlated to the coating thickness and conditions.

Optical Dispersion of Black A in relation to layer thickness



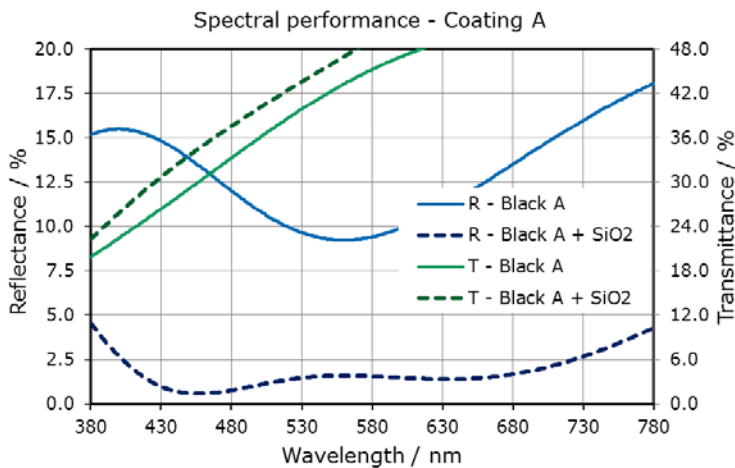
The dispersion can be described by the Cauchy and exponential extinction equations:

Cauchy's equation: $n(\lambda) = B + \frac{C}{\lambda^2} + \frac{D}{\lambda^4}$

Exponential extinction: $k(\lambda) = E_1 \exp(E_2 \cdot \lambda^{-1})$

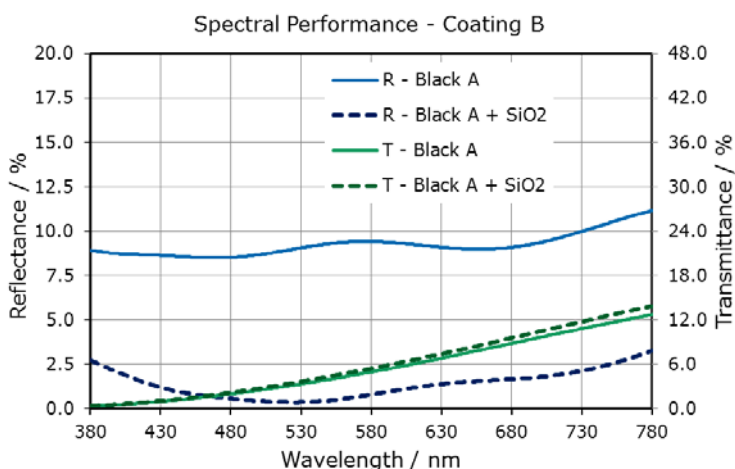
Cauchy's equation	Wavelengths			Exponential extinction	E ₁	E ₂	E ₃
	123 nm	256 nm	526 nm				
B	1.981	2.097	1.938	E ₁	0.126	0.206	0.162
C	9.056E-02	-5.091E-03	6.36E-03	E ₂	0.377	0.293	0.255
D	-1.171E-02	-1.680E-03	1.86E-03				

Black A layers develop an almost black glass/layer interface when observed in reflection, the layer/air interface will develop a more metallic behavior with increasing thickness and can be AR-coated by SiO₂ or SiO, depending on the deposition conditions. This should be determined by experiments.



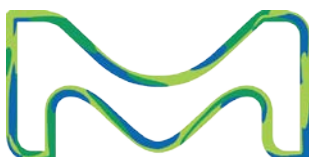
Coating A:

Black A 125 nm
 SiO₂ 80 nm
 Substrate BK7



Coating B:

Black A 525 nm
 SiO₂ 70 nm
 Substrate BK7



NOTES FOR EVAPORATION

Evaporator source	Resistance heated evaporator
Boat	Mo boat
Evaporation temperature	~1600 °C
Deposition rate	0.6 – 1.0 nm/s
Oxygen partial pressure	$\leq 5 \cdot 10^{-5}$ mbar
QCR-settings	Density 4.00 g/cm ³ , z-ratio 1.0

The substrates should be cleaned carefully prior to deposition and treated by glow discharge. It is recommended to evaporate Black A Powder Patinal® from molybdenum boats at a pressure of less than $5 \cdot 10^{-5}$ mbar.

The boat should be heated within one minute to the evaporation temperature of about 1600 °C. A layer thickness of 120 nm should be obtained within three minutes. The material remaining in the boat has to be rejected.

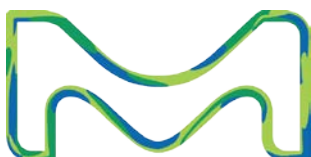
It is suggested to apply an overcoat with silicon dioxide or silicon monoxide in order to reduce reflection. For this purpose silicon monoxide should be evaporated with high deposition rate at a pressure less than $5 \cdot 10^{-5}$ mbar until the desired reflection is achieved. The resulting layer properties strongly depend on the conditions of the coating process.

INSTRUCTIONS FOR ETCHING

Refractive index n and extinction coefficient k are correlated to the coating thickness and conditions.

For masking to the appropriate pattern the film may be etched using the following procedure:

1. Treatment for 30 seconds with a mixture consisting of equal parts of hydrofluoric acid (HF) 40 %, concentrated sulfuric acid (H₂SO₄) and water (H₂O)
2. Rinse with water
3. Treat with concentrated ferric chloride (FeCl₃) solution until the color of the layer becomes light
4. Rinse with water
5. Apply the mixture as for step 1 again
6. Rinse with slightly warm (40 °C) water



PRODUCTS

Black A Patinal® is available as powder.

Product Code	Description	Dimensions
1.15031	Black A Powder Patinal®	Powder, less than 0.3 mm

Appearance

1.15031	Grey powder
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SPECIFICATION

RoHS information

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

Application test

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

Sizes

1.15031	< 0.315 mm ≥ 90 %
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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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