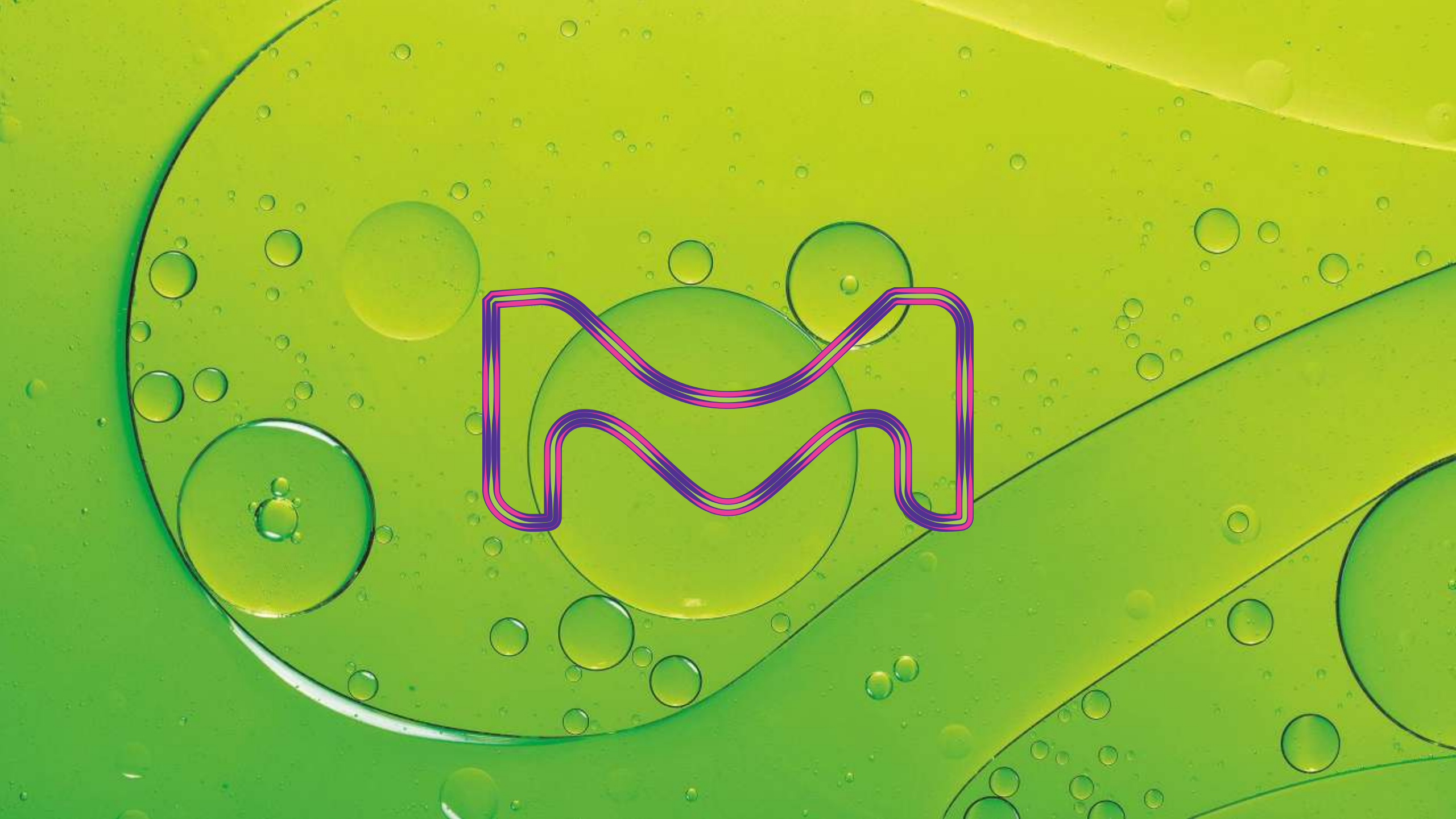


# PHOTONICS

## Patinal® & Optipur®

04/04/2019

MERCK

# Merck – Welcome Future

01 **Photonics**

1.1 **Patinal**

1.2 **Optipur**

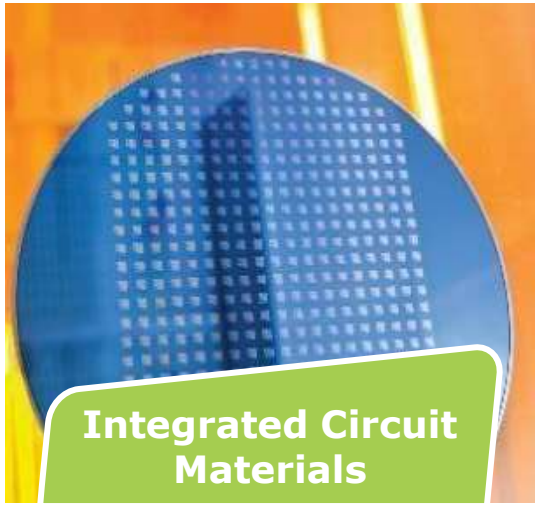
02 **Quality Assurance**

# Performance Materials

## Our products


Liquid crystals and photoresists for LCD televisions, smartphones, tablet computers, and other displays


Effect and functional pigments for coatings, plastics, foods or cosmetics as well as functional materials for specialist applications




Dielectrics, silica, lithography, photoresists, yield enhancers, edge bead removers and other ancillary products for the production of integrated circuits


Materials for organic (OLED) and inorganic (LED) light emitting diodes and functional materials for electronics and energy solutions

# Advanced Technologies


**OLED platform:**

- OLED materials for application by vapor deposition or printing for display and lighting applications

**Quantum materials platform:**

- Semi-conductor nanocrystals for next generation displays


**Lighting platform:**

- Phosphors for high efficiency LED lighting
- Photoresists for LED
- Barrier and encapsulation materials

**Photovoltaics platform:**

- Materials for high efficiency silicon and third generation solar cells

**Photonics and Technical Industries platform:**

- Evaporation materials for high performance optics
- Materials for single crystal growth
- Specialty chemicals for technical applications


**Identify & build new platforms for specialty materials, e.g.:**

- Materials for next generation organic and inorganic electronics e.g. sensors, circuits and flexible displays
- Fuel cell solutions for automotive applications
- Electrochemically stable ionic liquids e.g. for super capacitors
- Novel materials for adjustable intra-ocular lenses
- Material development in areas such as energy storage and other high-tech applications

02

# PHOTONICS PRODUCTS
## PATINAL® & OPTIPUR®

# Our Photonics Brands

**High quality functional materials for photonics applications:**

## Patinal®

Evaporation materials for high-performance optical coatings

## Optipur®

High purity precursors for single crystals

**Patinal®**
**Evaporation Materials**

# 2.1 PATINAL

# Patinal® Materials
## for High-Performance Optics

Patinal ®
for High-Performance Optics

**A portfolio of over 40 highly reliable materials for optical thin films**

- Whole range of low, intermediate and high refractive index materials
- High density and crystalline materials
- Excellent process stability
- Wide transparency range

# Materials Overview
## Fluorides, Oxides, Oxide Mixtures

Patinal ®
for High-Performance Optics

| | |
|---|---|
| Fluorides | $AlF_3$, $CeF_3$, Chiolite, Cryolite, $GdF_3$, $LaF_3$, $MgF_2$, $NdF_3$, $PbF_2$, $YbF_3$, $YF_3$ |
| Oxides | $Al_2O_3$, $HfO_2$, $Nb_2O_5$, $SiO_2$, TiO, $Ti_2O_3$, $Ti_3O_5$, TIO S, $TiO_2$, $Ta_2O_5$, $Y_2O_3$, $ZrO_2$ |
| Oxide Mixtures | H1, H2, H4, H8, L5, M1, M2, M3, M5, ITO |

# Materials Overview
## Sulfides, Metals, Color Mixtures, Hydrophobic/ Oleophobic

| | |
|---|---|
| Sulfides | ZnS |
| Metals | Ag, Cr |
| Color Materials | Black A, Brown A |
| Hydrophobic/ Oleophobic | WR1, WR4 |

# Applications
## Precision Optics, Ophthalmics, Lighting

Patinal ®
for High-Performance Optics

### Examples

Camera Optics, Microscopy

Optical Data Storage

Medical Lighting, Eyewear

…

### Fluorides
$MgF_2$, $CeF_3$, $LaF_3$, $NdF_3$, $PbF_2$, $YbF_3$, $YF_3$

### Oxides and Oxide Mixtures
$SiO_2$, $Al_2O_3$, $Y_2O_3$, SiO, M2, $HfO_2$, $Ta_2O_5$,
L5, M1, M2, M3, M5, H1, H2, H4

### Sulfides
ZnS

### Easy to Clean Coatings
WR1, WR4



Patinal®

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# Applications
## UV Optics

**Examples**

UV Laser Components for Lithography, Materials Processing, Surgery

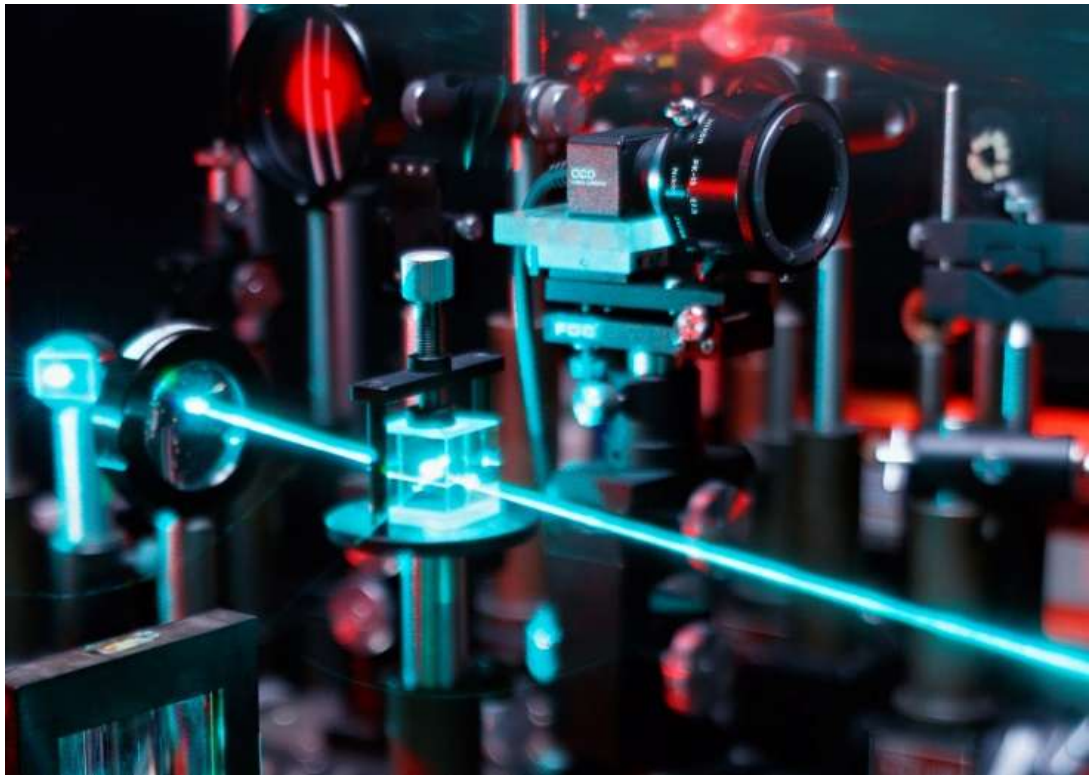
UV Astronomy

….

**Fluorides**
$AlF_3$, $MgF_2$, $NdF_3$, $LaF_3$, $GdF_3$, Cryolite

**Oxides**
$SiO_2$, $Al_2O_3$, $HfO_2$

**Oxide Mixtures**
M1, M2, M3, M5



# Applications
## IR Optics

### Examples

Night Vision / Thermal Imaging

Material Processing ($CO_2$ – Lasers)

Optical Data Networks

Guidance Systems

…

### Fluorides

$MgF_2$, $CeF_3$, $LaF_3$, $NdF_3$, $PbF_2$, $YbF_3$, $YF_3$

### Oxides and Oxide Mixtures

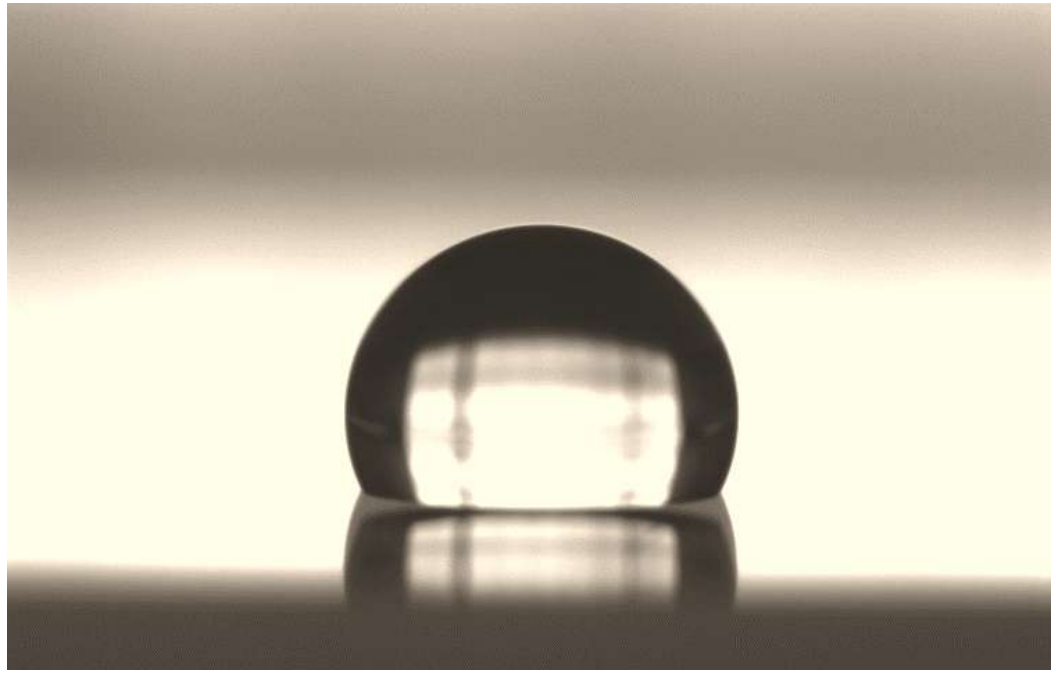
$SiO_2$, $Al_2O_3$, $Y_2O_3$, SiO, M2, $HfO_2$, $Ta_2O_5$, H4

### Sulfides

ZnS

# Substance WR4 Patinal®

Ready-to-use pre-doped tablets of evaporation material providing **water and smudge repellent durable coatings** to optical surfaces

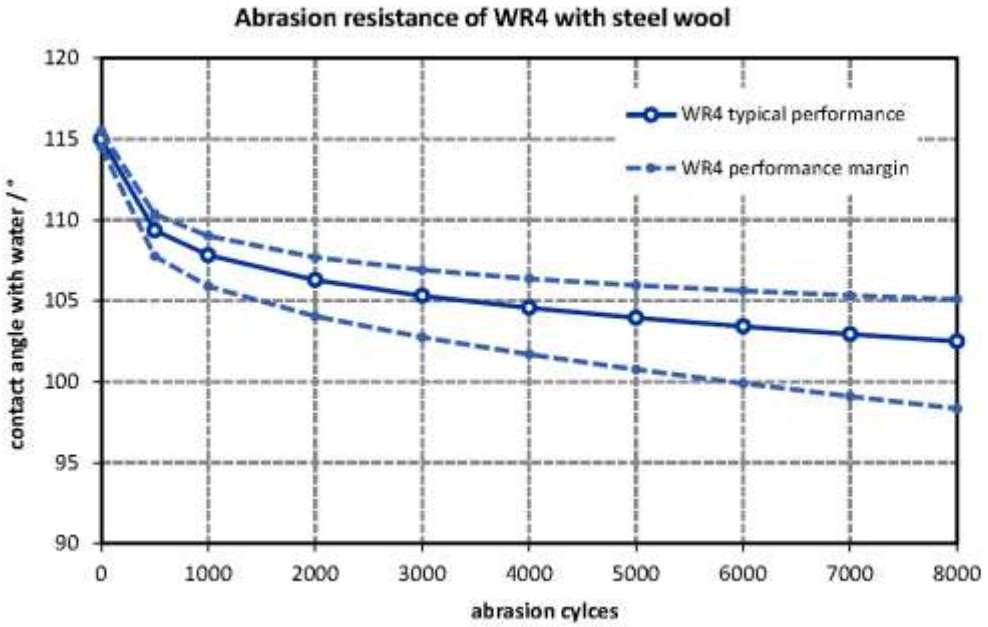


# Properties of Substance
## WR4 Patinal®

Patinal ®
for High-Performance Optics

**Enables solutions for every request in the field of hydrophobic and oleophobic coatings**

| Property | Substance WR4 Patinal® |
|---|---|
| Contact Angle (water) | 116° |
| Contact Angle Hysteresis (water) ($\theta_a$-$\theta_r$) | 12° |
| Sliding Angle (water) | 30° |
| Abrasion Resistance | + |






Patinal®

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# 2.2 OPTIPUR

# Optipur® Portfolio

## Materials for the production of single crystals

optipur®

percursors for single crystals

| Substance | Formula | Packages | Item No. |
|---|---|---|---|
| Barium Fluoride Optipur® | $BaF_2$ | 50 kg | 1.01705.9050 |
| Lead (II)-Fluoride Optipur® | $PbF_2$ | 10kg | 1.07386.9010 |
| Lithium Fluoride pieces Optipur® | LiF | 2.5 kg | 1.05689.2500 |
| Magnesium Fluoride pieces Optipur® | $MGF_2$ | 50 kg | 1.16715.9050 |
| Sodium Iodide Optipur® | NaI | 50kg | 1.06502.9050 |
| Potassium Dihydrogen Phosphate Optipur® | $KH_2PO_4$ | 25kg | 1.04872.9025 |

**Key-materials are NaI (scintillators) and $MgF_2$ (UV-optics)**

# Sodium Iodide - Optipur®

## Precursors for single crystals

optipur®

percursors for single crystals

Sodium Iodide (NaI) is the most popular activated scintillation material, utilized in medical and safety systems for the detection of x- and gamma-rays

- Our NaI Optipur material is a crystalline powder of high purity perfectly suitable for production of single crystals
- DIN-ISO and DQS-Certified processes
- Customer specific optimization
- Technical support

# Optipur® Portfolio
## Application

optipur®
percursors for single crystals

### Typical application of Optipur® materials for crystal growth

- Scintillator materials: NaI and $BaF_2$
- Laser optics (substrates): $MgF_2$ (UV), LiF (UV), $BaF_2$ (IR)
- Oxygen scavenger: $PbF_2$
- Non-linear-optics: KDP (the last in the list)

**Website**

optipur.com
MSDS, TDS, CoA online



Optipur®

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# 02 QUALITY ASSURANCE

# Production

**Merck Gernsheim Site Germany**

**Photonics**

… is part of the Performance Materials

**Advanced Technologies**

Business Unit

# GUARANTEED QUALITY

Emanuel Merck set standards for the quality of his products early on. In 1851, he personally guaranteed the quality of his products, writing in a letter to a customer:

**“I guarantee you consistent purity of my preparations and will compensate you for any loss arising from an impure preparation.”**

Shortly thereafter, he established his own control lab, with which he also set quality standards.

## Specification and Certificate of Analysis

- We selectively specify and analyze contaminants with the highest detrimental impact on product quality
- RoHS compliance is verified for each batch
- Purity values are included to assist in the search for high-purity materials
- The purity values have been calculated from the impurity concentrations $C_i$ using $P[\%] = 100\% - \Sigma_i C_i[\%]$,
  In most cases, this is identical to a **trace metal analysis**.

## Quality is a Matter of Trust

- We believe that reproducibility and consistency is a key factor for our customers in their coating operation
- Stable, high yield processes rely on stable, consistent material quality: **one problem less to worry about!**

# quality control

About Specifications of Patinal® Evaporation Materials



MERCK

**Physical properties**

E.g. sieve analysis (granule size), apparent density, bulk density

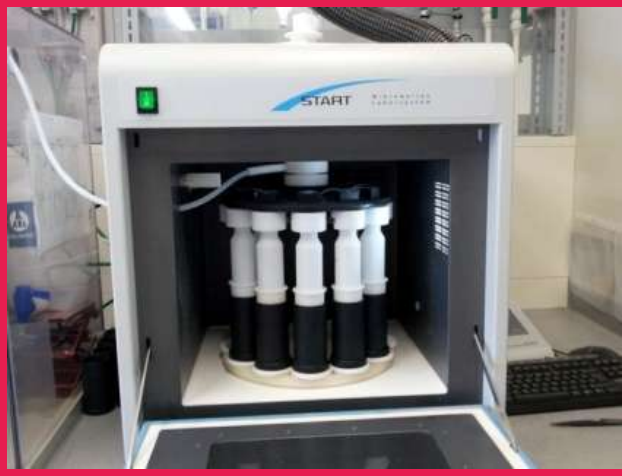
**Application tests**

Evaporation tests for Patinal®

Refractive index, spitting, absorption, fluorescence…

# quality control

Central Function




**Chemical composition**

- Composition determination
- Element spectroscopy (ICP-OES, F-AAS, GF-AAS, FI-CAAS)
- C-, O-, N-analysis
- Measurements at Darmstadt site (e.g. XRF, ICP-MS)

**All materials will be tested according to specifications (agreed physical, chemical and application test)!**

# THANK YOU!