

Light on Optics and Optometry

In streaming on YouTube

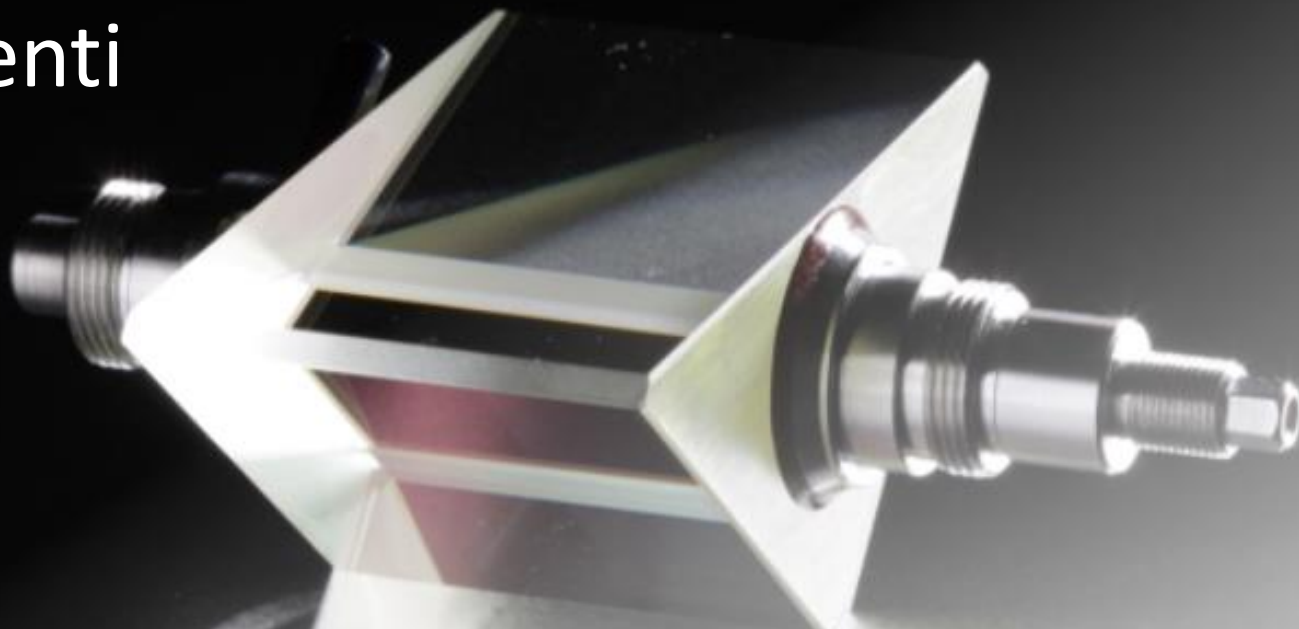
directed by **Giovanna Pacini**

<https://www.youtube.com/watch?v=MPBoTiwn3ho>



Componenti

Ottici



GESTIONE SILO 

SOCIETÀ ITALIANA LAVORAZIONE OTTICA



About us

Precision Optics since 1950

Via di Castelpulci 14/d
50018 Scandicci
Firenze
ITALY

+39 055 722 1367

info@silos.it

Glass cutting, grinding & polishing

Optical projects

Opto-mechanical assemblies

History

1950

Gestione SILO
was found as
spin-off of
Officine Galileo
Avionica

2002

Gestione SILO
opens
its unit for
Optical coating

2020

Gestione SILO
Inaugurates
its new
ISO 5 clean room

Departments



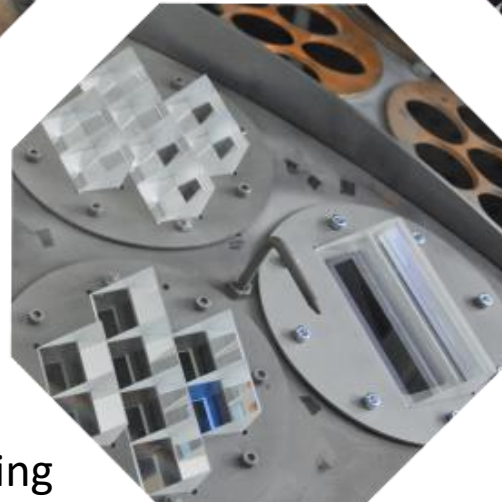
System
Engineering



Opto-mechanical
Manufacturing

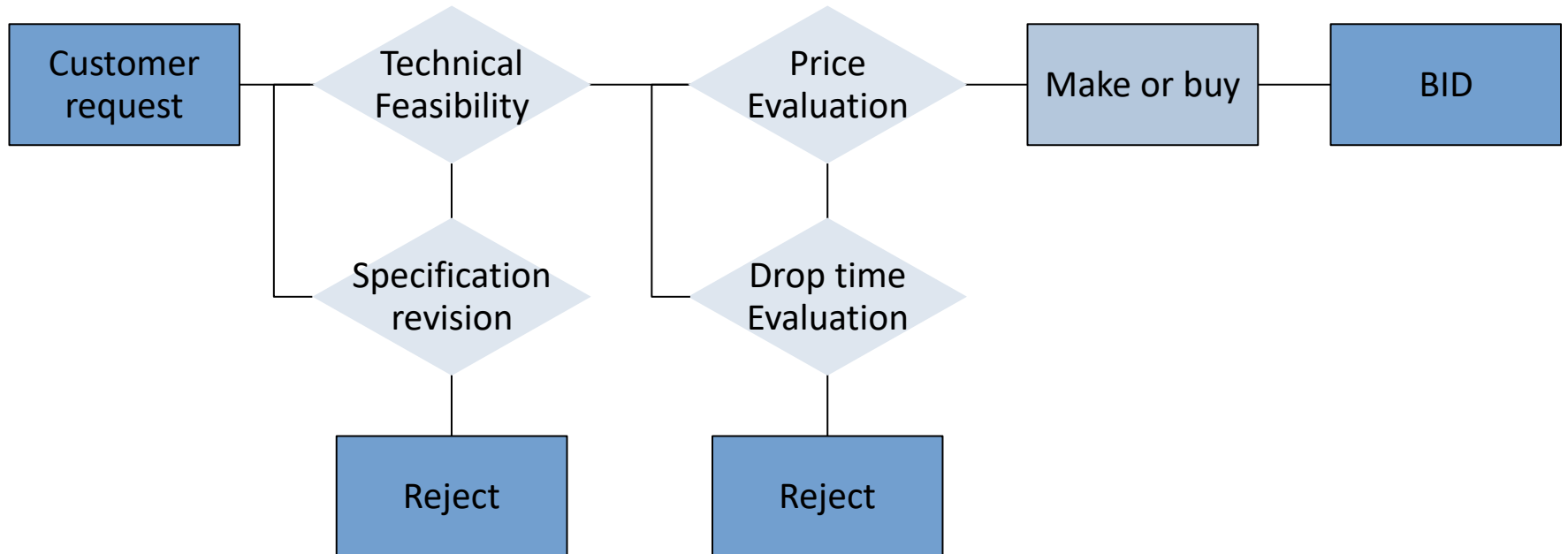


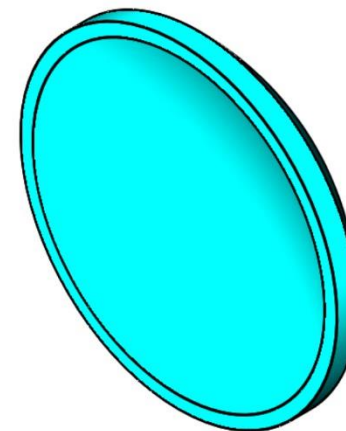
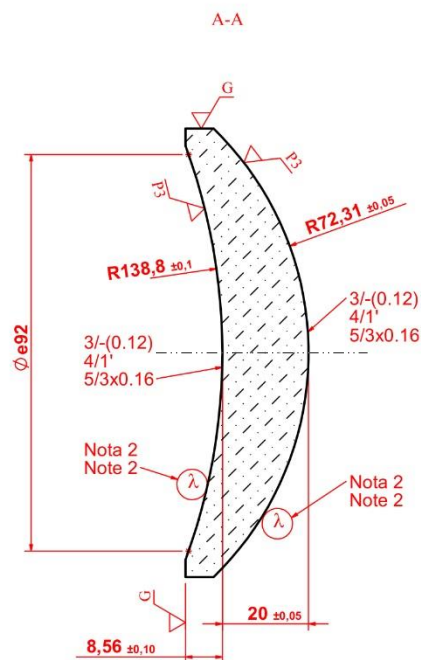
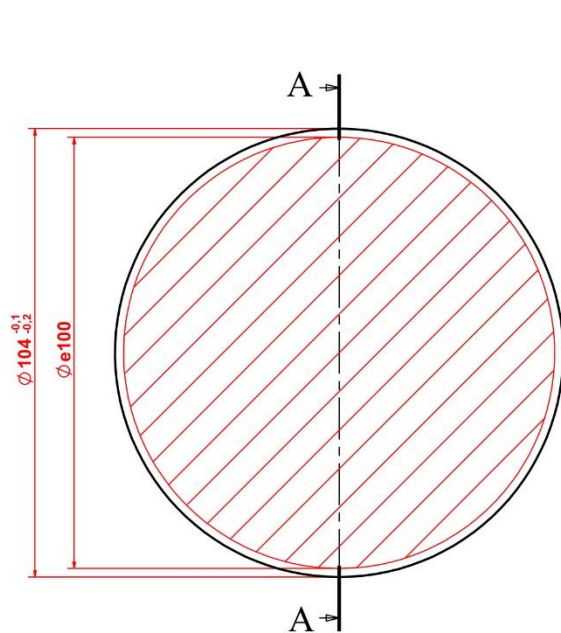
Quality &
Testing



Optical Coating

Flow Chart





3D VIEW

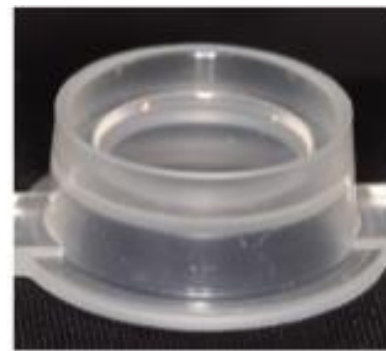
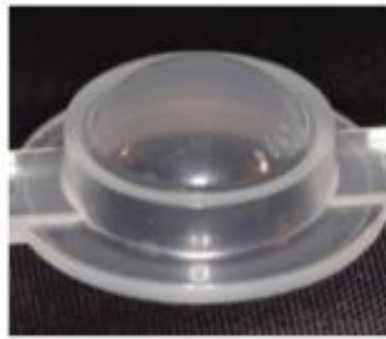
NOTA 1: MATERIALE: Schott BK7
 NOTA 2: TRATTAMENTO: AR @ 400 - 900 nm
 NOTA 3: TRATTAMENTO: ---
 NOTA 4: SMUSSI DI LAVORAZIONE: $\leq 0.3 \times 45^\circ$

NOTE 1: MATERIAL: Schott BK7
 NOTE 2: COATING ACCORDING TO: AR @ 400 - 900 nm
 NOTE 3: COATING ACCORDING TO: ---
 NOTE 4: CHAMFERS: $\leq 0.3 \times 45^\circ$

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		Gestione Silo srl Via di Castelpulci 14/d 50010 Scandicci Firenze WWW.SILO.IT 
DISEGNATO/DRAW		DENOMINAZIONE / TITLE
Vasco Milli		NL 1 Positive Meniscus Lens
PROGETTATO/DESIGNED		DISEGNO N° / DRAWING N°
		407/001.14/813
		DATA/DATE
		24/04/2014
APPROVATO/APPROVED		PESO/WEIGHT
Donati - Pieri		302.84
		SCALA/SCALE
		1:1.5
		FOLLIO / SHEET
		1 DI OF 1

Manufacturing methods

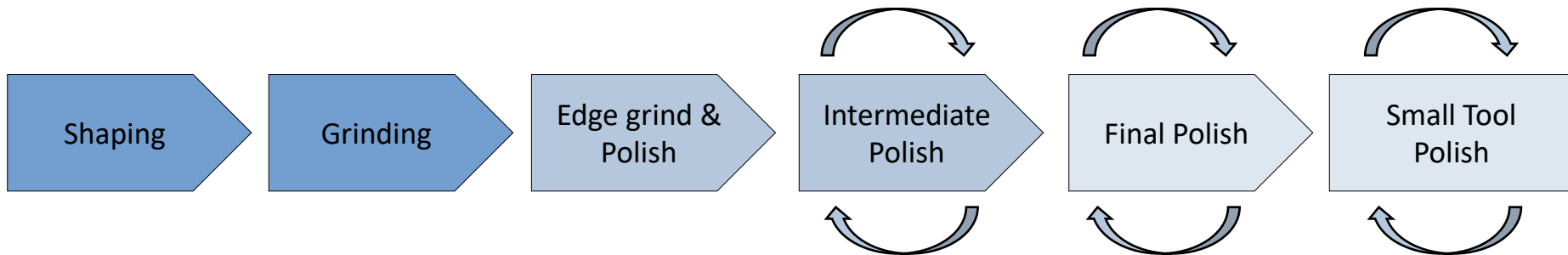
Moulding



Grinding & Polishing



Flow Chart



Manufacturing: Cutting

Ohara, Schott,
Corning glasses...

More than
4500 Kg
of raw materials

More than
800
different design



Manufacturing: Grinding

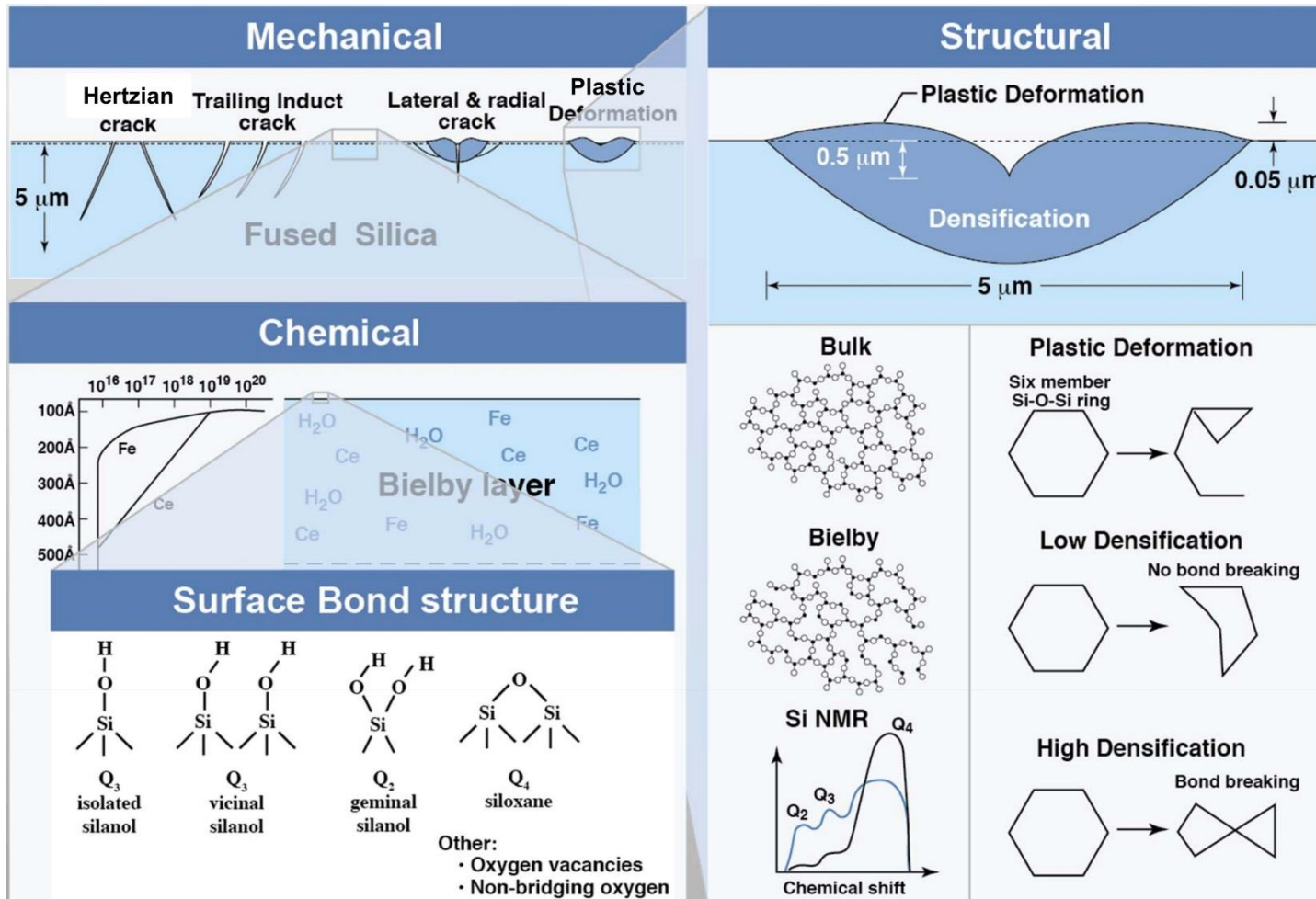
CNC or TRADITIONAL grinding

Optical shape generation:

Radius or plane (rough
surfaces)

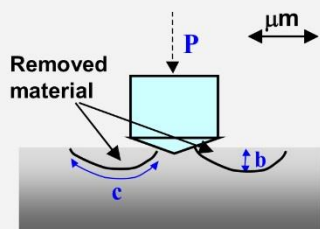


Manufacturing Material Science



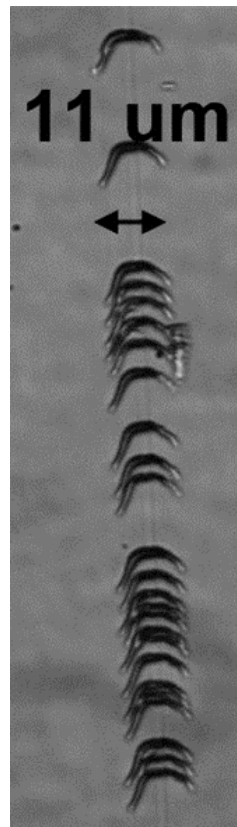
Manufacturing Material Science

Brittle Removal Grinding or scratching

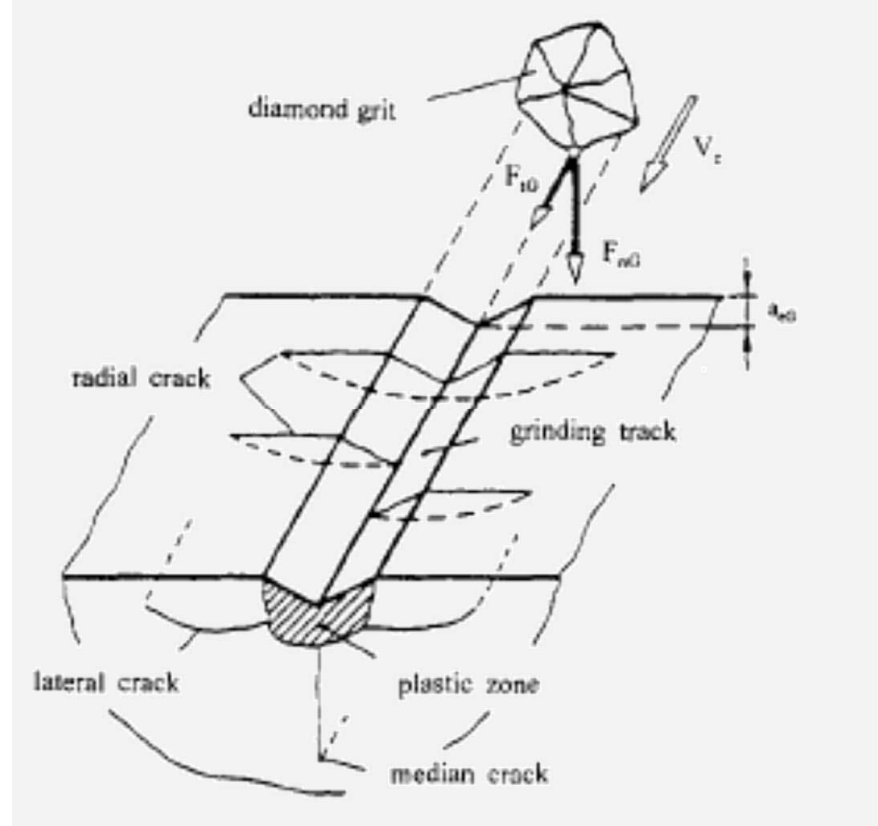


$$P_{\text{crit}} > 0.1 \text{ N}$$

- Material within lateral cracks are removed (grinding process)
- Leads to scratches



Schematic description of fractures associated with a scratch



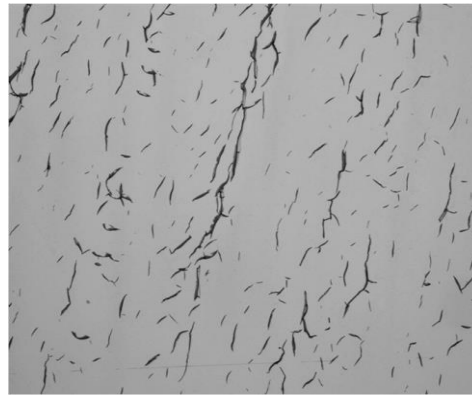
Roughness, Scratches & GRIT

Sand Blasted



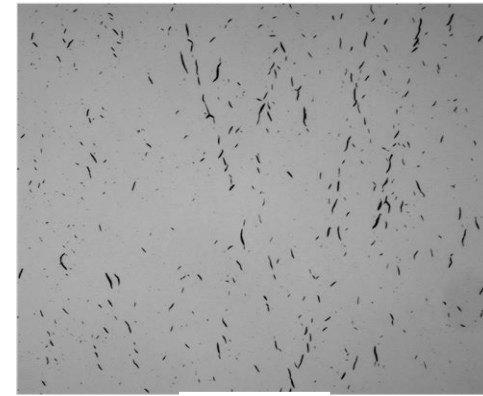
← 2.37mm →

120 grit (125 μm)



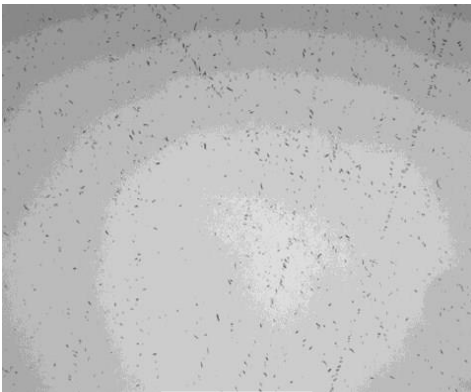
← 2.37mm →

150 grit (100 μm)



← 2.37mm →

15 μm loose abrasive



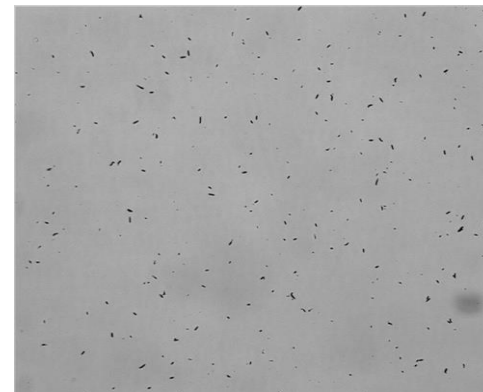
← 2.37mm →

15 μm fixed abrasive



← 2.37mm →

9 μm loose abrasive



← 0.6 mm →

Polishing



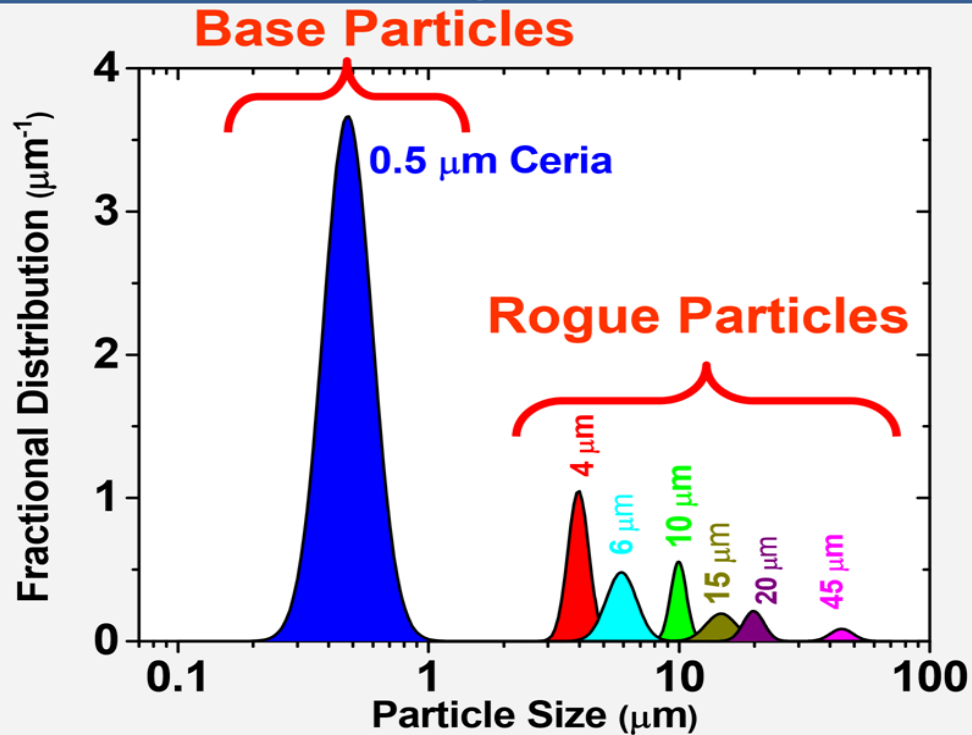
POLISHING

Smaller polishing particles: cerium, opal, diamond powder



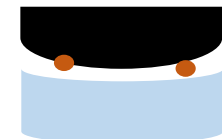
Polishing

Particle size distributions of ceria and rogue diamonds

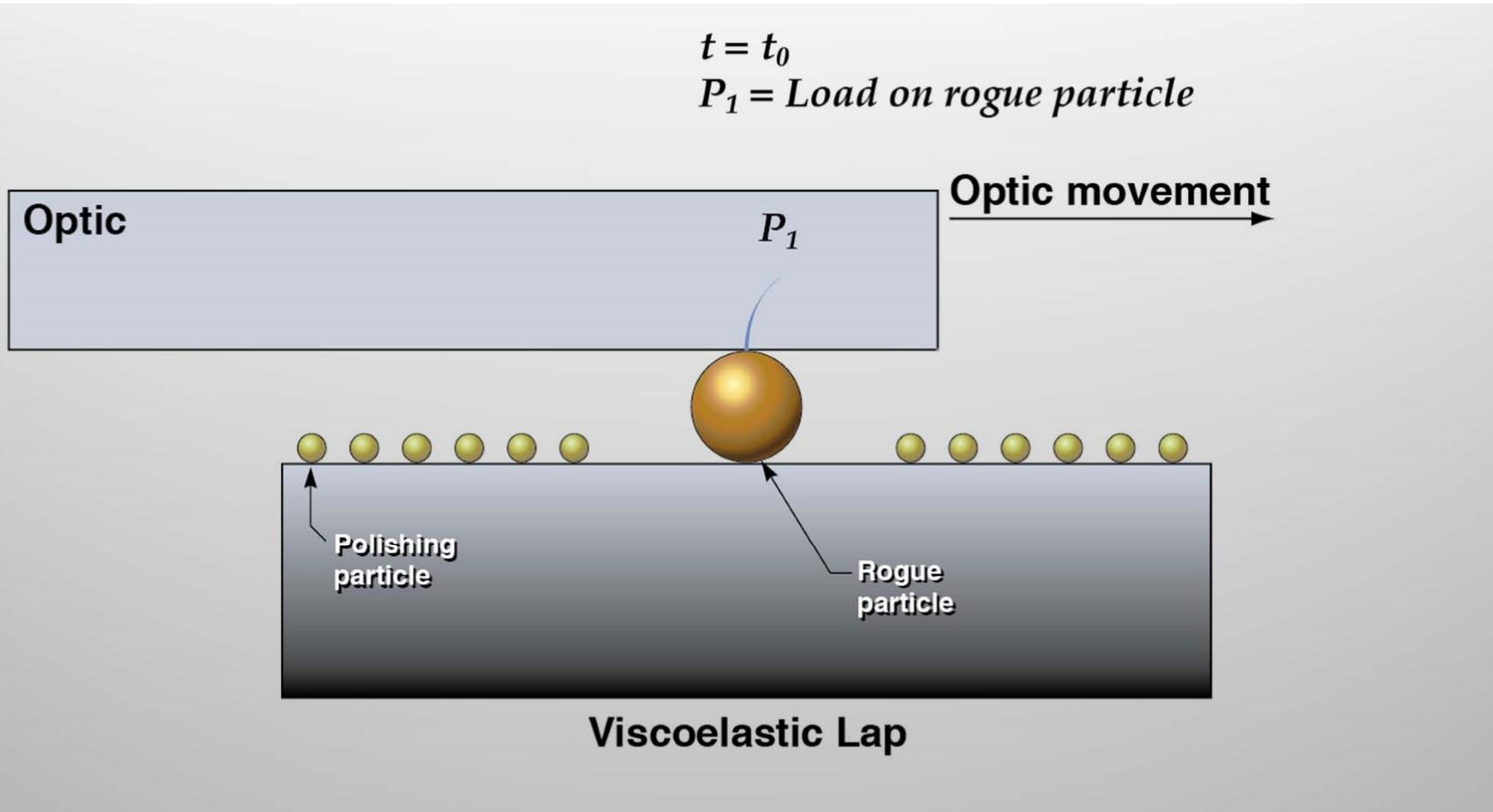


POLISHING

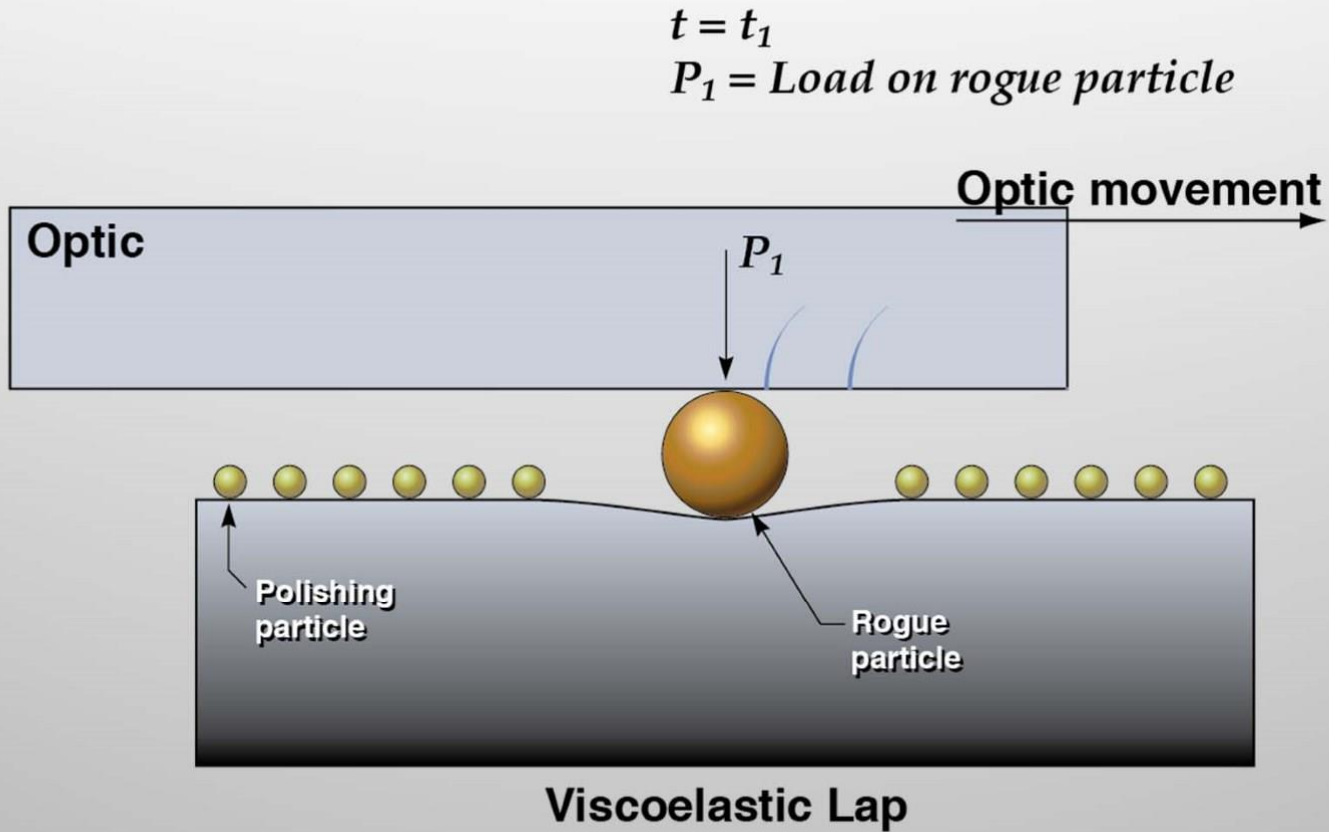
Smaller polishing particles: cerium, opal, diamond powder



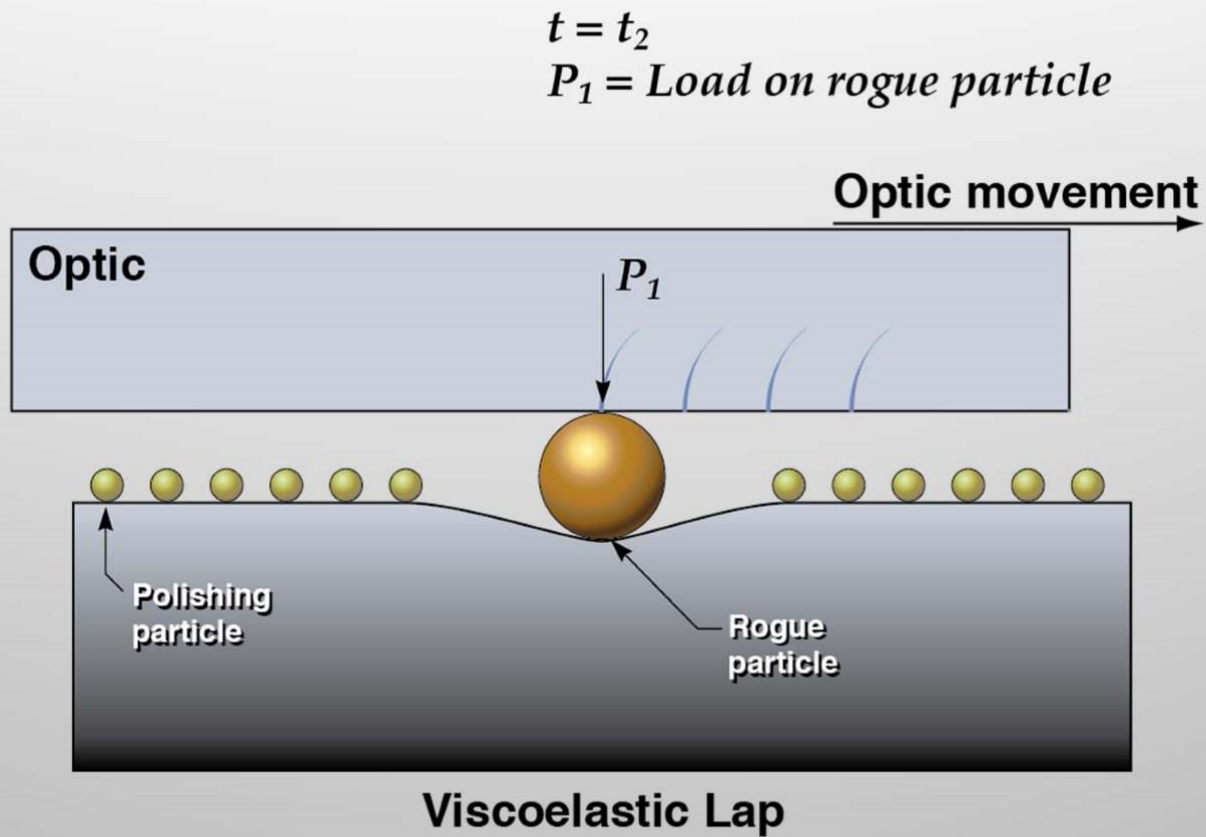
Polishing



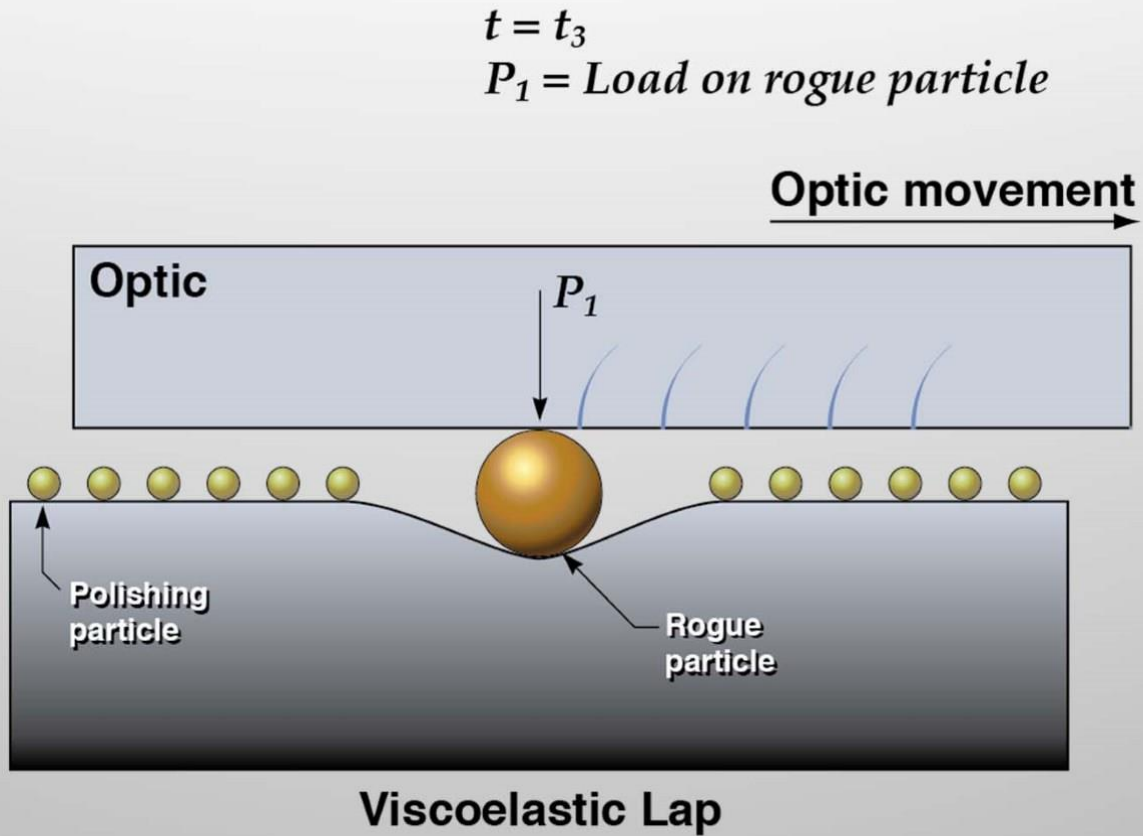
Polishing



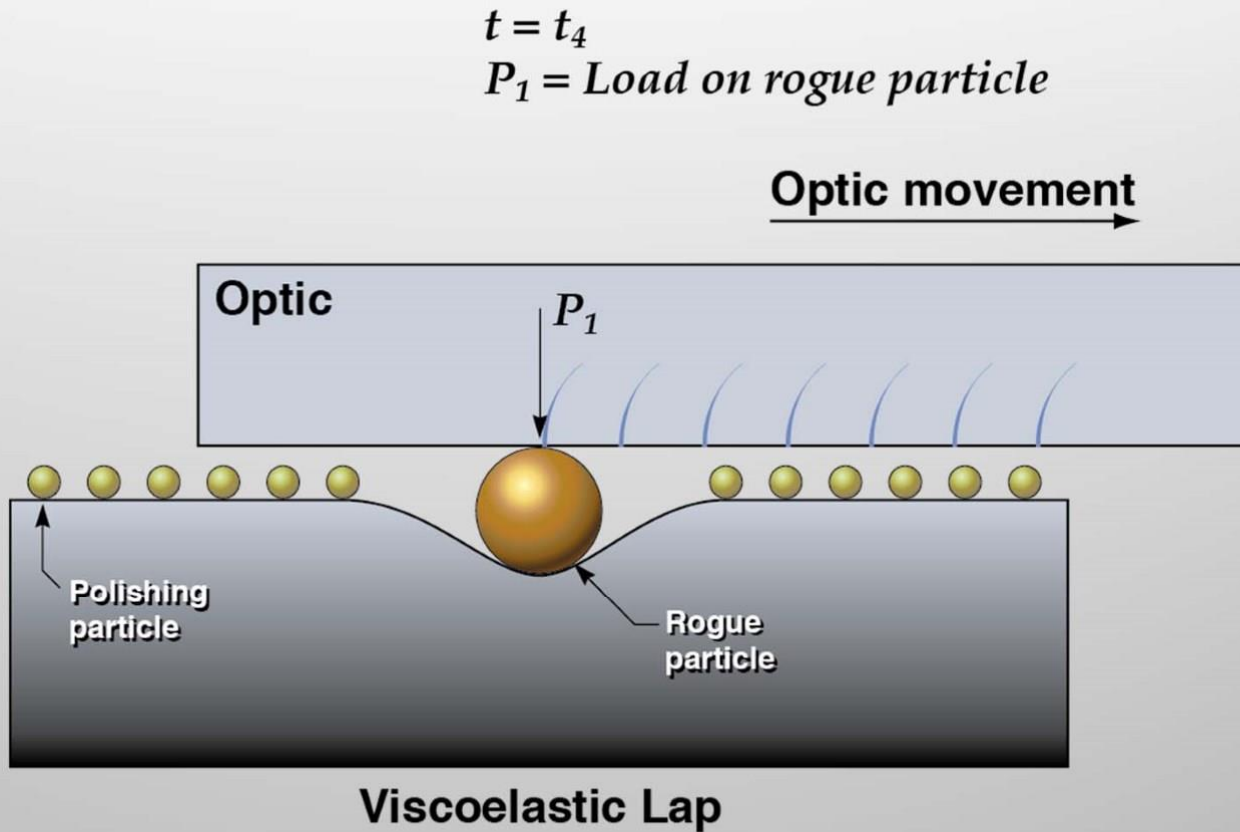
Polishing



Polishing



Polishing

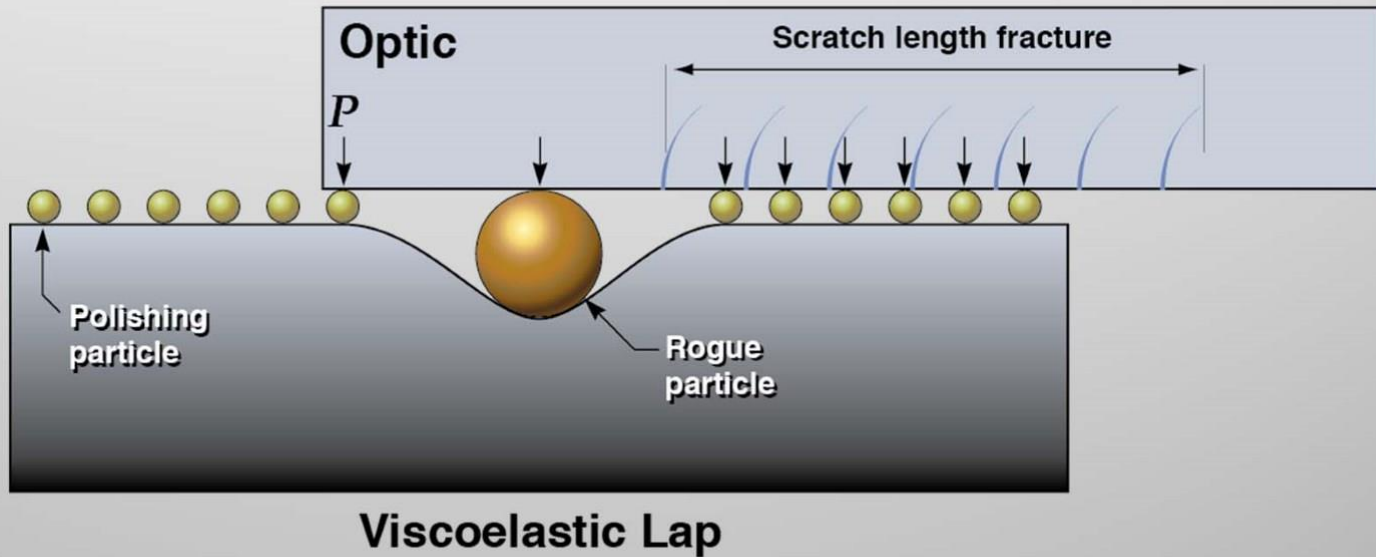


Polishing

$$t = t_5$$

$P = \text{Load on all particles}$

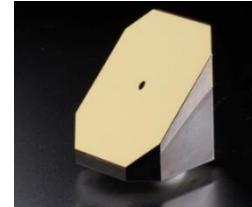
Optic movement →



Manufacturing

Spherical &
Cylindrical lens

Lenses, prisms, mirrors & free-form



Optical glasses, Fused
Silica, Si, Ge, ZnS, ZnSe,
CaF₂, MgF₂

Optical glasses, Crystals,
Materials for UV & IR



Special Applications,
XUV High power laser

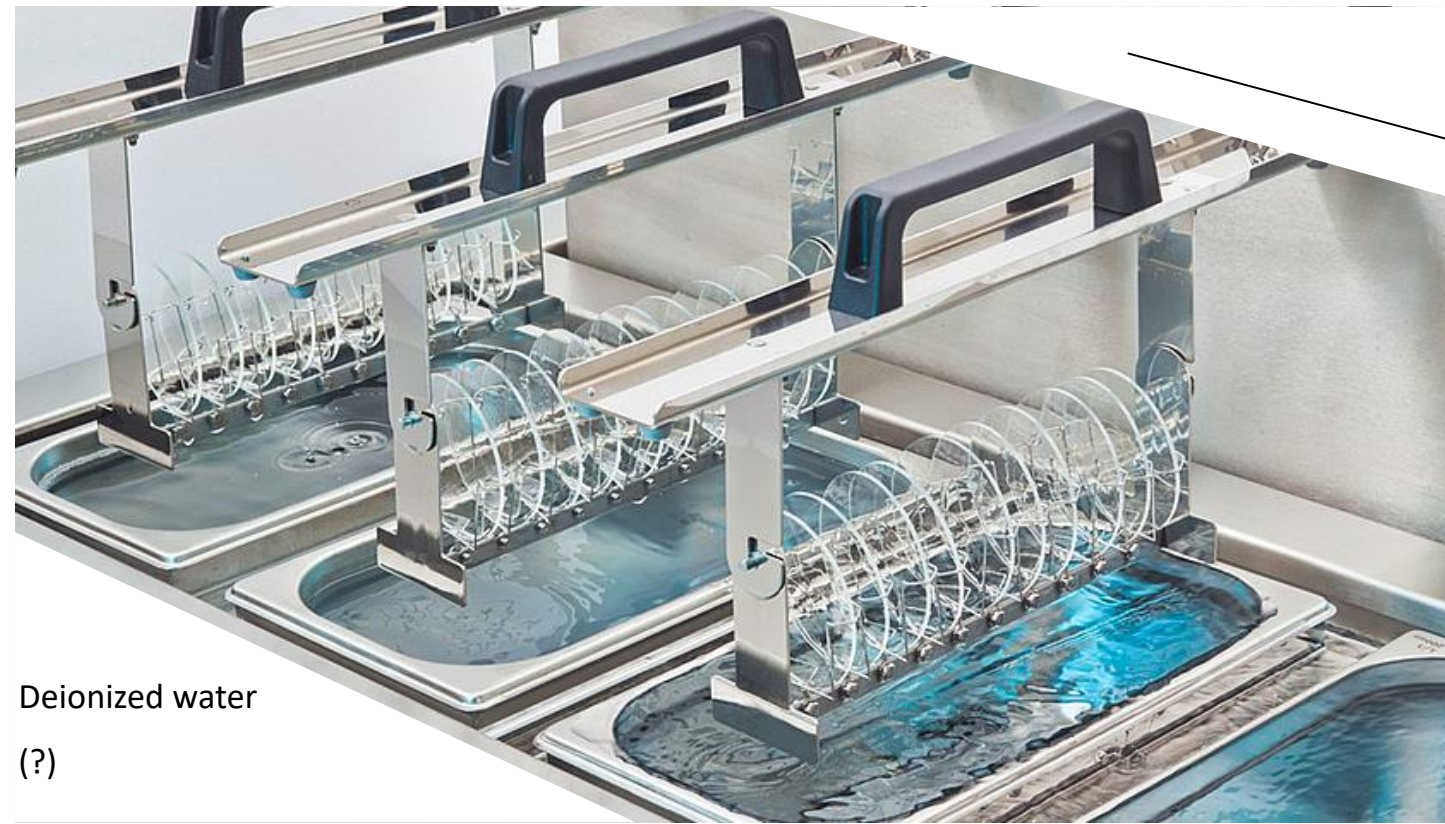
Super Polishing
up to 0.2 nm



On Steel, Aluminum & SiC

Metal Polishing





Deionized water
(?)

Solvents (?)

Cleaning agents
@ pH ?

Glass Cleaning

Optical Manufacturing: plane surfaces

THORLABS

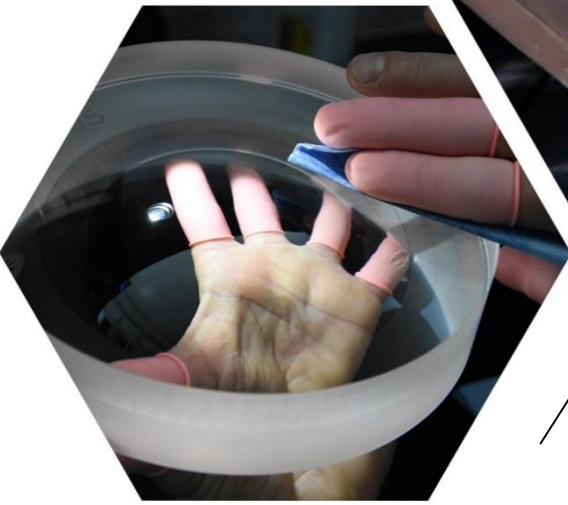
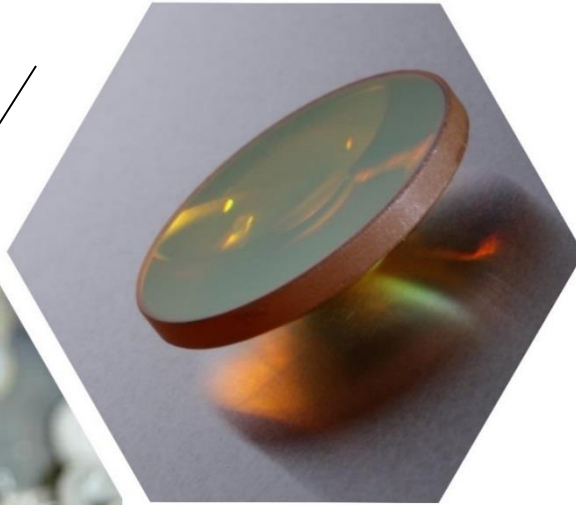
Optical Coating

UV VIS NIR & IR
optical coating

Dielectric & Metallic mirrors

Filters

Qualified according to
MIL Standards and ISO
standards



Optical Coating



E-gun Evaporation technology

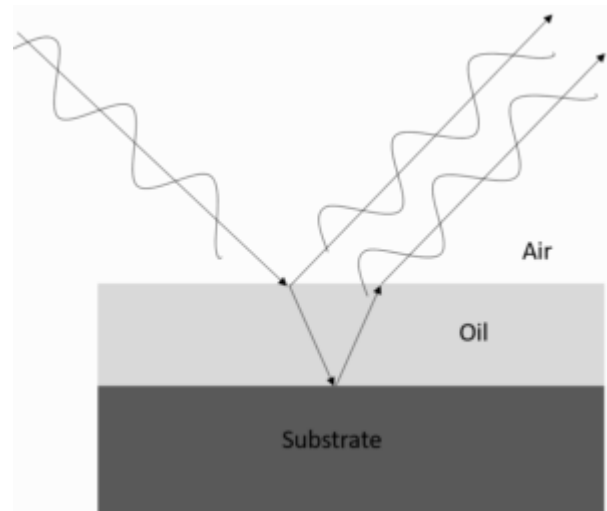
Ion gun assistance

Quartz rate monitor

Dome rotational substrate holder

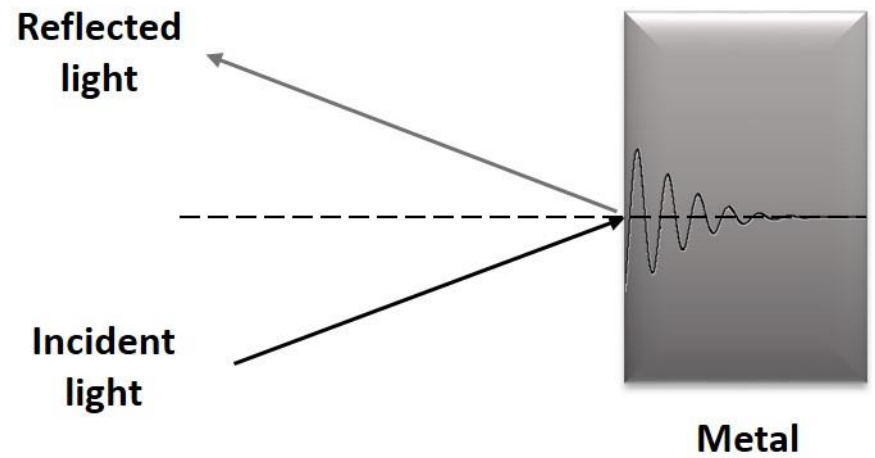


Optical Coating Mirror

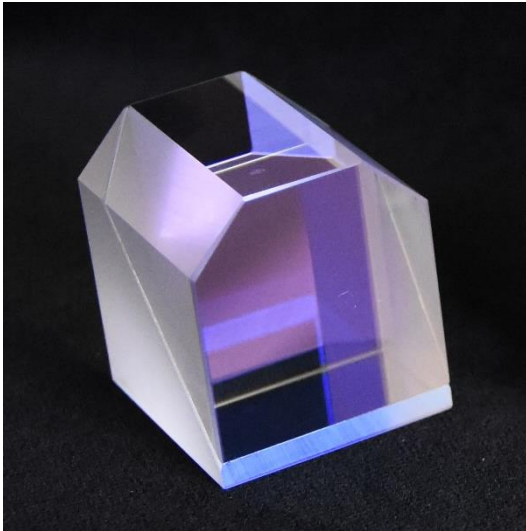


Dielectric optical coating

Metallic coating

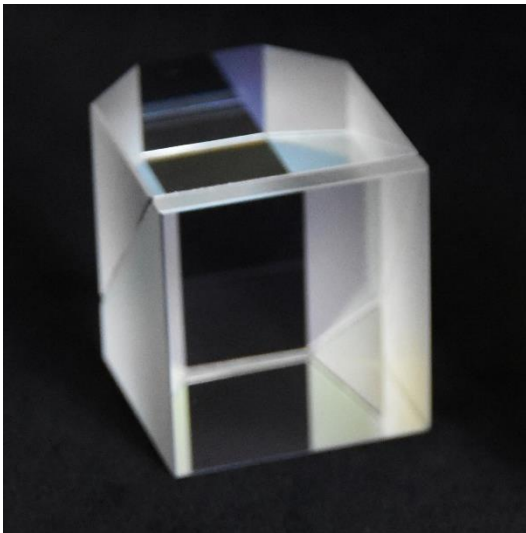


Dielectric Mirror

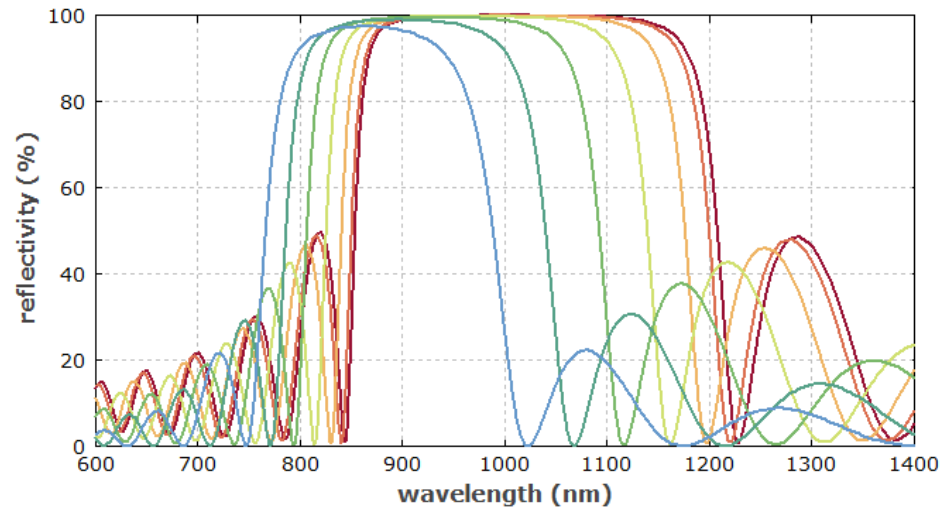


$$R = \left(\frac{n_1 - n_2}{n_1 + n_2} \right)^2$$

Layers thickness \sim Wavelength (phase adjust)



Bragg mirror behaviour as a function of AoI



Metallic Mirror

$$R = \frac{(n_1 - n_2)^2 + \kappa_2^2}{(n_1 + n_2)^2 + \kappa_2^2}$$

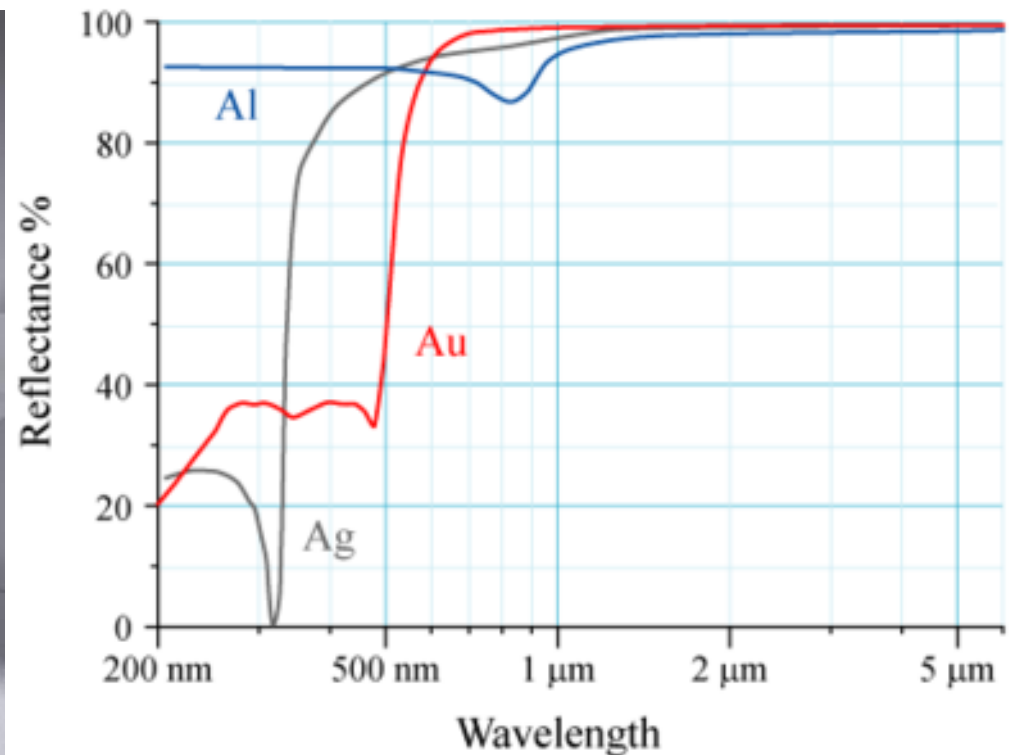
Metals: $\kappa_2 \gg n_1 \rightarrow R \sim 1$



Metallic Mirror

$$R = \frac{(n_1 - n_2)^2 + \kappa_2^2}{(n_1 + n_2)^2 + \kappa_2^2}$$

Metals: $\kappa_2 \gg n_1 \rightarrow R \sim 1$



Optical Coating

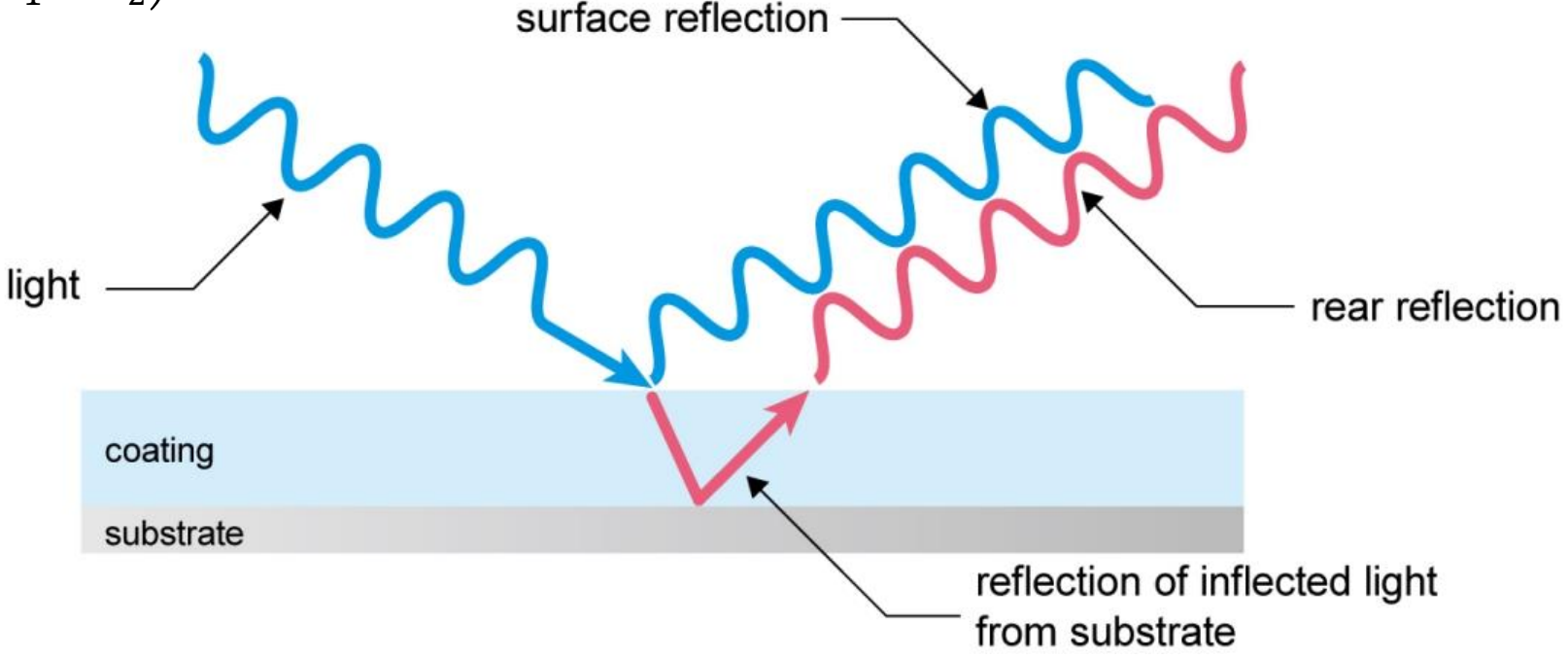
AR coating



Without Anti-Reflective

With Anti-Reflective

$$R = \left(\frac{n_1 - n_2}{n_1 + n_2} \right)^2$$



Optical Coating

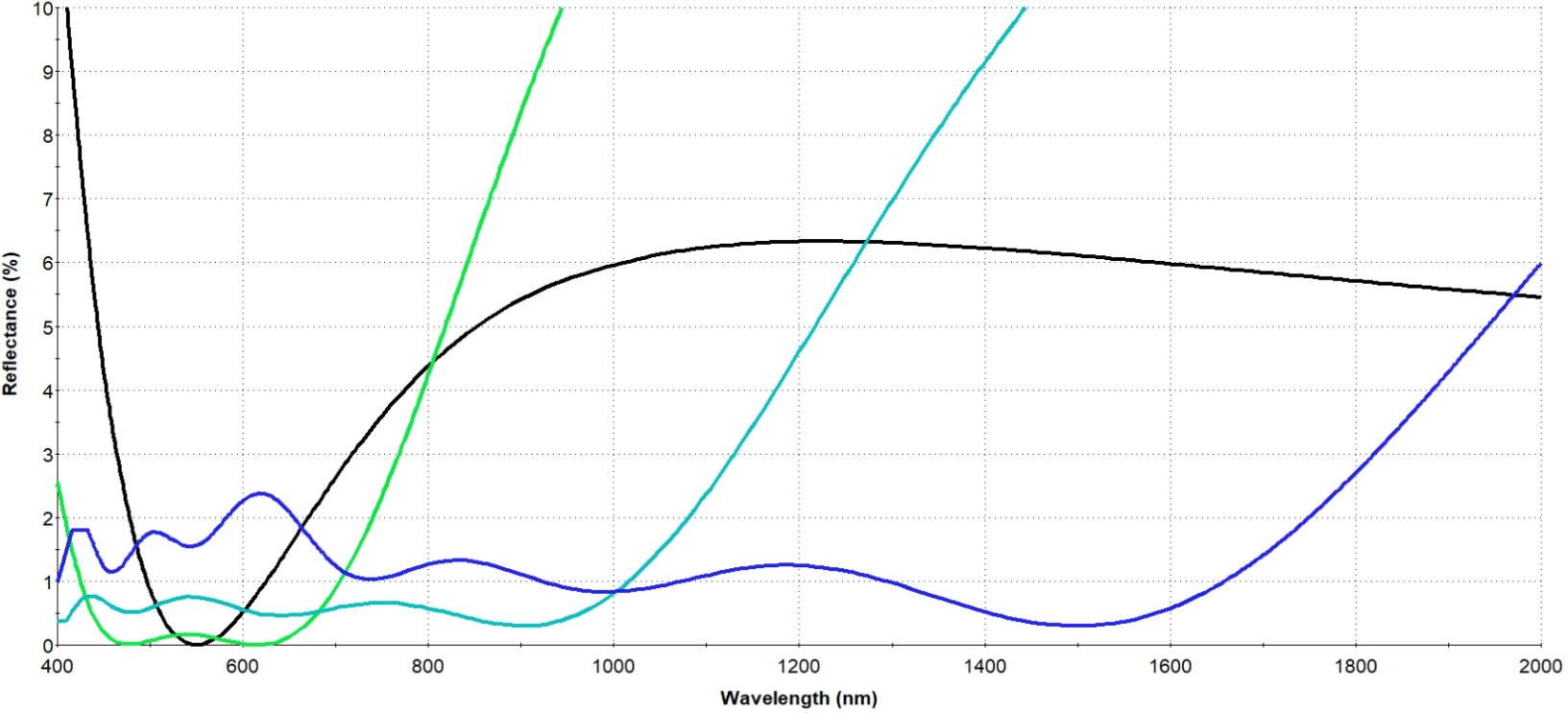
AR coating



Without Anti-Reflective

With Anti-Reflective

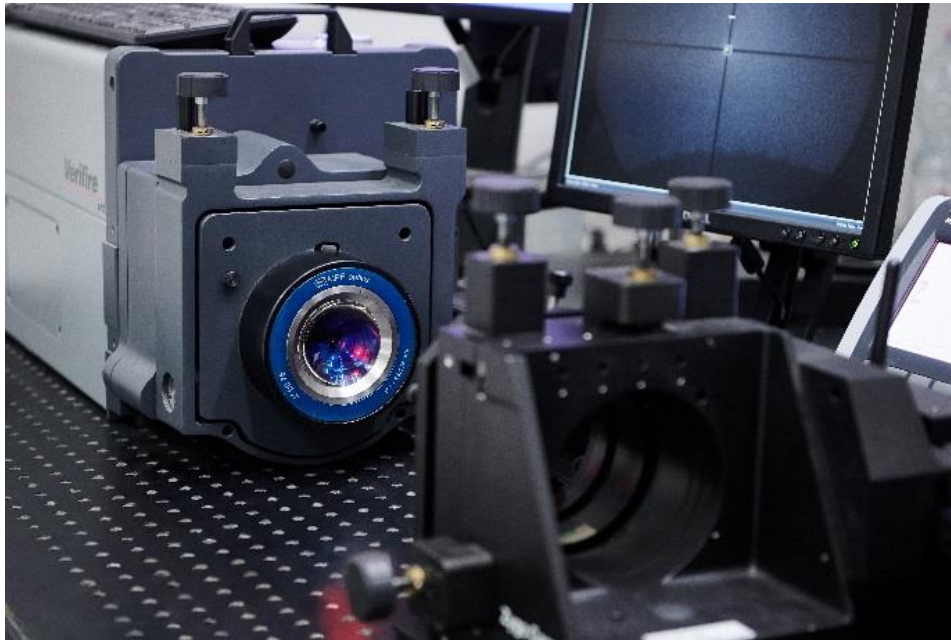
AR Coatings on Glass



Optical Measurements

INTERFEROMETRY
CA up to 150 mm
 $\lambda/20$

MICRO-ROUGHNESS
up to 0.5 nm



OPTICAL CENTERING
up to 10''

SCRATCH & DIG
0.01÷5 mm

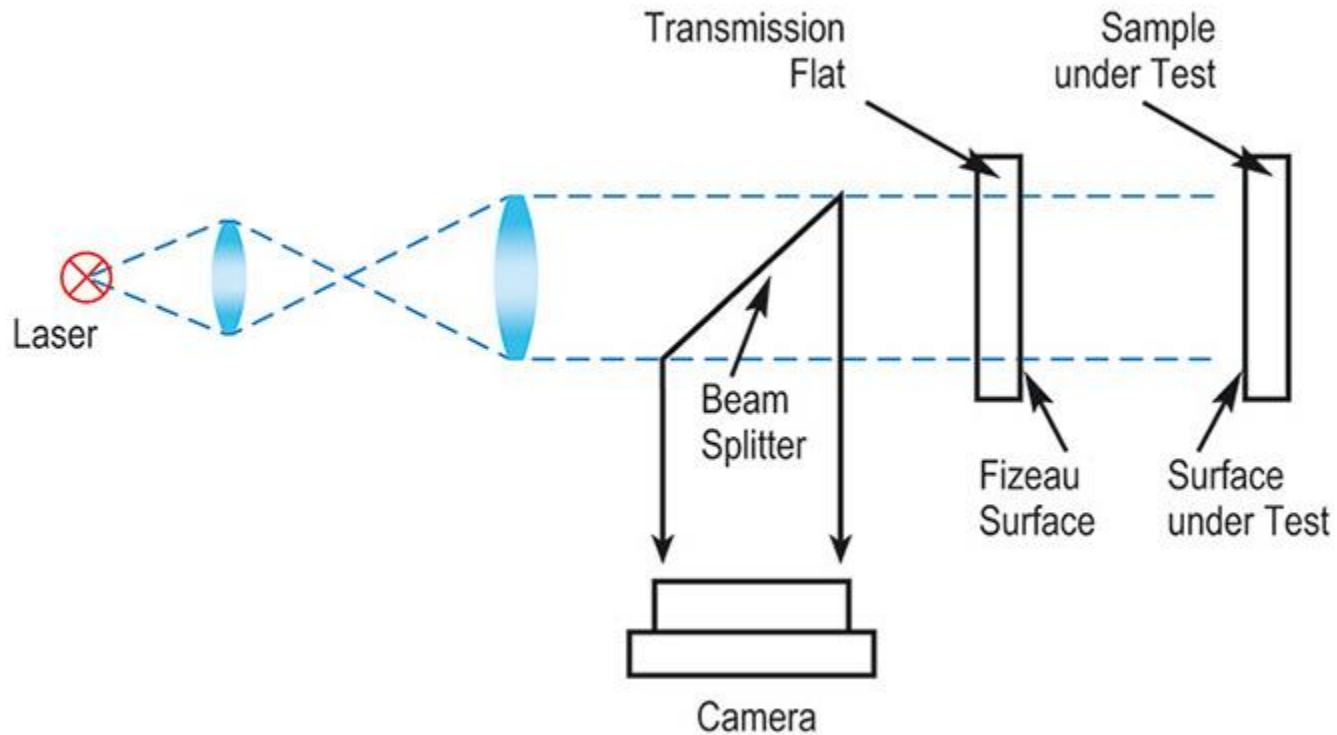
SPECTROFOTOMETRY
(VIS) in 200 nm ÷ 3 μ m
(IR) in 1.8 ÷ 25 μ m

Surface Quality



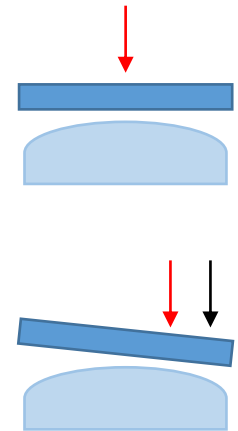
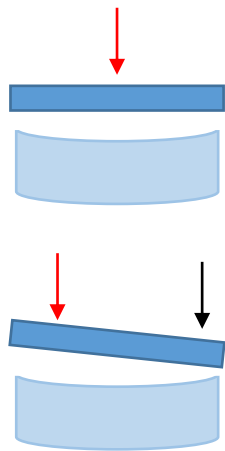
Surface Quality Interferometry

Reference:
Standard Flat



Surface Quality Interferometry

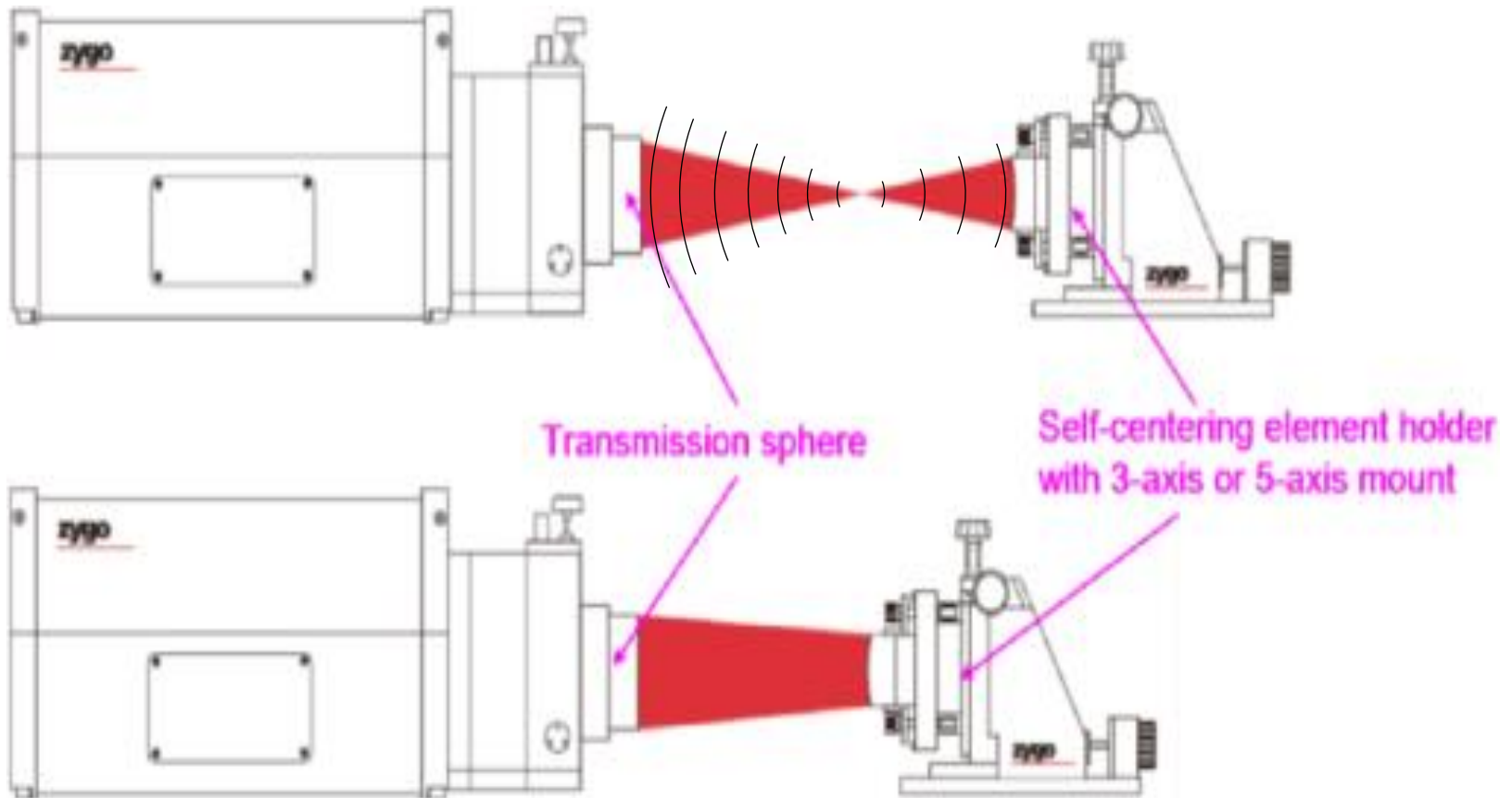
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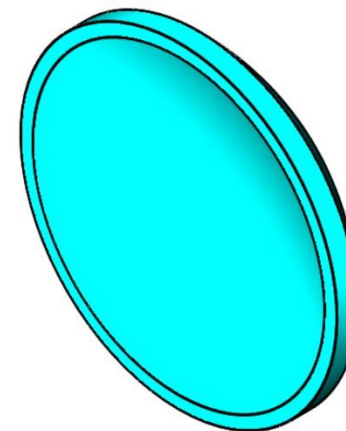
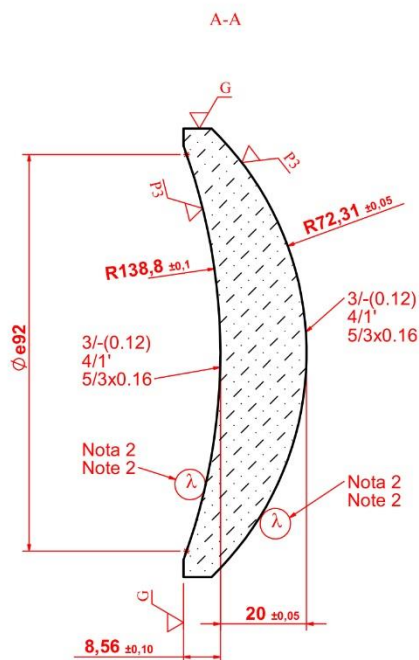
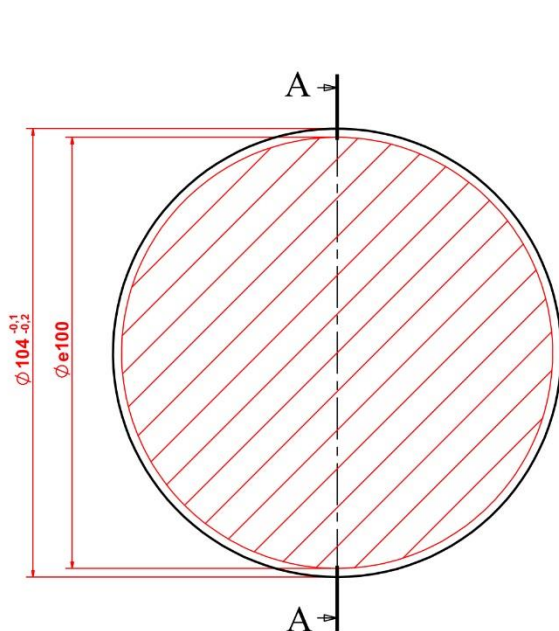


S. No.	Surface type	Appearance of the Newton fringes	
		Without tilt	With tilt
1	Plane		
2	Almost plane		
3	Spherical		
4	Conical		
5	Cylindrical		
6	Astigmatic (curvatures of same sign)		
7	Astigmatic (curvatures of opposite sign)		
8	Highly irregular		

Surface Quality Interferometry

Reference:
Standard Spherical





3D VIEW

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 NOTA 2: TRATTAMENTO: AR @ 400 - 900 nm
 NOTA 3: TRATTAMENTO: ---
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