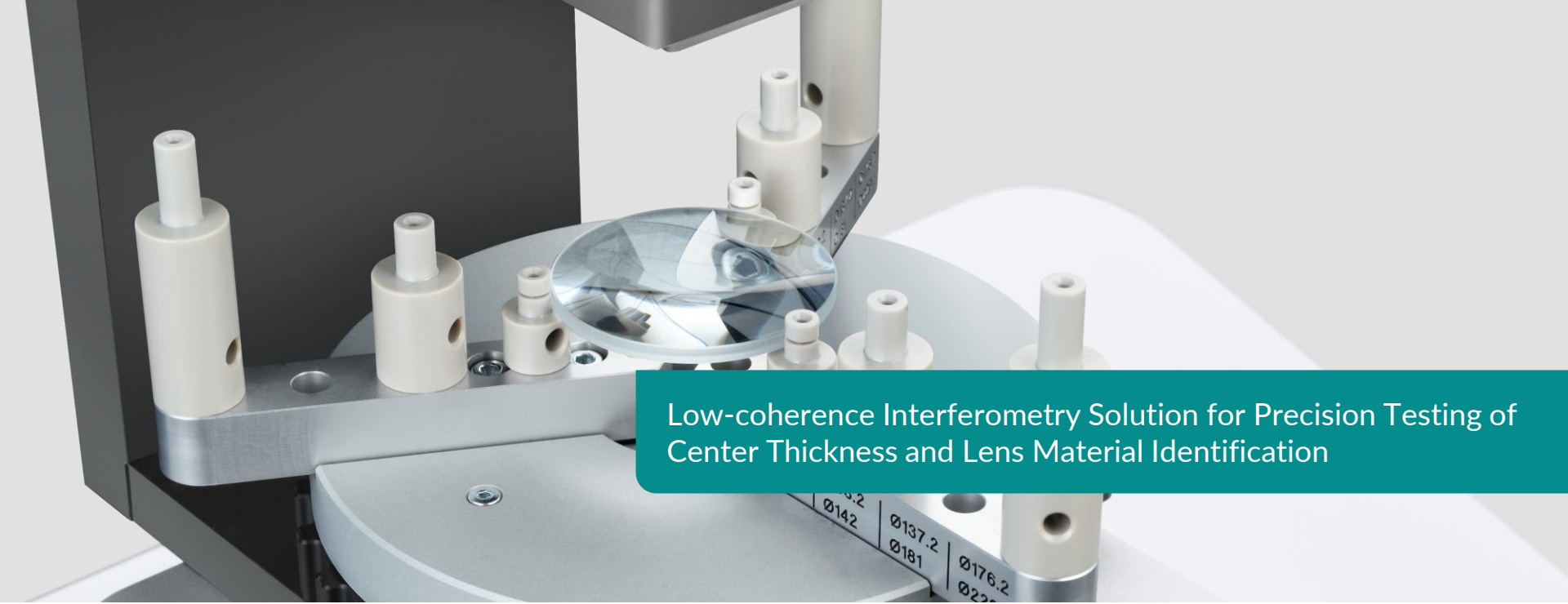


Low-coherence Interferometry Solution for Precision Testing of Center Thickness and Lens Material Identification

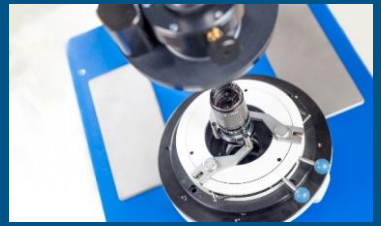
TRIOPTICS
See the Difference

Dr. Patrik Langehanenberg, March 30th, 2023

Our product groups

Testing of optical components
MPO

Assembly and testing of lens systems
MPO



Testing of image quality
Image Quality

Assembly and testing of camera modules
Automation

Customer device development
Engineering

Non-contact measurement of center thickness

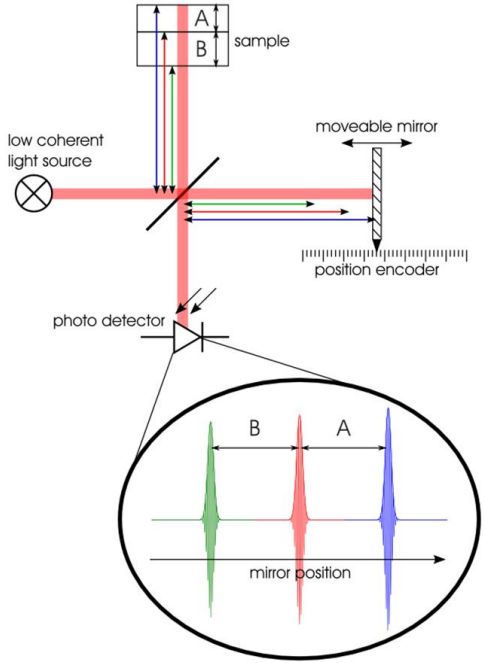
- Short coherent interferometric technique that measures the optical path length between optical surfaces
- Lens thickness of glasses can be calculated using the refractive index

$$\mathrm{OPL} = d \cdot n_g$$

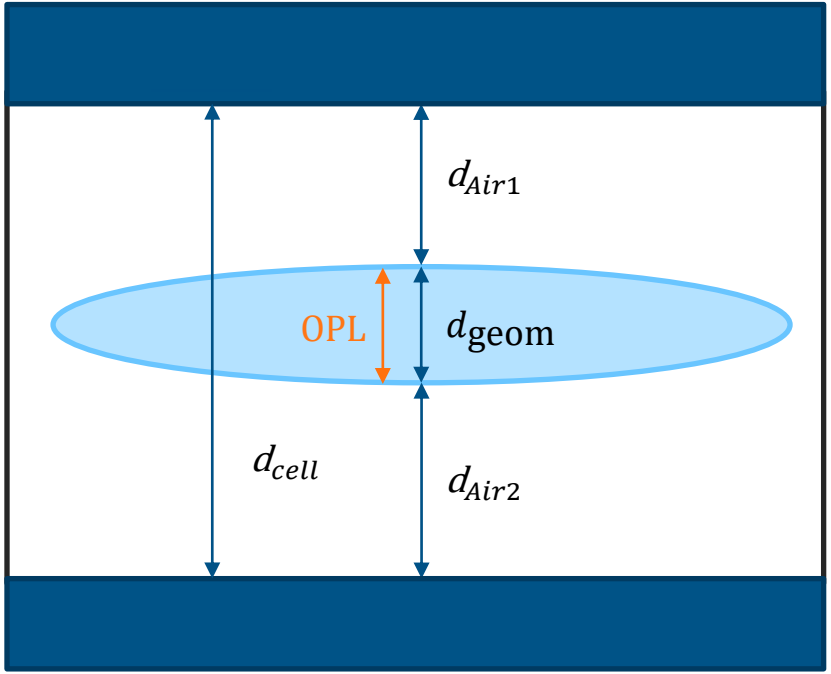
with **group** refractive index n_g

$$n_g(\lambda) = n(\lambda) - \lambda \frac{\mathrm{d}n(\lambda)}{\mathrm{d}\lambda}$$

- Knowledge about material properties essential for this technique



Non-contact CT measurement of unknown glasses



1. Measurement of the distance between the glass plates d_{cell}
2. Measurement of distances:
   a. Top glass plate to top lens surface d_{Air1}
   b. Bottom lens surface to bottom glass plate d_{Air2}
   c. Lens surface 1 to lens surface 2 "OPL"

- Calculation of the lens thickness without material information:

$$d_{\mathrm{geom}} = d_{\mathrm{cell}} - d_{\mathrm{Air1}} - d_{\mathrm{Air2}}$$

- The group refractive index:

$$n_{\mathrm{group}} = \frac{OPL}{d_{\mathrm{geom}}}$$

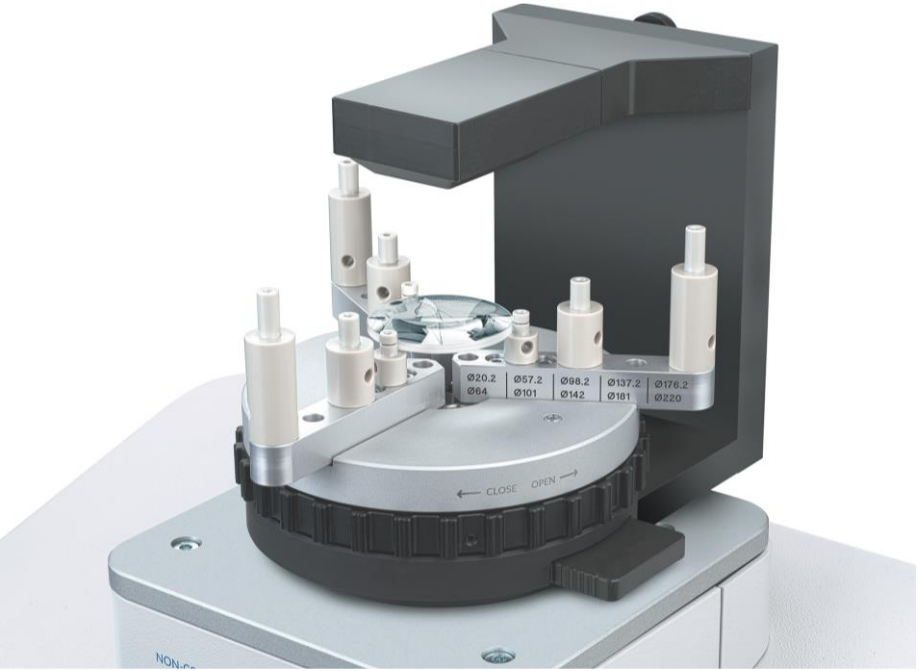
- Inverse search of n_{group} to narrow down the material

NEW: LensGage

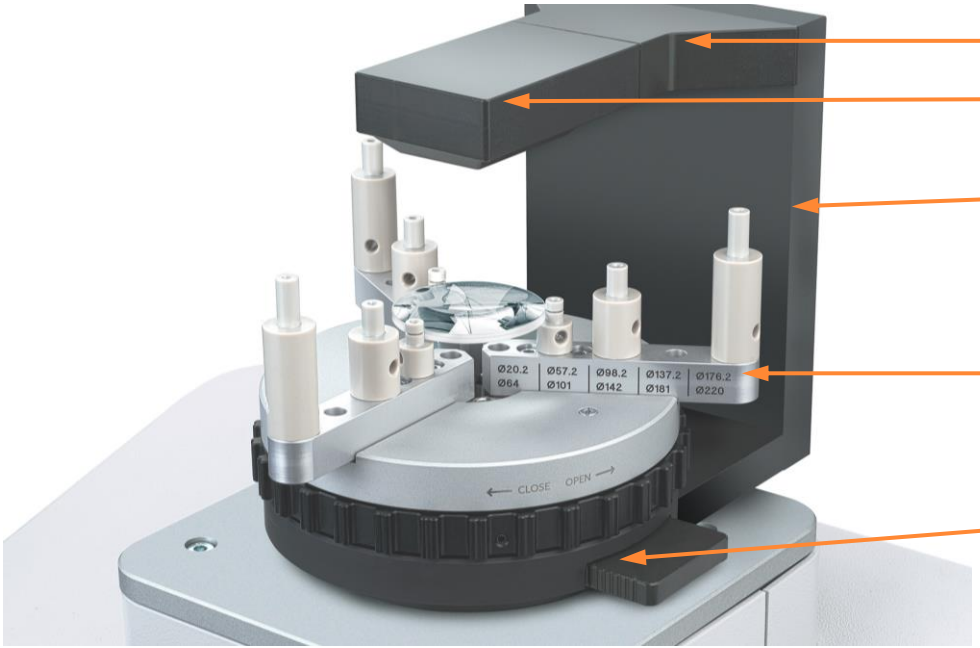
The LensGage is used for:

- Determination of the lens thickness without knowledge of the material
- Determination of the group refractive index
  - Usage for later OptiSurf® measurements when the objective lens is mounted
  - Quality inspection to secure a consistent group refractive index throughout batches
- Determination of glass material

➢ Accessory for OptiSurf® and OptiSurf® LTM



Set up



Fast mounting

Top plan-parallel glass plate

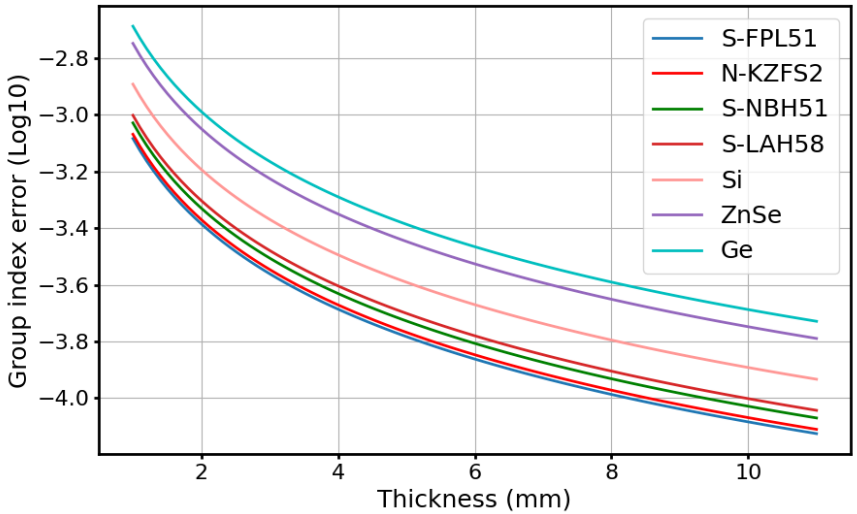
Build out of invar for little thermal expansion
→ Little calibration, reproducible, stable results

Standard self-centering mechanical clamping chuck

Lower plan-parallel glass plate on slider for easy removal

Non-contact CT measurement of unknown glasses

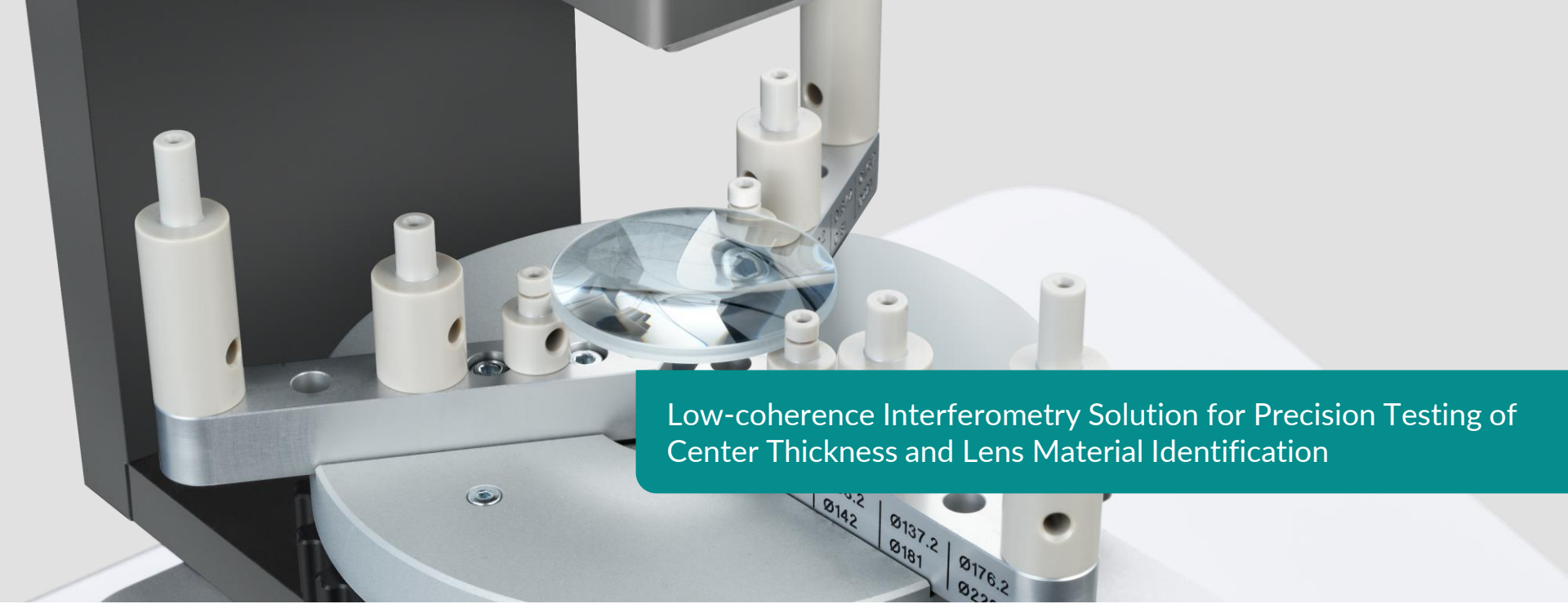
Material	Thickness [mm]	Group refractive index		Deviation
		Nominal	Measured	
S-LAH58	7.9265	1.878438	1.878415	0.00002
F_silica	5.0430	1.461648	1.461705	0.00006
N-KZFS2	10.9143	1.561912	1.562031	0.00012
S-FPL51	5.6865	1.497283	1.497406	0.00012
S-NBH51	1.0681	1.745795	1.746083	0.00029
S-LAH58	3.8951	1.878418	1.878833	0.00041



Technical data: OptiSurf® LensGage

	OptiSurf® „LensGage" Module
Max. Sample diameter	200 mm
Accuracy	n_g: ~10^{-4} for d_{geom} > 6 mm d_{geom}: 1.5 µm
Measurement wavelength	1310 nm; spectral band width of 85 nm
Thickness range for LensGage module	Up to 55 mm optical thickness (larger on request)

This new approach is a very powerful tool to precisely test the center thickness of (unknown) lenses, to monitor refractive properties, and to identify the glass material of lenses



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