



OPTOSIGMA

Your Optical Coating Experts

What is an Optical Coating?

- Optical coatings enhance or reduce surface reflection
 - Uncoated N-BK7 glass loses ~4% per surface
- Typically 1 to over 100 layers of various materials
 - Alternating groups of higher and lower index materials
 - Either $\frac{1}{4}$ -wave or $\frac{1}{2}$ -wave optical thickness layers
 - Optical thickness = physical thickness x index of refraction
- Most basic antireflection coating is single $\frac{1}{4}$ -wave layer Magnesium Fluoride or Silicon Dioxide
 - $\frac{1}{2}$ -wave used as protective layer on metallic mirrors



Key Design Considerations

SUBSTRATE FEATURES

- Aspect ratio
 - Longest dimension to thickness
- Surface quality
 - Print through
 - Stress point for single-layer coating
- Clear aperture

ENVIRONMENT

- Temperature
 - Cryogenic v. hot
 - Large excursion
- Humidity
- Radiation

OPTICAL DESIGN

- Angle(s) of incidence
 - Extreme angles harder to design for
 - Shift performance to longer wavelength
- Soft glass types v. hard
- Broadband v. narrowband
- Out of band blocking

SYSTEM REQUIREMENTS

- Wavelength(s)
- Laser power
- Required Reflectance
 - High performance may require lower laser damage threshold materials
- Polarization sensitivity

Part Coating Process

- First, meticulously clean the substrates & chamber
 - Catalog or Custom are handled the same way
 - Materials dictate cleaning method
- Second, Load coating layer materials into crucible(s)
- Third, carefully load substrates into appropriate carrier for chamber, part size and part geometry
- Fourth, pull vacuum on sealed chamber
- Fifth, Heat chamber to appropriate temperature
- Finally, Initiate deposition process



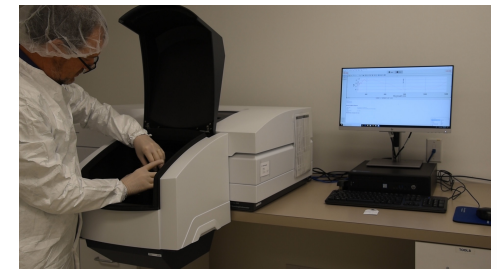
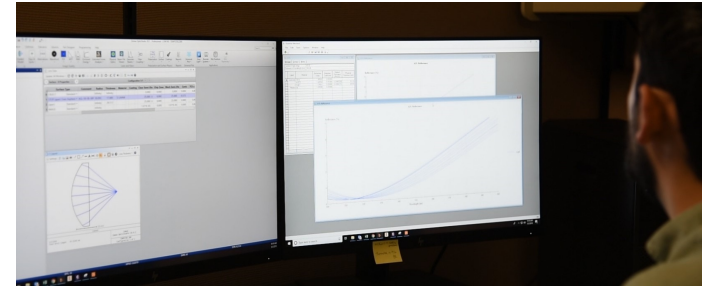
How Long Does Process Take?

- Depends on the number of layers
 - Single layer coating is fastest
 - Very broadband AR coating takes the longest
 - Can be > 100 layers
- Overall performance and tolerances
 - Transmission/Reflection
 - Absolute (P-V) or average (RMS)
 - Transition requirements
 - Width of transition zone
 - No instantaneous transitions
 - Number of layers
 - Single band v. multi band
- Also depends on number & size of substrates



OptoSigma USA Capabilities

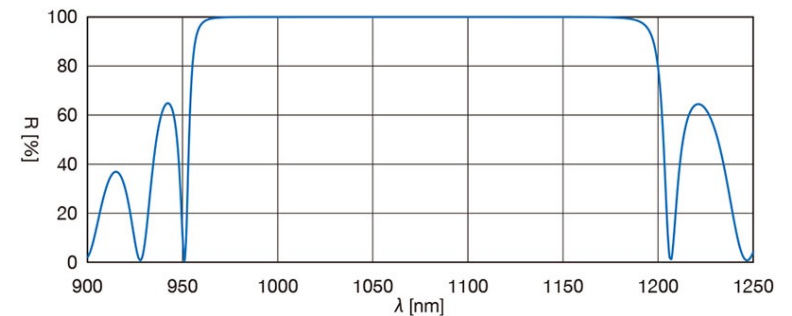
- 100+ make to order standard coating recipes available!
- Working WL Range: 248nm-2700nm
 - Antireflection
 - All Dielectric
 - V-coat, U-Coat, W-Coat
 - High Laser Damage Threshold (LDT)
 - Low Temperature Process Capability
 - Reflection
 - All Dielectric
 - Single band, Broadband
 - Dichroics
 - Short-Wave and Long-Wave Pass
 - **ITAR Registered**



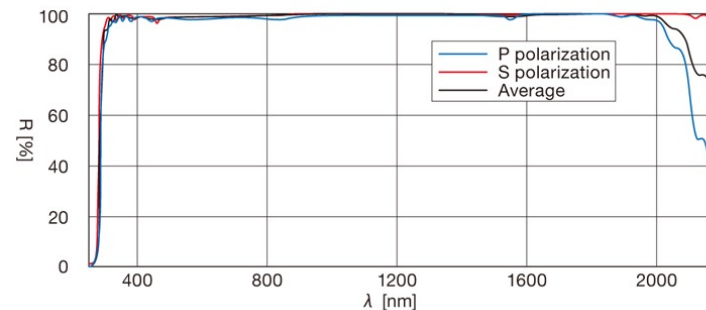
OptoSigma Global Capabilities

- High Finesse and Low Loss Coatings
 - Standard Catalog Items and Custom
 - Super Mirrors: $R < 99.999\%$ - 8PPM
 - **Development for six 9's and 1PPM Ongoing!**
 - Ultrafast Mirror Coatings
 - Low and Negative Dispersion (GDD)
 - Standard Catalog Items and Custom
 - Antireflection
 - Filter
 - Polarization
 - Ultra-Broadband
- **Coating for Flight and Space Applications

Super Mirrors



Ultra Broadband



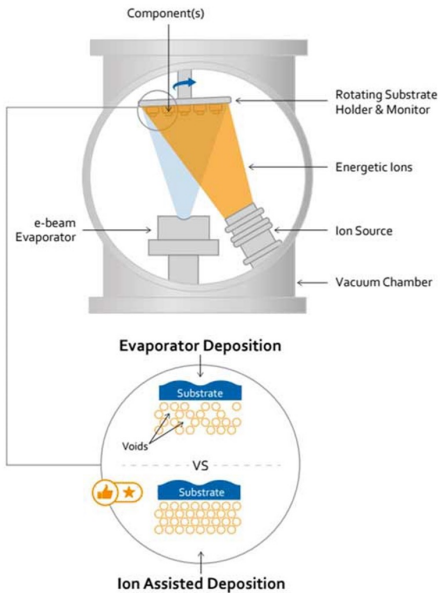
OptoSigma Coating Methods (1 of 3)

Electron Beam Deposition (EBeam)

- Charged tungsten filament gives off electron beam which bombards target anode
 - Anode - crucible of coating layer material
 - Gaseous material from crucible deposits in solid layer on everything in line of sight



OptoSigma Coating Methods (2 of 3)

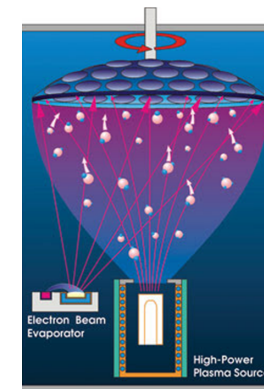


Ion Assisted Deposition (IAD)

- Material deposition assisted by ion source
 - Increases mobility of molecules or atoms
 - Increased grain size
 - Increased density
 - Optimized step coverage

Plasma Assisted Deposition (PAD)

- Material deposition assisted by Plasma source
 - Much higher particle kinetic energy
 - Greater molecule impact energy
 - Increased density



OptoSigma Coating Methods (3 of 3)

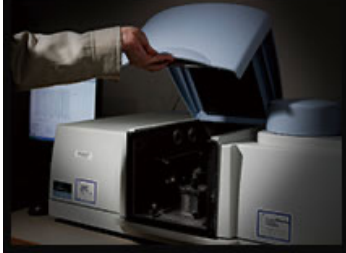
Ion Beam Sputtering

- Creates more dense film layers
 - Increased durability
 - Higher performance coatings
 - Improved deposition uniformity
 - Tighter packing of molecules and atoms
 - More available materials



If You Can't Measure It, You Can't Make It!

UV-NIR Spectrophotometer



DUV Spectrophotometer



3D Optical Surface Profiler



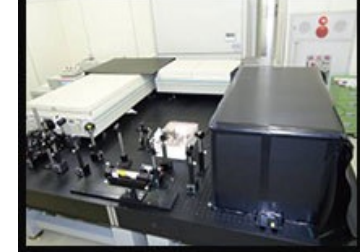
AFM (Atomic-Force-Microscope)



Scanning Electron Microscope



CRD (Cavity Ring-Down)



Worldwide Coating Capabilities

- 44+ years of experience
- Applications include Space Rated, Bio-Medical, Semiconductor, Sensing, High Power and much more!
- 25+ coating chambers
 - E-Beam w/ IAD and IBS Chambers
- Substrate size: 3 to 400 mm
 - (1-Meter Online in 2021)
- Catalog or custom
- ISO 9001:2015 and 14001:2015



➔ **OptoSigma (California) is ITAR Registered**

Thank you!

We appreciate your interest in the coating capabilities of our family of companies. Please contact us with any questions or projects.

We strive to be cost effective!

Eastern & Southern US:

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