



**umicore**  
Metal Deposition Solutions

**PASSION FOR  
PERFECT SURFACES**

**THIN FILM PRODUCT SOLUTIONS  
FOR OPTICAL APPLICATIONS**

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# WORLD LEADER IN MATERIAL TECHNOLOGY

Umicore is a materials technology group focused on application areas where know-how in materials science, chemistry and metallurgy offers a competitive advantage, be it for everyday products or new products or for new technological developments. Umicore's primary objective is the creation of sustainable value for our customers and to design, produce and recycle materials in a manner that meet the aspiration of "Materials for a better life". Umicore generates about 50% of its revenues technologies, such as automotive catalysts, materials for rechargeable batteries or photovoltaic applications, fuel cells batteries or photovoltaic applications, fuel cells and recycling. In addition, 80% of the budget for research and development is dedicated to this area. The Umicore Group offers production facilities and consulting services on all continents.

## OUR GROUP STRUCTURE



Battery Metals Refining  
Umicore Battery Materials

Automotive Catalysts  
Fuel Cell & Stationary Catalysts  
Precious Metals Chemistry

Battery Recycling Solutions  
Jewelry & Industrial Metals  
Precious Metals Management  
Precious Metals Refining

Cobalt & Specialty Materials  
Electro-Optic Materials  
Metal Deposition Solutions

# ABOUT THIN FILM PRODUCTS AG

We, as Umicore Thin Film Products AG, are specialists for development, manufacturing and supply of high performance evaporation material, sputter targets and accessories for micro-electronic, optoelectronic, optical thin Film applications and wear protection. Our customers benefit from our more than 70 years of experience in development, manufacturing and customization of coating materials. With this unique historical background and our operational excellence, Umicore Thin Film Products makes a difference when it comes to your coating applications.

Our products enable the implementation and further development of high-technology applications such as EUV/DUV lithography, LIDAR systems, AR/VR glasses and high-power laser systems following our mission: "Materials for a better Life"

## OUR UMICORE EXCELLENCE PROMISE TO OUR CUSTOMERS



# „CUSTOMER SUCCESS...

## OUR PROMISE TO OUR CUSTOMERS

### PERSONAL CUSTOMER CARE

- Defined representative
- Local representative
- Local business sites

### PROFESSIONAL TECHNICAL SUPPORT

- Technical sales team
- Technical competence Center Coating
- Technical competence Center Analytics

### INNOVATIVE COATING PRODUCTS

- Low defect coating materials
- Coating material mixtures
- Precious metal business model

### HIGH QUALITY STANDARDS

- QM following IATF characteristics
- ISO 9001 Quality Management System
- ISO 14001 Environmental Management
- ISO 45001 OHS Management System

### SUSTAINABLE PRODUCTION SOLUTIONS

- Quality products result in increased yield
- Material recycling model
- Production focused on renewable energy

## YOUR BENEFITS

### SMOOTH OPERATION

- Personal face-to-face contact
- Easy & fast communication
- Local handling of goods

### TOP NOTCH PROCESSES

- Guidance & consulting
- Material & process support
- In-depth troubleshooting

### COMPETITIVE ADVANTAGES

- Higher production yield and LIDT
- Increased environmental stability
- Easy transaction incl. weight account

### SECURE PRODUCTION AND OPERATION

- Stable and reliable supply chain
- Continuous quality improvement
- Continuous sustainable improvement
- Continuous OHS improvement

### TOP NOTCH PROCESSES

- Reduced handling effort
- Reduction of waste
- Minimized CO<sub>2</sub> footprint

# ...IS OUR SUCCESS“

## PRODUCTS | PRODUCT LINES

### SPUTTER TARGETS

- Cleanroom packaging
- Target production
- Backing plate production
- Indium bond shop
- Ultrasonic quality inspection (100%)

### EVAPORATION MATERIAL

- Fluorid-production-system
- Tablet production system
- Vacuum sintering furnaces
- Vacuum melting furnaces

### ACCESSORIES

- Boat manufacturing
- Liner manufacturing

## YOUR BENEFITS

### TAILORMADE PRODUCTS

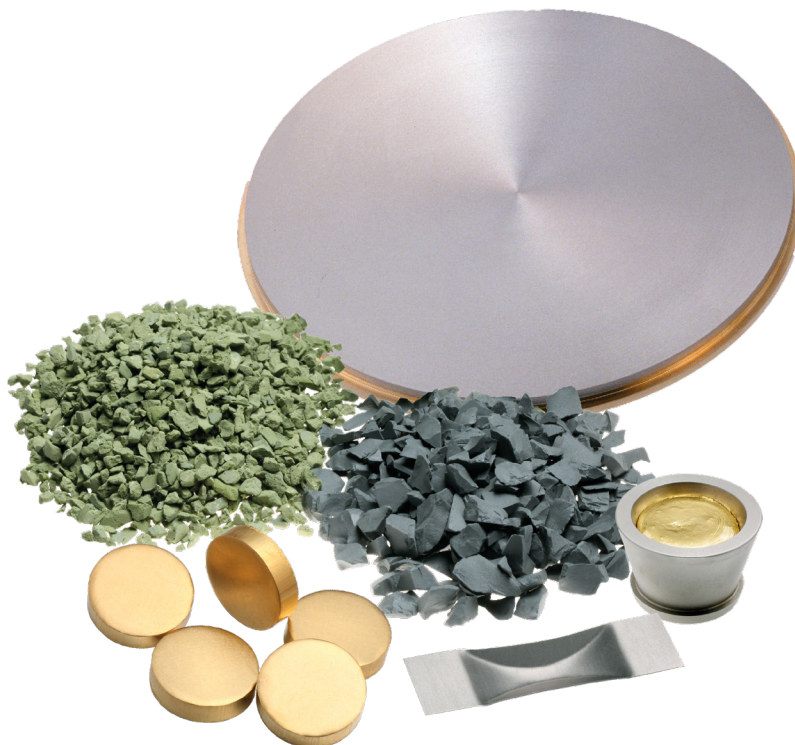
- Minimal particle contamination
- Optimized microstructure
- Perfect sealing and heat transfer
- Professional bonding & debonding
- Highest process stability of bonding

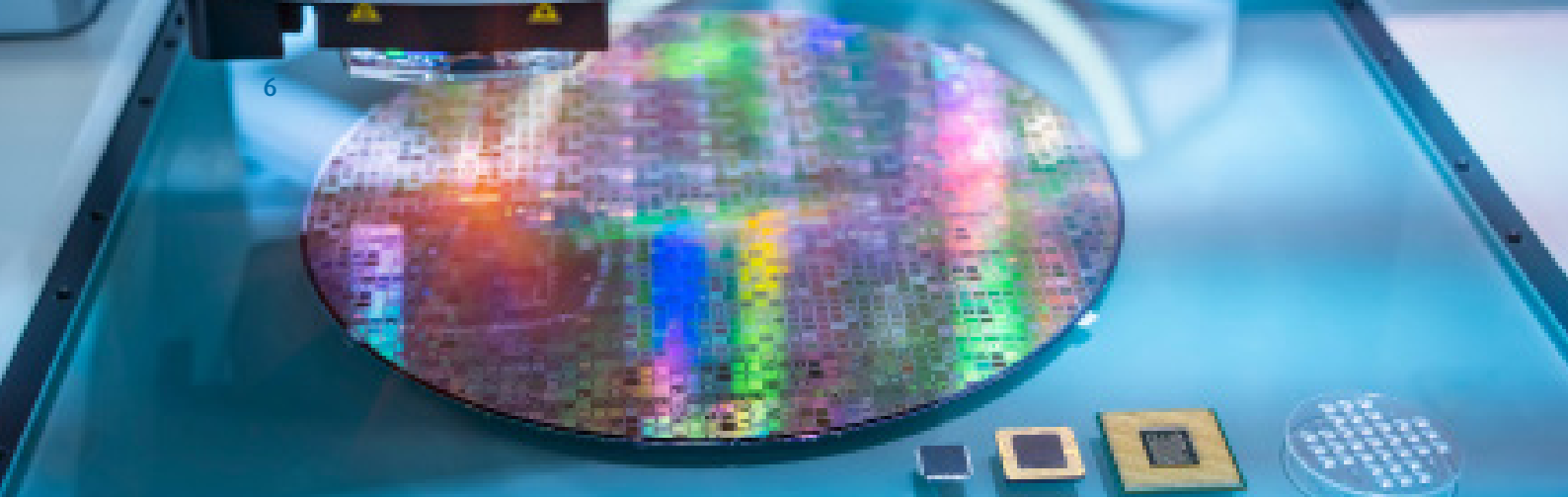
### PERFECT COATING RESULTS

- Lowest oxygen content in fluoride products
- Reproducibility of tablet characteristics
- Preconditioning of coating material
- Pre-melting of (mixed) coating material

### RELIABLE PROCESS REPRODUCIBILITY

- High quality craftsmanship
- Reproducibility of liner characteristics





# OPTICS & PHOTONICS

## UV-OPTICS PORTFOLIO

- Oxides:** SiO<sub>2</sub> | Al<sub>2</sub>O<sub>3</sub> | HfO<sub>2</sub> | ...
- Fluorides:** LaF<sub>3</sub> | GdF<sub>3</sub> | MgF<sub>2</sub> | AlF<sub>3</sub> | ...
- Metals:** Ru | Mo | Au | Ag | Al | Mg | ...
- Element Materials:** Si

(other materials on request)

## COATING MATERIALS

	UV			VIS	IR	
	EUV	DUV	NUV		NIR-MWIR	MWIR-FIR
Precious metals	■	■	■	■	■	
Metals, pure elements	■	■	■	■	■	
Oxides			■	■	■	
TCO				■	■	
Fluorides		■	■		■	
Chalcogenides				■	■	
Nitrides	■				■	
Silicides	■					
Color materials				■		

Coating Technology Legend: ■ Evaporation ■ Magnetron Sputtering ■ Ion Beam Sputtering

# UMICORE'S KEY MATERIALS FOR LOW DEFECT UV-COATING APPLICATIONS



## Low oxygen DUV fluorides $\text{LaF}_3$ , $\text{GdF}_3$ , $\text{MgF}_2$ , $\text{AlF}_3$ , ...

Based on state-of-the-art proprietary fluorination processes, Umicore supplies high-purity, low oxygen & carbon coating materials for low-loss, low-defect coatings used in photolithography & metrology.



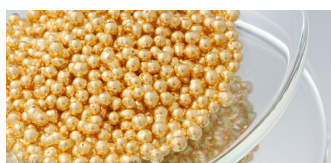
## Wide range of high-performance, low-loss coating materials

Originating from our history and more than 70 years of experience, Umicore provides the full range of wide-bandgap oxides and fluorides for high-performance and low-loss DUV & NUV applications.



## Hf & $\text{HfO}_2$ products for low-loss, high-power laser applications

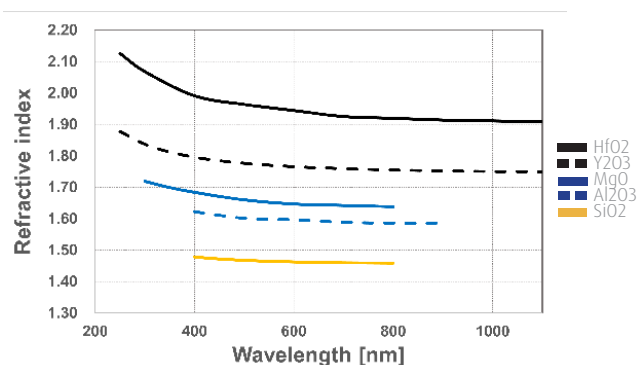
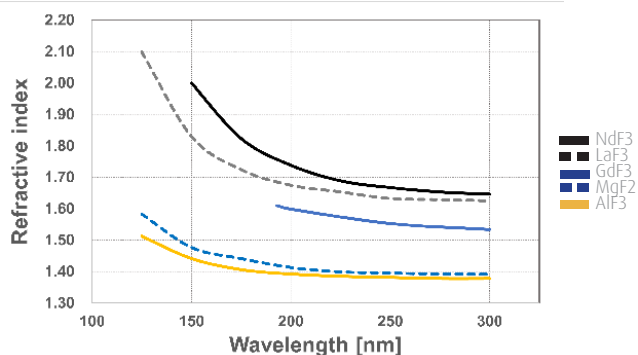
Using well-proven in-house combinations of sintering & melting vacuum technology and based on its long-term supply chain for raw materials, Umicore is your reliable supplier for high-purity Hf and  $\text{HfO}_2$  products for low-loss, high-power laser applications.



## Reliable partner for metal & element solutions Ru, Mo, Si, Au, Ag, Al, Mg, ...

Based on our experience in the field of high-purity metals & alloys, Umicore ensures a stable supply of tailored, high quality products for your specific high-reflecting & absorbing application. Combined with our professional and transparent precious metal management we are able to offer an attractive package.

## PROPERTIES OF FILMS DEPOSITED FROM UMICORE MATERIALS



Typical values of the refractive index as a function of wavelength for selected Umicore UV materials

## APPLICATIONS FOR UV-OPTICS



### Microelectronics

- ◇ Photolithography
- ◇ Metrology



### Lighting / Illumination

- ◇ LED
- ◇ Curing



### High-Power Laser

- ◇ Material analysis
- ◇ Materials processing



### Life Science & Medical

- ◇ Fluorescence microscopy
- ◇ Flow cytometry
- ◇ DNA & RNA analysis & engineering
- ◇ Food & drug analysis





# OPTICS & PHOTONICS

## VIS-OPTICS PORTFOLIO

- Oxides:**  $\text{SiO}_2$  |  $\text{Al}_2\text{O}_3$  |  $\text{Y}_2\text{O}_3$  |  $\text{HfO}_2$  |  $\text{Ta}_2\text{O}_5$  |  $\text{Nb}_2\text{O}_5$  |  $\text{TiO}$  |  $\text{TiO}_2$   
 $\text{Ti}_2\text{O}_3$  |  $\text{Ti}_3\text{O}_5$  | ... | IDA | DRALO | LATI | RENA | ...
- Fluorides:**  $\text{MgF}_2$  |  $\text{YF}_3$  |  $\text{CeF}_3$  | ...
- Metals:** Au | Ag | AgCu | Al ...
- Chalcogenides:** ZnS | ...

(other materials on request)

## COATING MATERIALS

	UV			VIS	IR	
	EUV	DUV	NUV		NIR-MWIR	MWIR-FIR
Precious metals						
Metals, pure elements						
Oxides						
TCO						
Fluorides						
Chalcogenides						
Nitrides						
Silicides						
Color materials						

Coating Technology Legend: ■ Evaporation ■ Magnetron Sputtering ■ Ion Beam Sputtering

# UMICORE'S KEY MATERIALS FOR LOW-DEFECT VIS-COATING APPLICATIONS



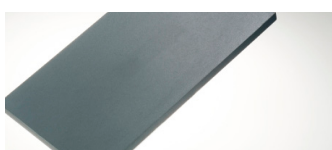
## Tailormade high-performance Si & SiO<sub>2</sub> grades

To address the current most stringent & upcoming requirements with regards to e.g. low-defect, low-loss & high-power damage resistance, Umicore has developed a number of new Si & SiO<sub>2</sub> solutions for evaporation and sputtering applications using SiO<sub>2</sub> films.



## Tantalum & Hafnium oxides

For superior coating performance Ta<sub>2</sub>O<sub>5</sub> and HfO<sub>2</sub> derived products have been tuned to lowest absorption, scatter & defect generation & highest LIDT. This was achieved by improved purity & density, material mixture & stoichiometry as well, as product geometry.



## Hf, Ta, Nb, Si, ... targets for various sputter platforms

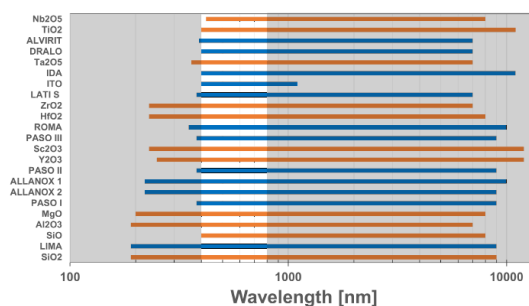
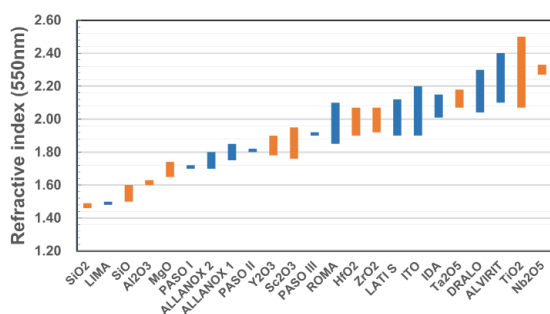
Due to our long history of servicing the optics & optoelectronics industry, coating companies benefit from a wide portfolio of targets & related solutions for the most common sputter technologies and geometries e.g. MSP, HELIOS, SPECTOR, NAVIGATOR.



## Mixed oxide materials for special applications

For wide-angle & polarization dependent requirements, as well as for coating on plastics and other sensitive components, Umicore provides a wide range of tailored oxide compositions with optimal density, stoichiometry & geometry. This enables highly stable deposition processes leading to congruent, low-defect, homogenous coating results.

## PROPERTIES OF FILMS DEPOSITED FROM UMICORE MATERIALS



Typical ranges of refractive index at 550 nm and of the transmittance for common Umicore materials

■ Pure oxides  
■ Mixed oxides

## APPLICATIONS FOR VIS-OPTICS



### Imaging & Sensing

- ◇ Camera
- ◇ Microscopy
- ◇ Sighting
- ◇ Endoscopy
- ◇ Cinema projection



### Office

- ◇ Scanning
- ◇ Printing



### Industrial & Analytical

- ◇ Position measurement and alignment
- ◇ Machine vision
- ◇ Photospectrometry



### Security

- > Anticounterfeiting
- > Surveillance and monitoring



### Lighting / Illumination

- ◇ Lamp, LED & headlight reflectors
- ◇ Medical lighting



# OPTICS & PHOTONICS

## IR-OPTICS PORTFOLIO

<b>Oxides:</b>	SiO <sub>2</sub>   Al <sub>2</sub> O <sub>3</sub>   Y <sub>2</sub> O <sub>3</sub>   SiO   HfO <sub>2</sub>   Ta <sub>2</sub> O <sub>5</sub>   ...
<b>Fluorides:</b>	CeF <sub>3</sub>   YbF <sub>3</sub>   YF <sub>3</sub>   ...
<b>Chalcogenides:</b>	ZnSe   ZnS
<b>Metals:</b>	Ag   Au   Al   ...
<b>Element materials:</b>	Ge   Si
<b>Mixtures:</b>	IR-F625   IR-F900   Y-Ca-fluoride   MIRA   ...

(other materials on request)

## COATING MATERIALS

	UV			VIS	IR	
	EUV	DUV	NUV		NIR-MWIR	MWIR-FIR
Precious metals						
Metals, pure elements						
Oxides						
TCO						
Fluorides						
Chalcogenides						
Nitrides						
Silicides						
Color materials						

Coating Technology Legend: ■ Evaporation ■ Magnetron Sputtering ■ Ion Beam Sputtering

# UMICORE'S KEY MATERIALS FOR LOW-DEFECT IR-COATING APPLICATIONS



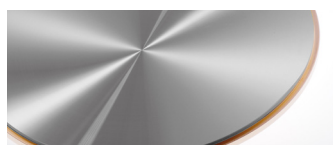
### LWIR and multispectral pure & mixed fluorides

YbF<sub>3</sub>, YF<sub>3</sub>, CeF<sub>3</sub> & proprietary mixtures like IR-F625 and IR-F900 from a refined in-house production process match highest requirements with respect to stable & reproducible evaporation processes. Furthermore, Umicore offers tailored material alternatives for ThF<sub>4</sub>-based applications.



### Ge, Si, ZnS and ZnSe

Umicore provides H- and M-index materials with excellent purity for high-performance IR applications. Umicore ZnS grades cover the core of the IR spectral band as well as an extended range down to the visible spectrum. Along with ZnSe they address high-power laser coatings as well.



### High-quality metal & oxide sputter targets

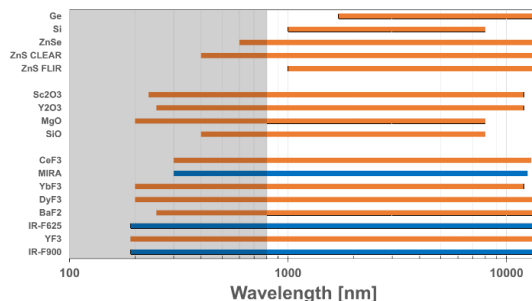
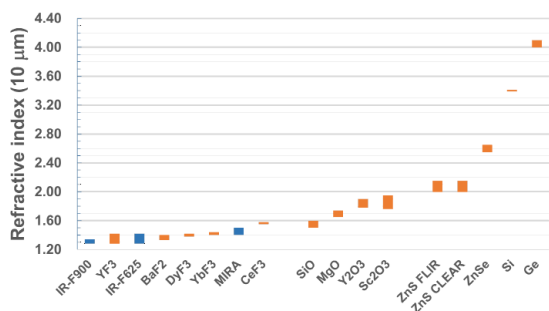
Based on our manufacturing & application competencies Umicore provides a wide range of targets for applications ranging from the LWIR to the NUV spectral range. In combination with our inhouse target bondshop, small series up to high throughput coating production scenarios can be addressed.



### Wide range of high-quality metal & oxide evaporation materials

High-purity metals & alloys as well as substoichiometric and oxygen-saturated material solutions are available for premium evaporation applications. In addition, Umicore offers precious metal products including recycling services.

## PROPERTIES OF FILMS DEPOSITED FROM UMICORE MATERIALS



Typical ranges of refractive index at 10'000 nm and transmittance for selected Umicore LWIR materials

■ Pure materials  
■ Mixed materials

## APPLICATIONS FOR IR-OPTICS



### Optical communication

- ◇ Thin film type of DWDM, CWDM, GF filters
- ◇ Waveguide type of telecom NIR multiplexers
- ◇ Satellite communication



### Geo-Mapping & 3D-Sensing

- ◇ Multispectral imaging
- ◇ LIDAR for PDA, AR/MR



### Material processing & gas sensing

- ◇ Solid state and CO<sub>2</sub> lasers for material processing
- ◇ Analysis for solid material and gases



### Defense & Security

- ◇ Directed energy, ranging and tracking
- ◇ Reflected or thermal IR cameras and thermography devices



### Life Science & Medical

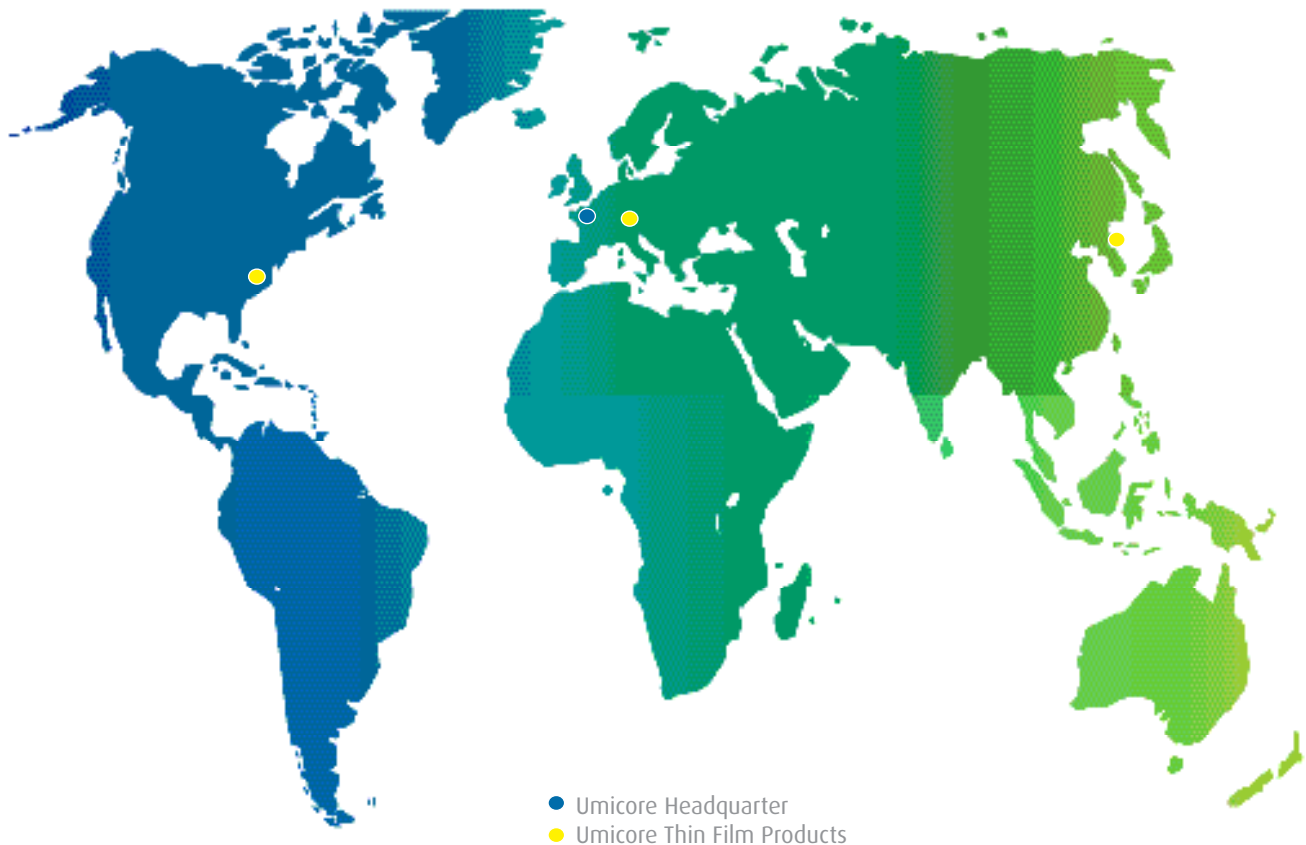
- ◇ Surgery and Diagnostics

# GLOSSAR

<b>Term</b>	<b>Definition</b>
AR	Augmented Reality
CWDM	Coarse Wavelength-Division Multiplexing
DNA	Deoxyribonucleic Acid
DUV	Deep Ultraviolet
DWDM	Dense Wavelength-Division Multiplexing
EUV	Extreme Ultraviolet
IR	Infrared
LED	Light-Emitting Diodes
LIDAR	Light Detection and Ranging
LIDT	Laser Induced Damage Threshold
MWIR-FIR	Mid-Wavelength Infrared-Far Infrared
NIR	Near-Infrared
NUV	Near-Ultraviolet
OHS	Occupational Health and Safety
PDA	Advanced Photonics Design Automation
RNA	Ribonucleic Acid
TCO	Transparent Conductive Oxides
UV	Ultraviolet
VIS	Visible
VR	Virtual Reality

# UMICORE THIN FILM PRODUCTS AG

## NETWORK FOR GLOBAL SUPPLY



Find more information here:  
[www.tfp.umicore.com](http://www.tfp.umicore.com)

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