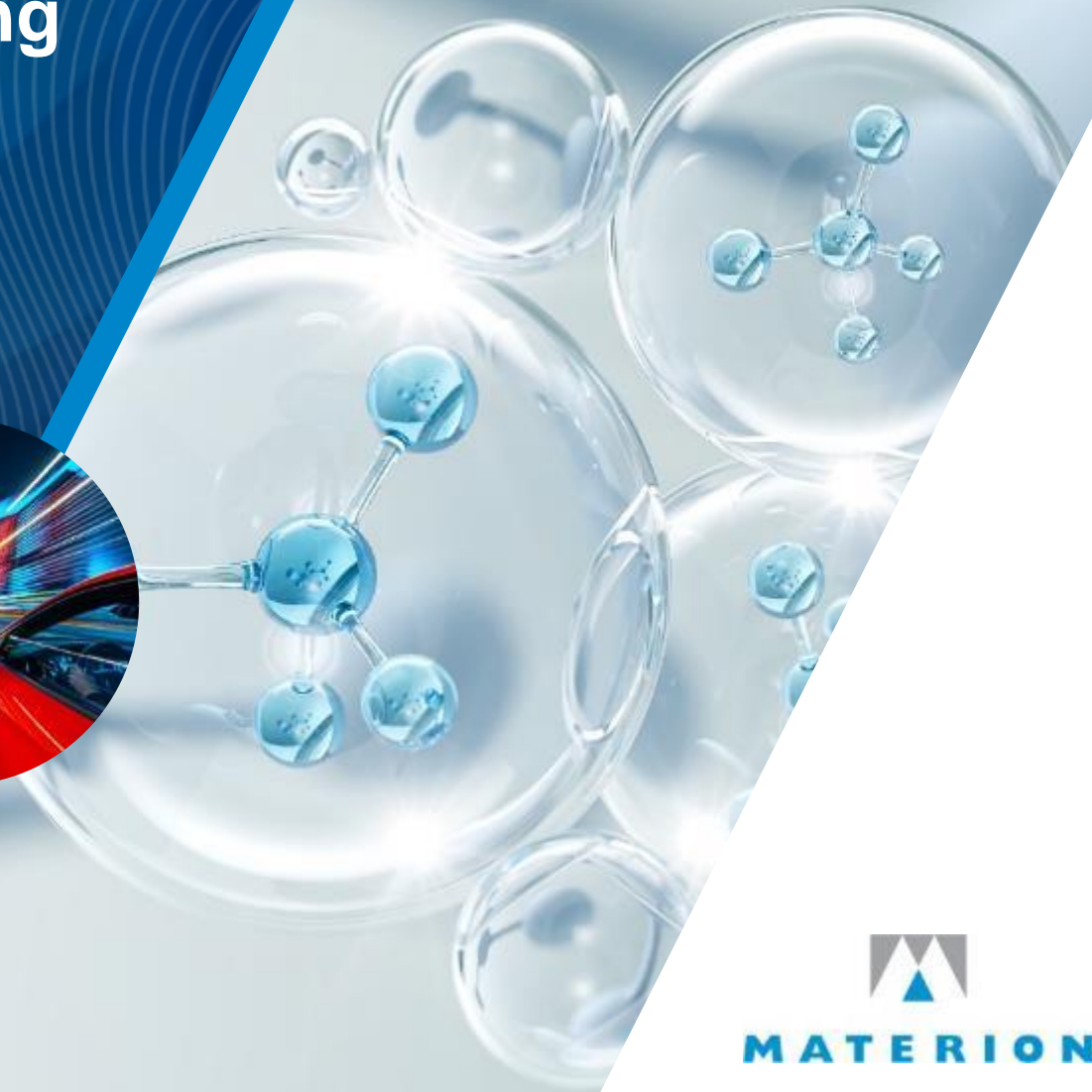
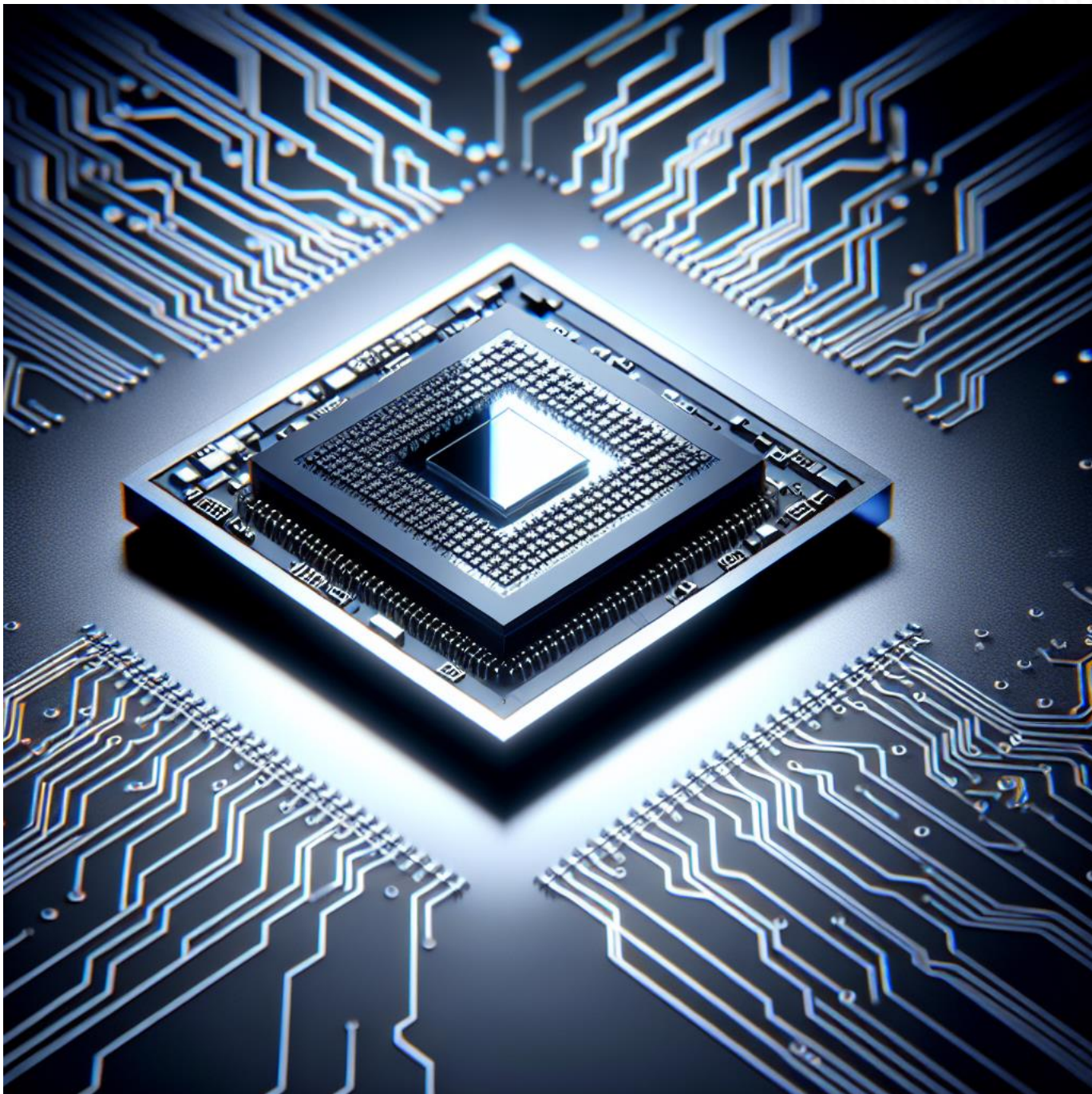


# Cover glasses for image sensors driving advancements in imaging technology

*Carsten Dietrich*  
26.09.2024





## **Versatile and advantage of high-end coatings on cover glasses for image sensors**

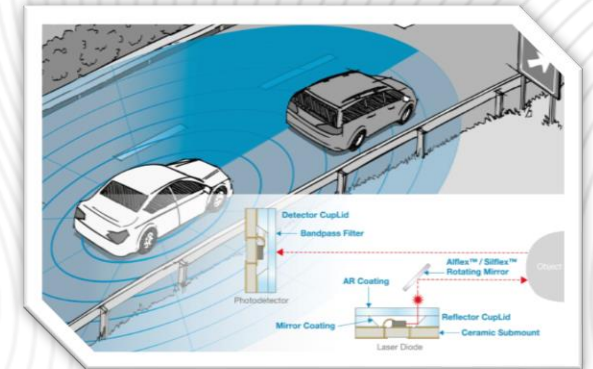
- High-end coatings
- Patterning
- Low Defect

**Our message – one-stop-shop**

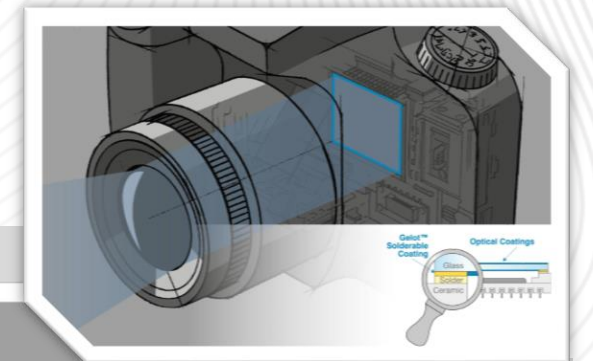
**Our booth is on B11b**

# Cover lid applications for optical sensors and cameras

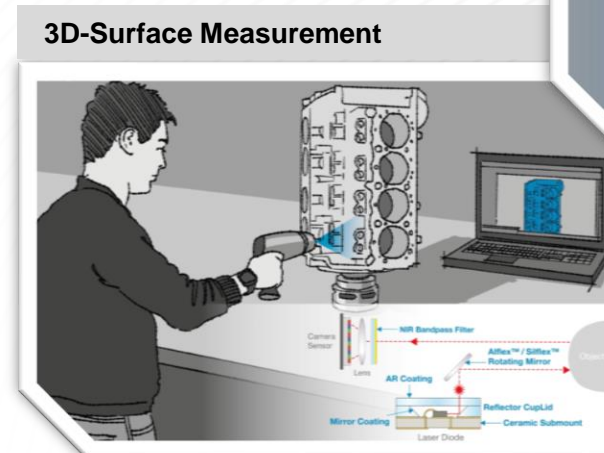
- Automotive industry
  - ADAS (advanced driver assistance systems) and AD (autonomous driving)
  - Lane detection, traffic sign detection, pedestrian & vehicle detection
  - Enhanced visibility at nighttime or in bad weather conditions
  - Blind spot detection, parking system
  - Driver monitoring regarding drowsiness/health status
- Industrial camera market
  - Advanced machine vision
  - Factory automation, digital measurement
  - Motion control, surveillance cameras
- Professional studio cameras and projection display
  - CCD or CMOS image sensors in digital cameras
  - LCOS micro-displays in projection applications



Scanning and solid-state LiDAR



Digital Imaging



3D-Surface Measurement

# Overview- Advanced Coatings on Cover Glasses

## Solderable Coatings ①

- Hermetic package
  - Rough environment
  - Defined environment (no humidity)
  - Increased lifetime
- Electrical contact for TCOs, e.g. ITO

## AR Coatings ②

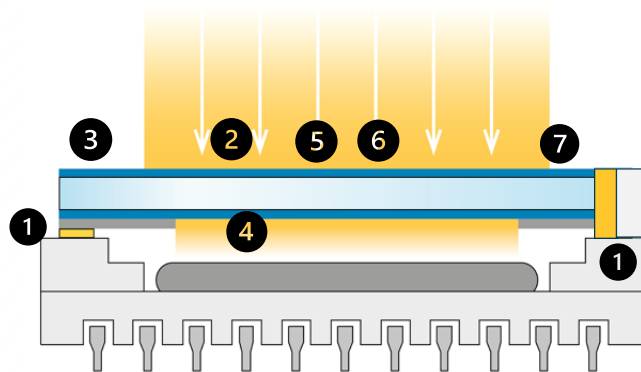
- Enhanced broadband ARC
- No waste of photons
- Signal to noise ratio

## TopFlex™ ③

- Hydrophob
- Easy to clean

## Low defect ④

- Suits high resolution applications



## ITO ⑤

- Anti static (anti dust)
- Anti fog
- Capacitive sensing
  - surface check (dirt, smutch)
  - Integrity check (e.g. eye safety)
- MIR protection
- Reflect heat rays

## Filter ⑥

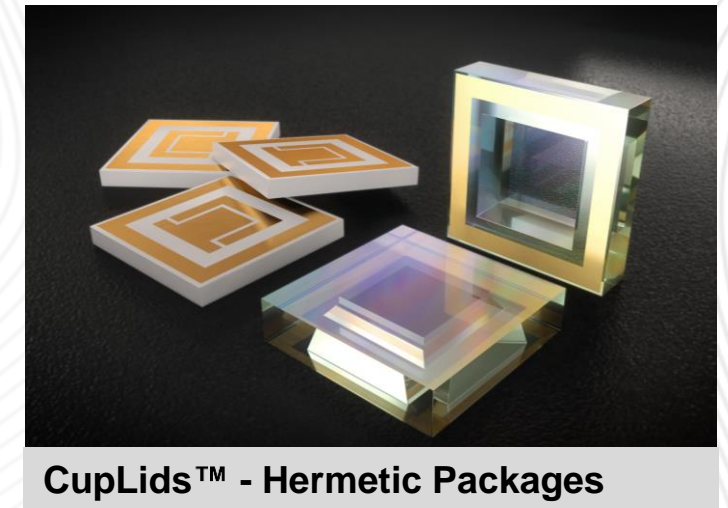
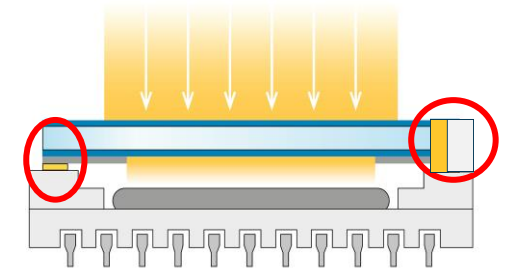
- High transmission
- Steep edges
- UV to IR

## Structured Chrome and CrBlack™ ⑦

- BICr / Ti / Laquer
- Defined aperture size
  - No crosstalk
  - No back reflections

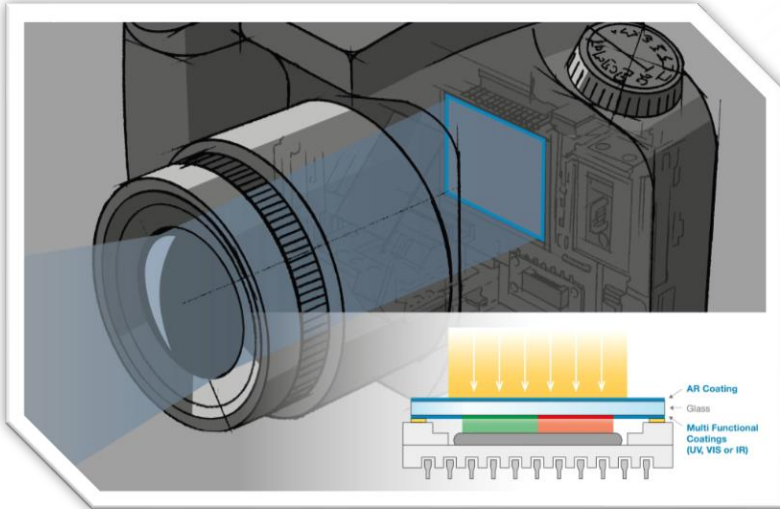
# Solderable coatings

- Fine leak hermetic - solder-bonded cavity windows with ceramic submounts
- Applicable on all types of glasses and many ceramic materials
- Top side, edge and circumference coatings
- Structured forms by lithography possible
- Clean-room quality

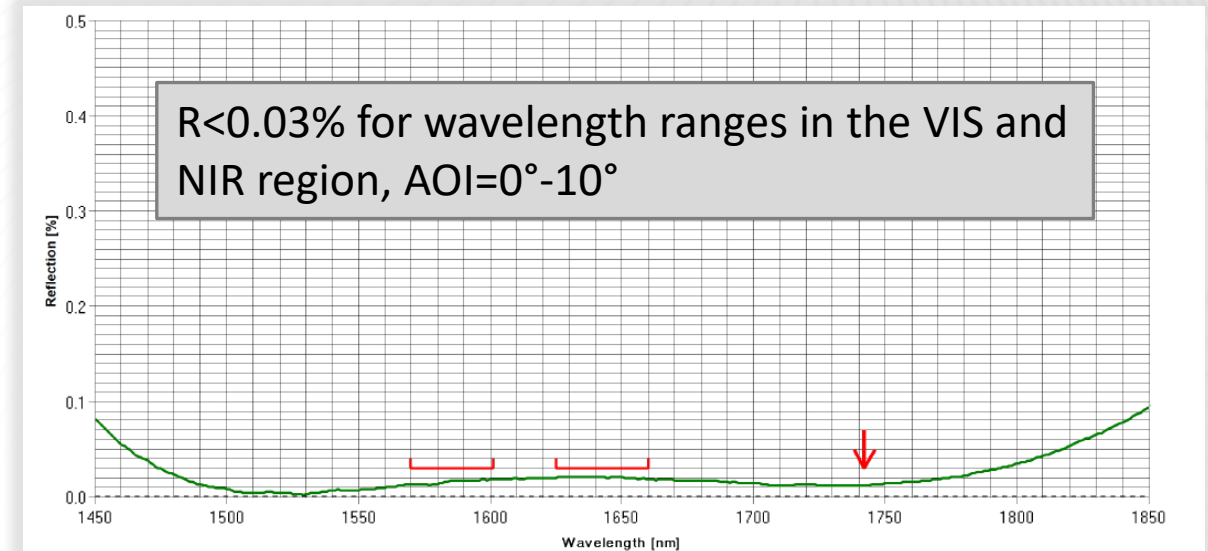
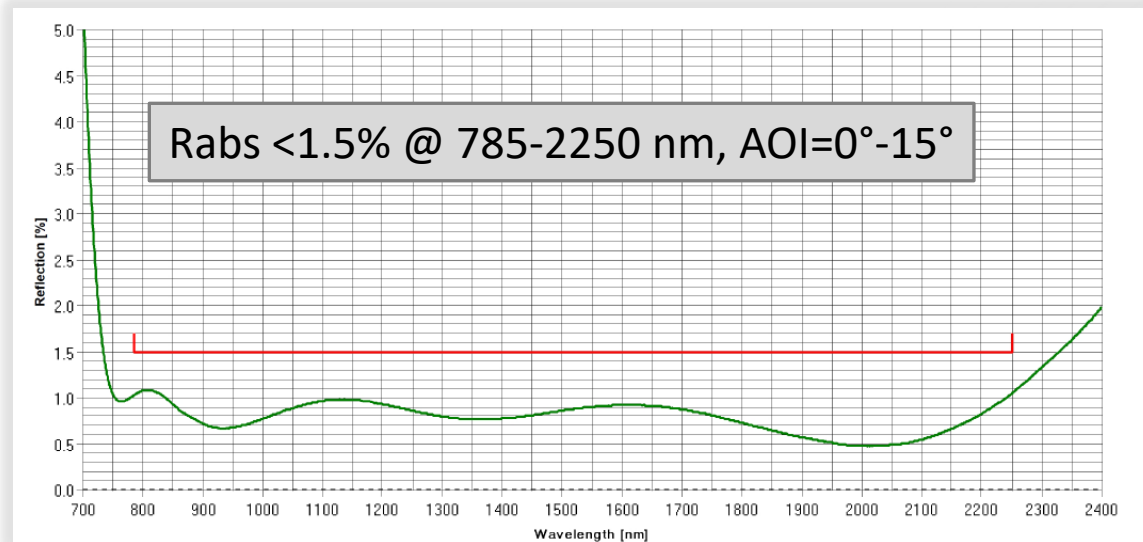
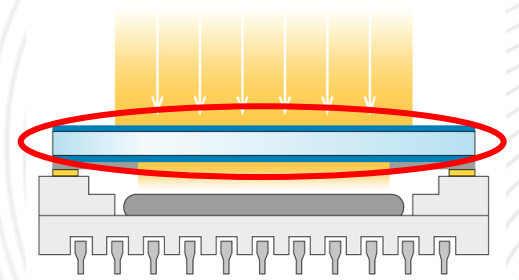


- Can be deposit as well on several other existing coatings
- Compatible with a wide variety of solders and fluxes.
- Electrical contacts like bus bars for ITO-coatings
- Stable processes and high reproducibility

# AR Coating

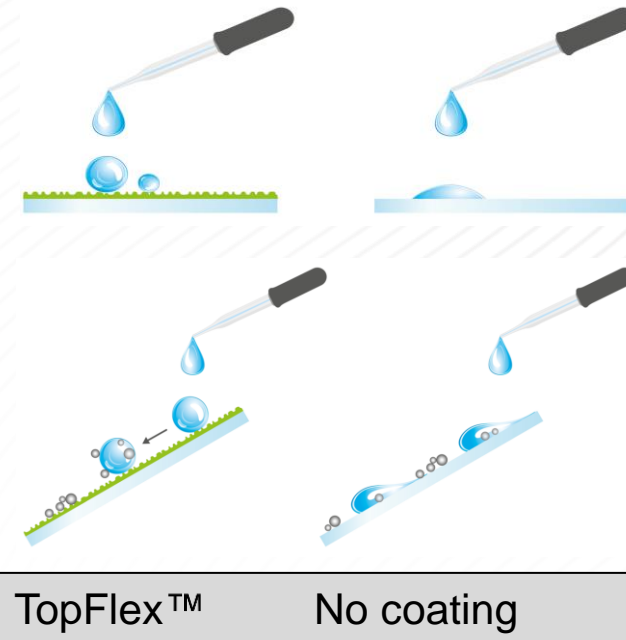
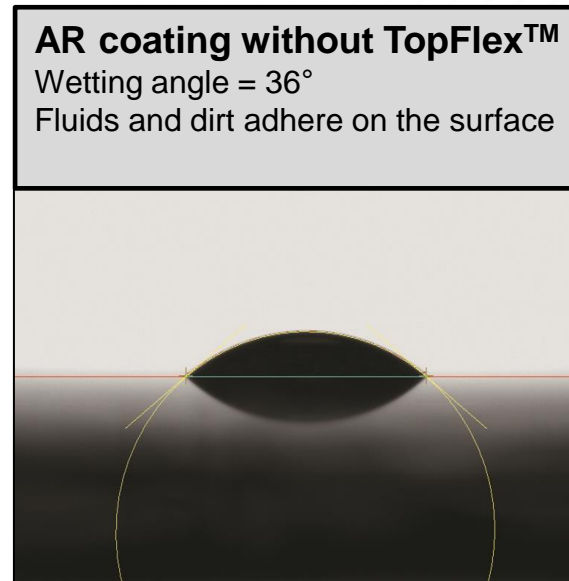
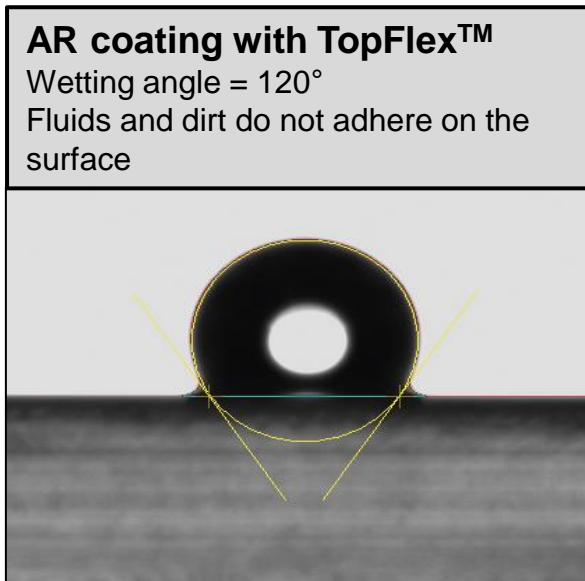
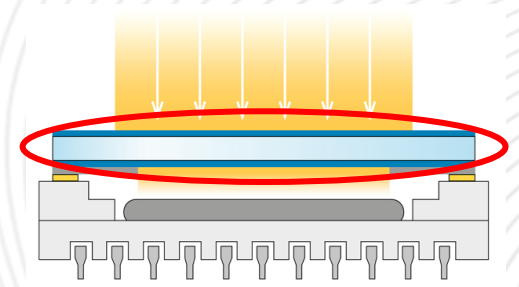


- Increased transmission
- Defect Sizes: 10 $\mu$ m max for piece parts
- Stable processes and high reproducibility
- From V-coatings to Advanced Broadband Coatings
- Enhanced signal-to noise ratio and contrast, eliminating ghost images
- Up to factor 10 lower reflection than with standard AR coatings



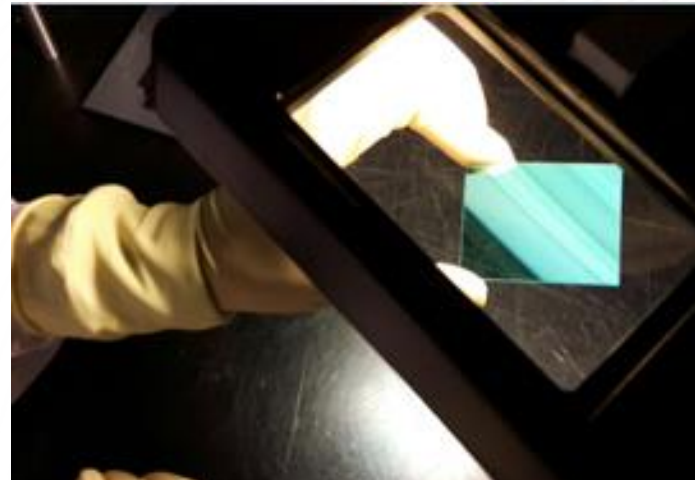
# TopFlex™ – hydrophobic coating

- Easy-to-clean coating
- Solvent- and Soil-Repellent Coating
- Spectrally neutral in VIS and IR range, UV / IR Transparent
- Temperature stability up to 250°C
- Excellent environmental stability (tested according to automotive requirements)

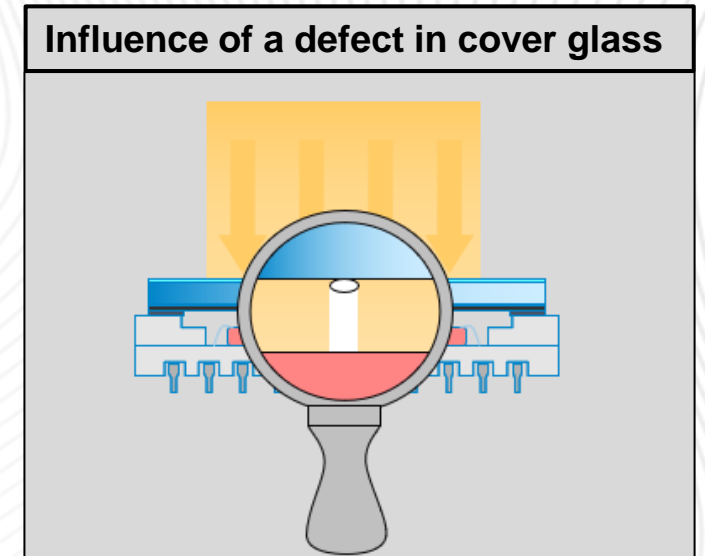
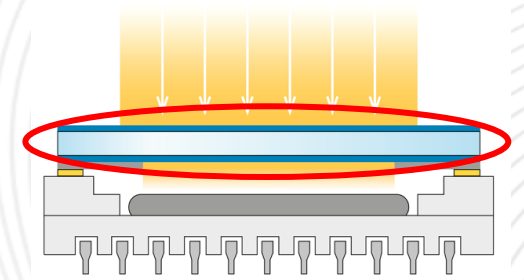


# Low Defect

- Protective Cover wherever extreme clean surfaces are required
- Reliable protection for the “digital eye” of the camera, shields the delicate image sensor, allows operation at peak performance
- No failure of pixel
- Suitable for high resolution applications
- Typical defect specification on CCD/CMOS sizes:
- AR Coating:
  - Scratch/dig 10/2 or better
  - No defects >10 $\mu$ m
- NIR Blocking filter:
  - No defects > 20 $\mu$ m



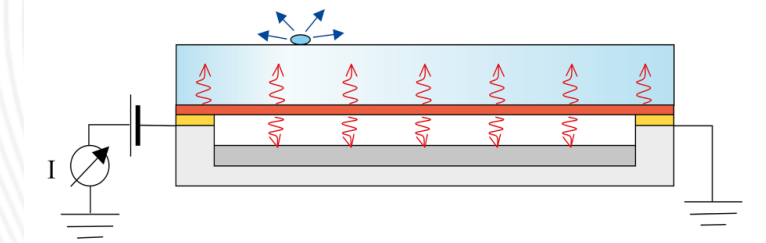
CoverLid™ under magnifying glass for checking against flaking and other contamination





# ITO coatings

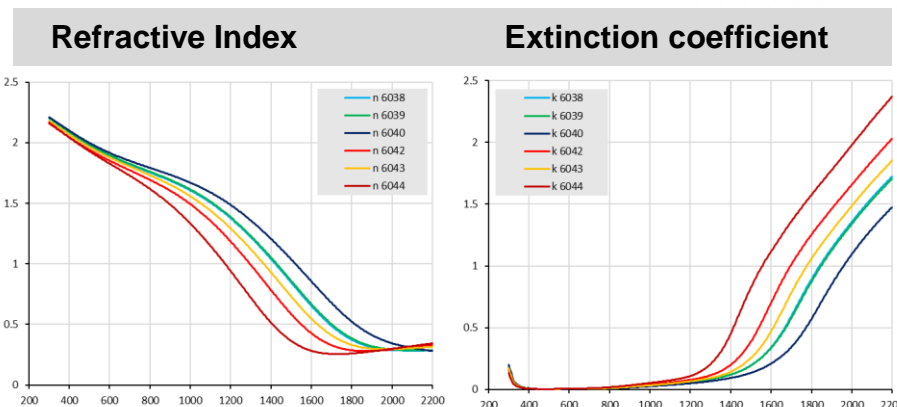
- Index Matched ITO by integration into an anti-reflective multilayer
- High conductive ITO to heat the cover glass and prevent fogging
  - LIDAR / Space application in demanding environment
- Low conductive ITO to prevent static charges
  - SMD sorting / X-Ray imaging
- Reproducible uniformity of sheet resistance of +/-20%
- Structured forms by masks and lithography possible
- Transparent in VIS and also high reflection in IR (Laser applications)



**Heater Window:** Electrical current across ITO layer (red line) heats the glass and prevents from condensing moisture on surface. Yellow lines are busbars made of Gelot™ for electric contacting of ITO.



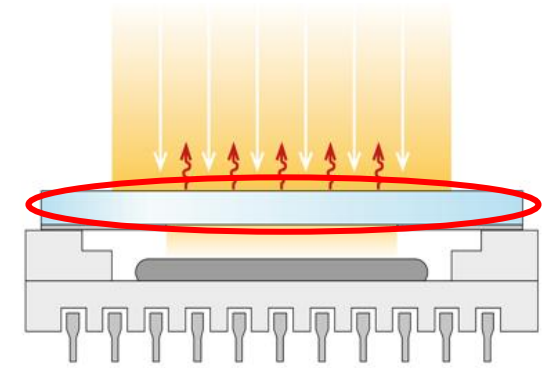
**ITO with bus bars made of Gelot™**



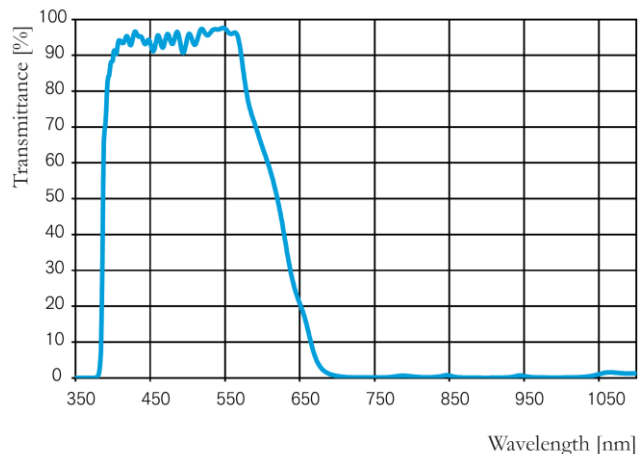
- Single layer ITO
- Low or high conductive ITO with low absorptance
- Low stress and low bow with high reproducibility
- ITO with space heritage

# Filter Coating

- Blocking of NIR in a broad wavelength range, NIR radiation is reflected
- Minimized angle of incidence dependence
- Edge shape depending on application → customizable
- Low Defect and Chrome Apertures possible



**Measured spectrum of an NIR blocking filter with defined linear slope and broad blocking range**



## Typical Specification:

### Transmittance:

$T_{avg} > 90\%$  @ 430-570 nm

### Blocking:

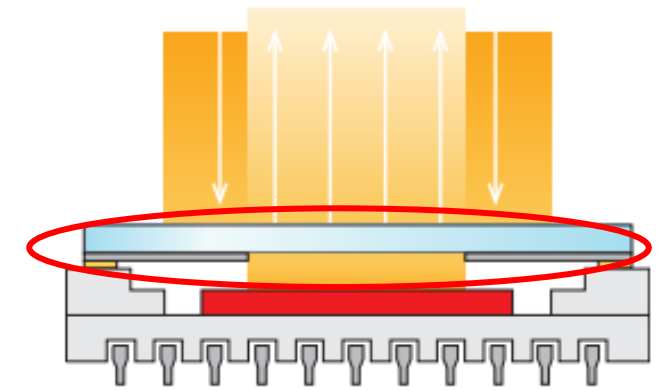
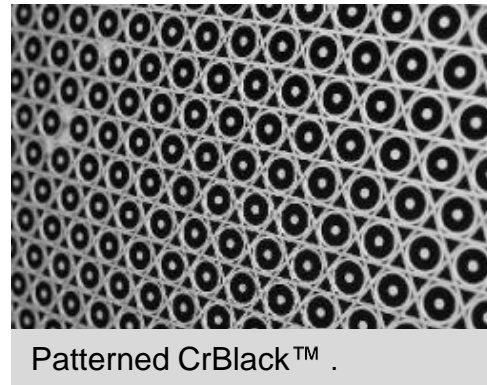
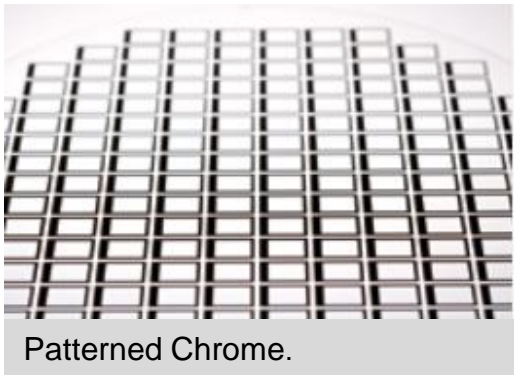
$T_{avg} < 1\%$  @ 700-1100 nm

## NIR Blocking Filter for Image Sensors



# Patterning

- Patterned Chrome by photolithography enables the production of high-precision structured coatings and gratings in the submicrometer range
  - Opaque - low reflective, low transmittance coating
  - High resolution, low defect patterns
  - High edge performance

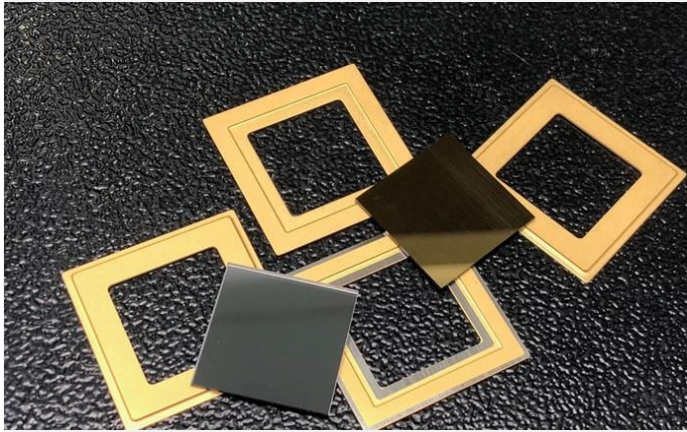


**Patterned Chrome:** applied as aperture defining a light beam of a projected picture..

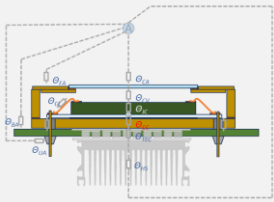
- CrBlack™ - optical black coating (micro)patterned by lift-off techniques
  - High absorption and low reflection in the VIS and NIR range
  - Specifically adjusted color impression and optical density according to customer requests
  - Background noise reduction
  - Precise alignment marker

# Optical Packaging Solutions

## VisiLid™

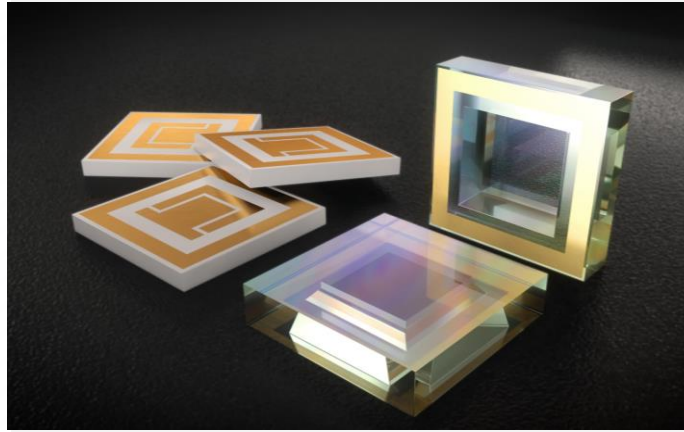


- Optical Lids and packaging materials for fine-leak hermetic packaging of Opto-Semiconductors in Hi-Rel applications
- Portfolio of thermally conductive and CTE-matched packaging materials (metals & ceramics)



No	Materials	TC (W/m-K)	CTE (ppm/K)
1	FR-4	0.2	16
2	Al <sub>2</sub> O <sub>3</sub>	17	7
3	Si <sub>3</sub> N <sub>4</sub>	43	3.7
4	GaAs	46	5.7
5	GaN	150	3.2
6	Si	153	3.5
7	AlN	200	4.5
8	CuW	225	7
9	CuMoCu	210	8
10	Cu	393	17
11	SiC	430	4
12	Ag-Diamond	600	9
13	Diamond	1500	1.4

## CupLid™



- Surface-mount, fine-leak hermetic packages for Laser Diodes, LEDs & Photodetectors
- Developed for high-volume, automated chip-scale packaging of Opto-semiconductors

### Edge-Emitter CupLid



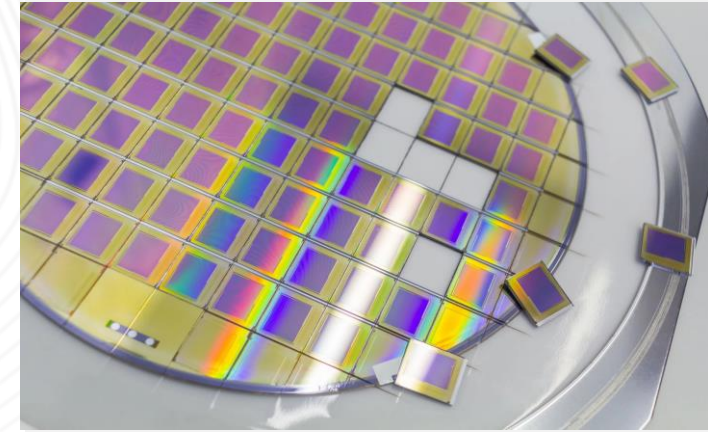
Edge-emitter laser diode package with polished and AR coated sidewalls

### Reflector CupLid



LED emitter package with integrated reflector and antireflective coating

## Wafer-level Packaging



- Coated & bonded wafer stacks for fine-leak hermetic packaging of MEMS- and Opto-semiconductors
- Developed for cost-effective wafer-level packaging



# Materion Corporation

A global high-tech solutions provider of performance alloys, precision coatings and advanced materials

- 100+ years of materials knowledge
- Publicly traded since 1972 – NYSE (MTRN)
- In excess of \$1 billion in sales

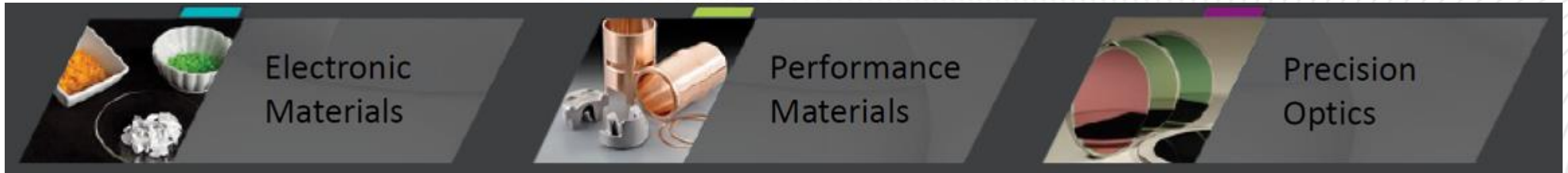
 **36**  
WORLDWIDE  
LOCATIONS

 **3,000**  
EMPLOYEES

 **61**  
COUNTRIES  
SERVED



# Corporate Overview – Materion’s Business Units



- Precious and engineered materials for sputtering & evaporative coating
- Advanced chemicals & powders
- Microelectronic packaging materials
- Large area targets for sputtering
- Precision parts cleaning, precious metal recovery and life cycle management services

- Specialty engineered Alloy systems
- Beryllium & Composites
- Engineered Clad & Plated Metal Solutions
- Ceramics
- Advanced performance parts

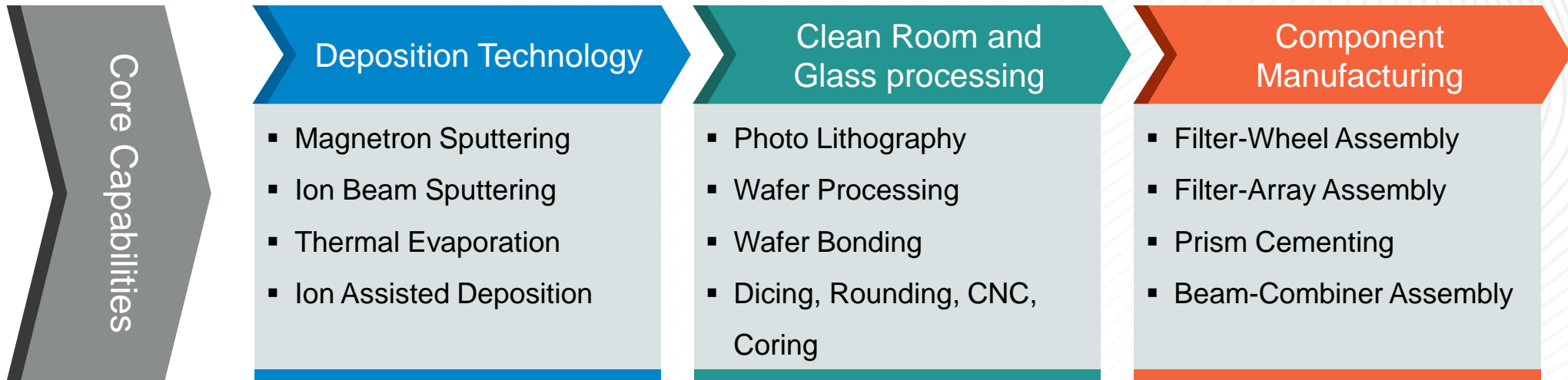
- Precision filters & optical coatings
- Wafer level coatings
- Specialty thin films
- Projection display components
- Optical assemblies



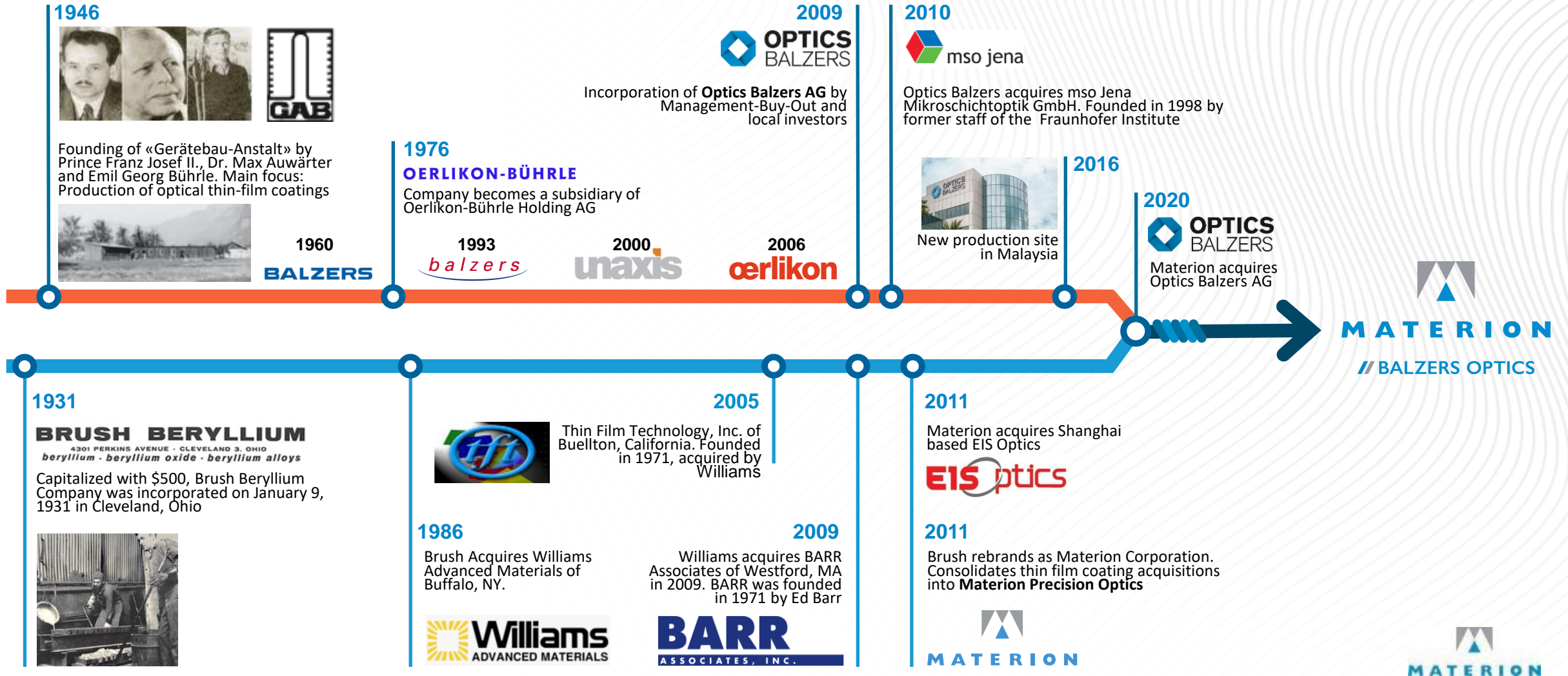
**MATERION**

**// BALZERS OPTICS**

# Providing high performance solutions across the spectrum

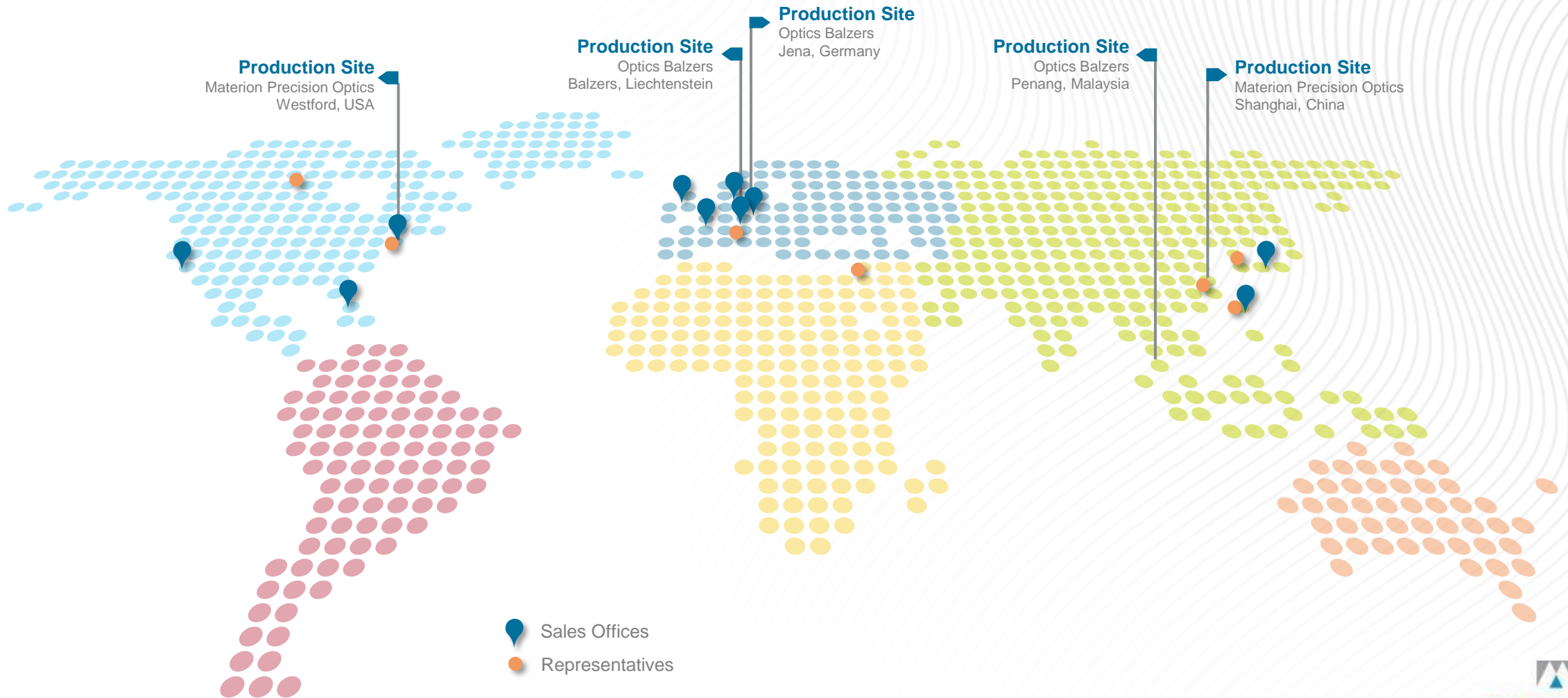


# Our History





# 5 Production Sites and a Worldwide Presence



# Unlimited Applications in High-Tech Markets



# Core Capabilities

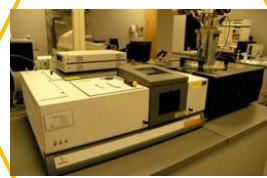
## Deposition Systems

- Magnetron Sputtering
- Ion Beam Sputtering
- PARMS
- IAD
- E – Beam evaporation



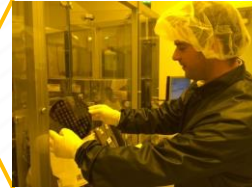
## Spectral Test

- UV – LWIR
- FWHM < 0.1nm
- Size > Ø1m
- Cryogenic < 10K



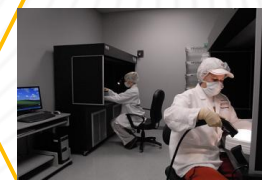
## Photolithography

- Semiconductor grade
- Feature size < 10um
- Artwork < 1.0 um
- Precision placement +/- 1 um



## Assembly Lab

- Class 10,000 room
- Class 100 ASM station
- Temp & Humidity control
- Measurement accuracy < 0.002mm



## Dicing

- High magnification system
- Accuracy to +/- 0.002mm
- Up to Ø200 mm
- Up to 10 mm thick
- Specialty blades & procedures
- Control edge roughness < 30 A rms
- Minimize edge chipping

## Environmental Test

- Humidity
- Abrasion
- Adhesion
- SALT / Fog
- Solubility
- Thermal (storage & Shock)
- Solar Flux
- **Radiation**

## Substrate Preparation

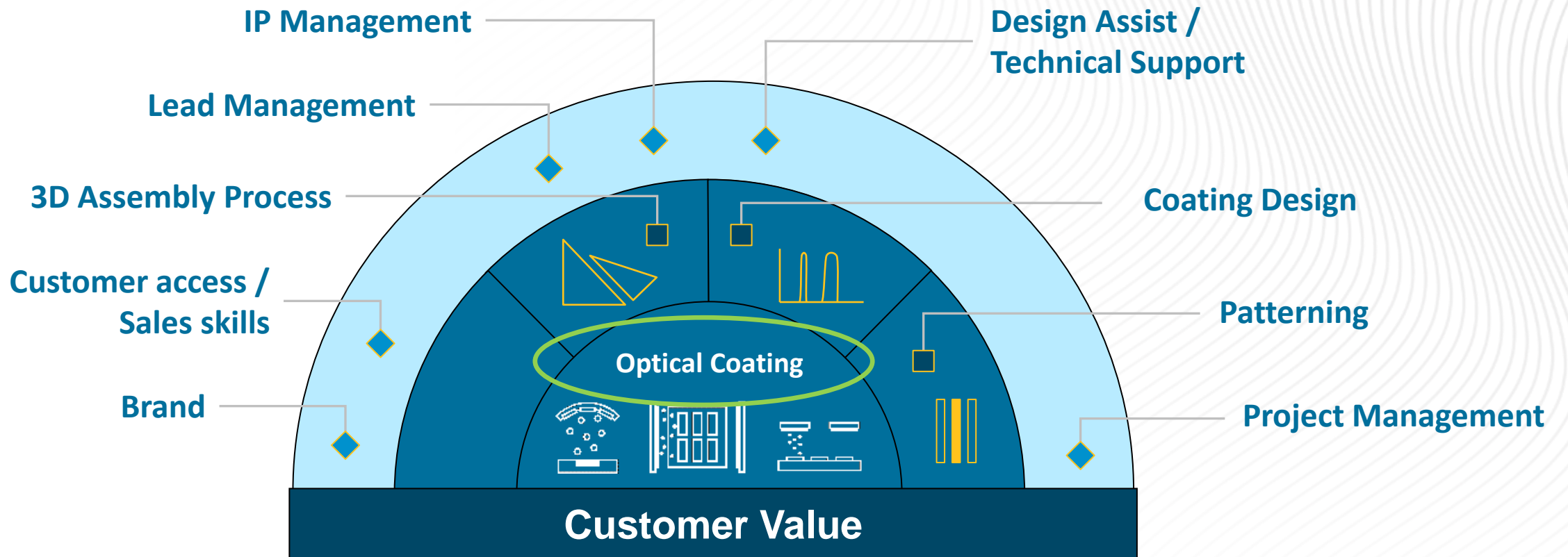
- Large wafers > 1M
- Automated & manual
- Individual & batch
- Detailed inspection

## Clean Rooms

- Substrate Preparation
- Assembly
- Inspection
- Surface Metrology
- Deposition labs

# Core Competencies and Key Skills

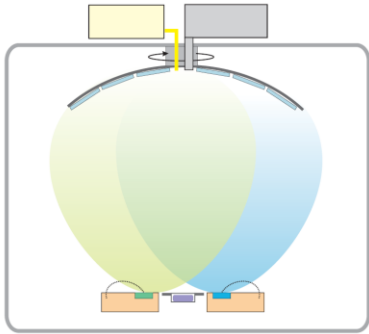
Due to the ongoing improvement and development of our core competencies and skills, we can gain a competitive advantage and maximize customer value



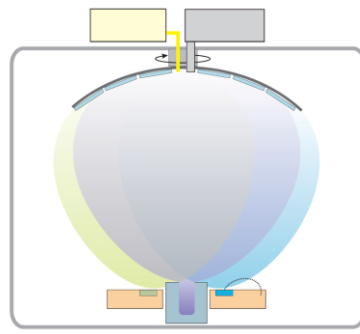
Core Competencies: ■ Optical Coating ■ CoatingPlus™ ◆ Key Skills



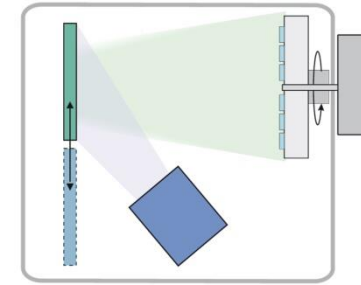
# Available coating technologies



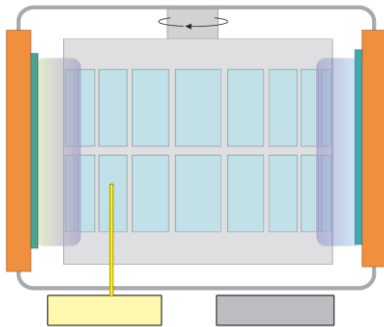
**Evaporation**  
(e-beam and boat sources)



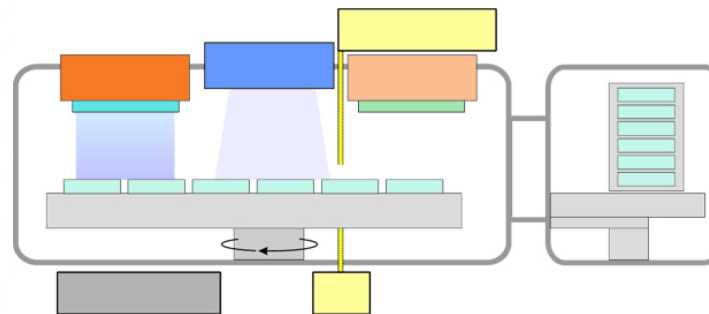
**IAD-Evaporation**  
(Ion Assisted Deposition)



**IBS-Deposition**  
(Ion Beam Sputtering)



**Magnetron Sputter**  
**Deposition**



**PARMS (Plasma-Assisted Reactive**  
**Magnetron Sputter Deposition)**

To learn more about Materion  
and our capabilities, please feel  
free to contact us:



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*Business Development Manager*

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<http://www.materion.com>

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