Low-coherence tomography in 3D surface scanning

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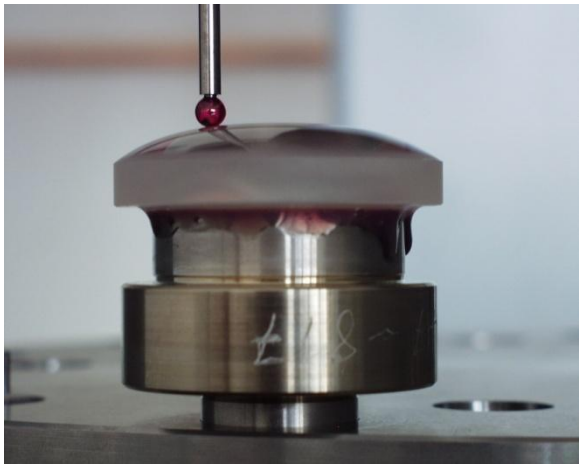
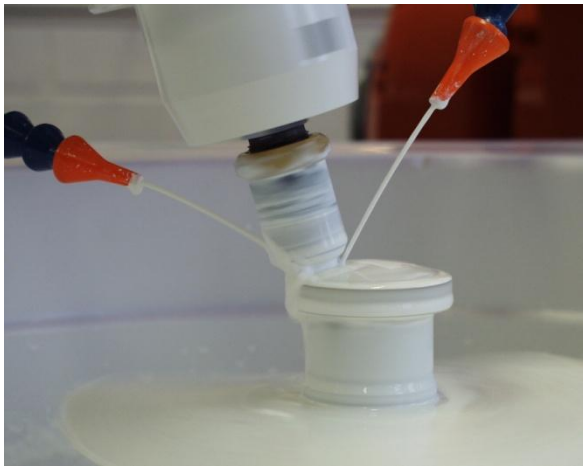
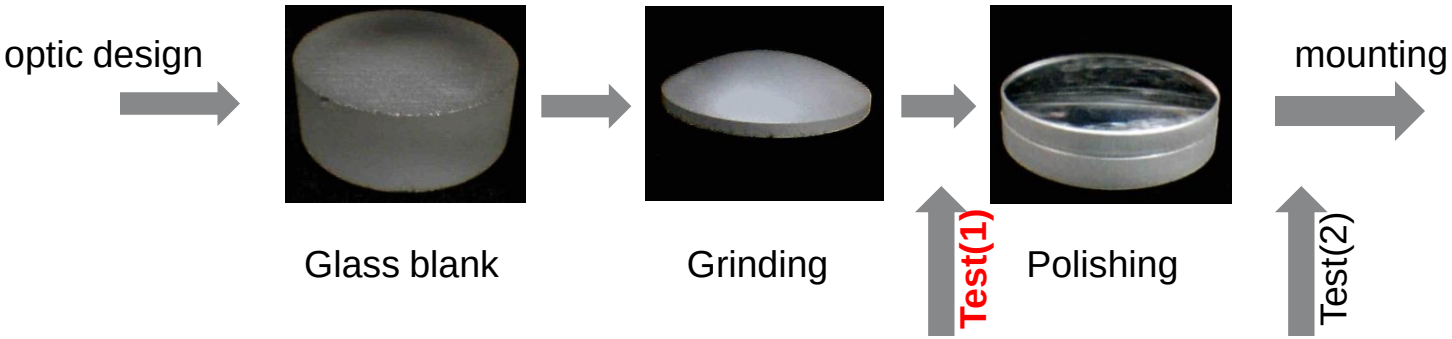
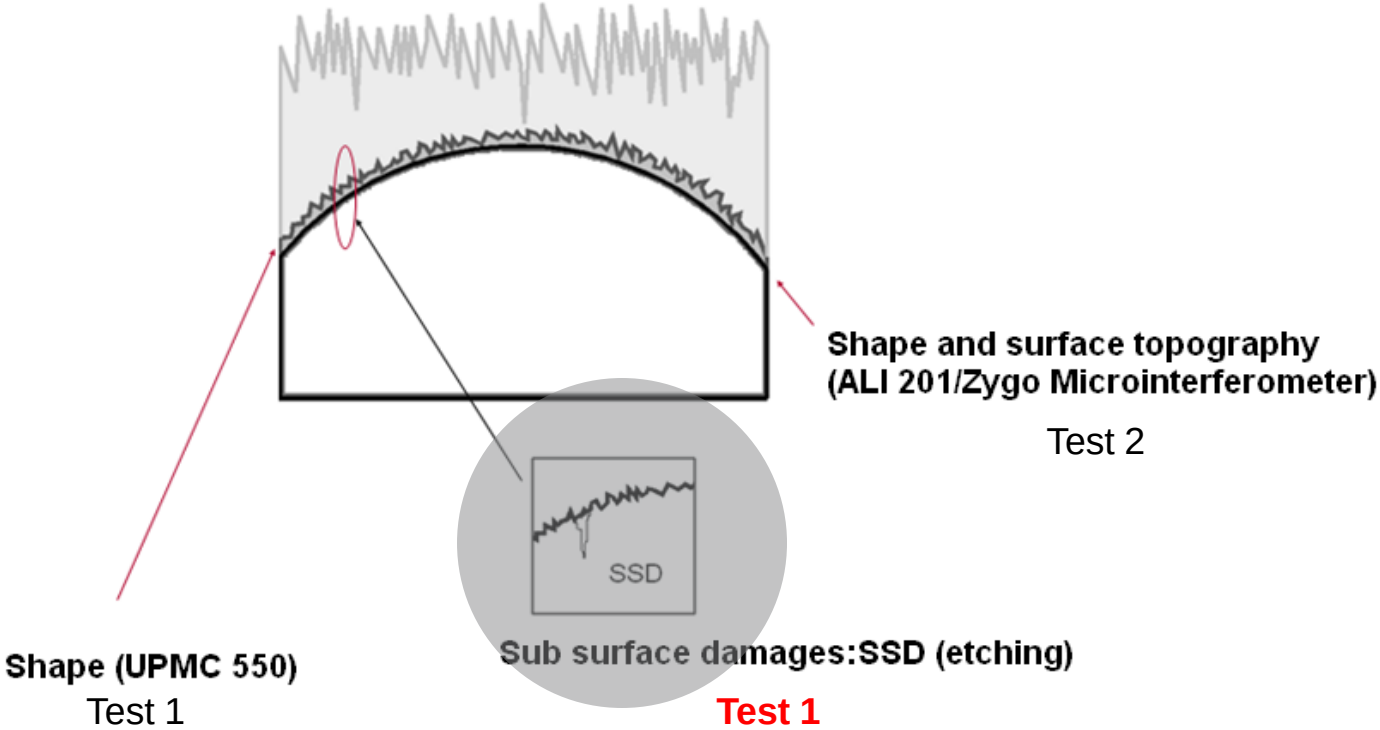




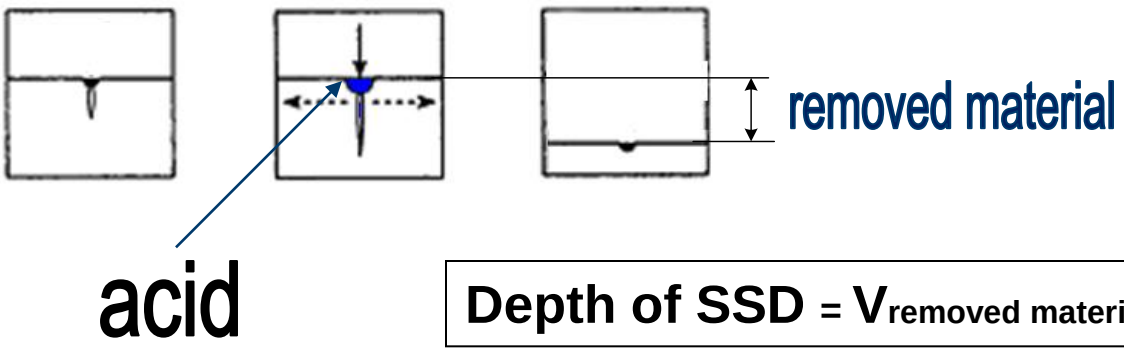
Process chain





To make the whole process cheaper and faster, grinding should be well <u>optimized</u> to bring the lens as close to nominal as possible.

Etching



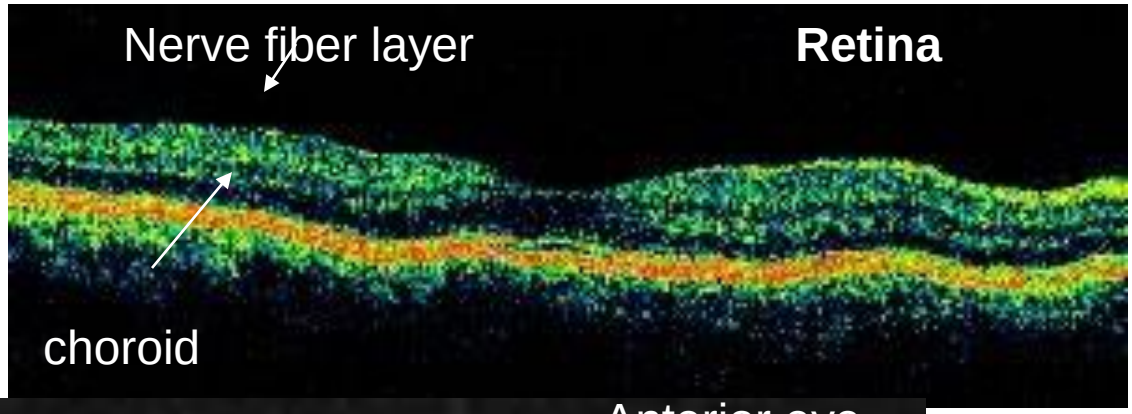
Depth of SSD = $V_{removed\ material}$ / x min

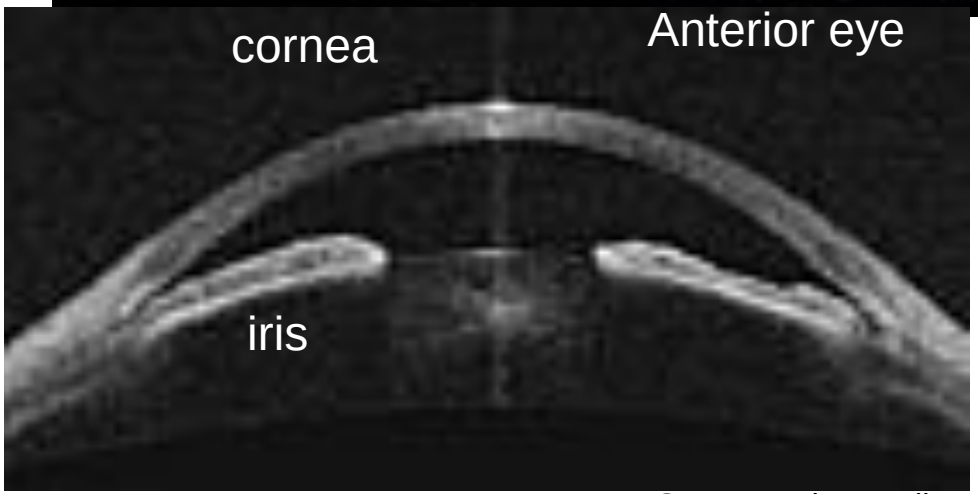
Disadvantages:

- time consuming (weeks, months)
- dangerous
- destructive method

Proposed alternative approach – non destructive optical measurement method!!!

OCT in ophthalmology – typical application



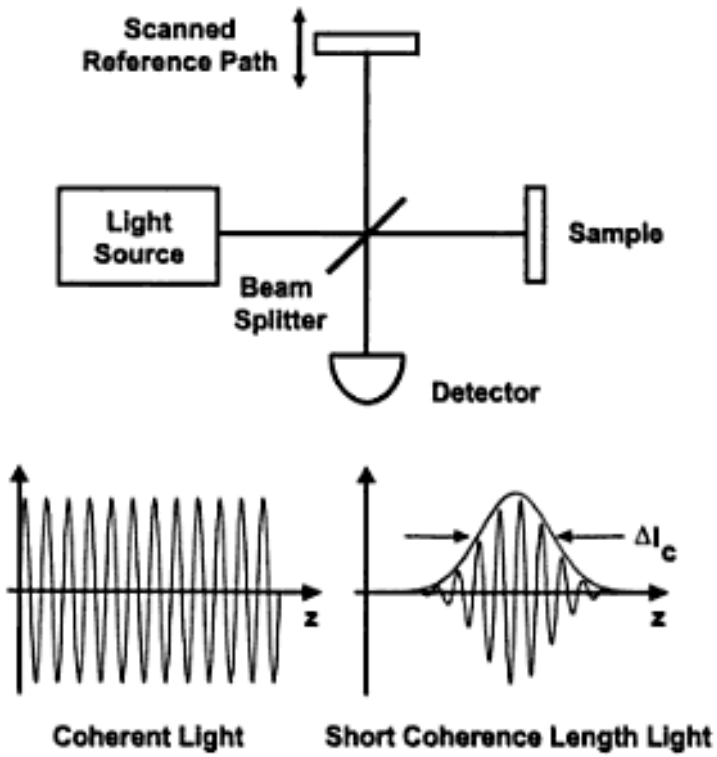


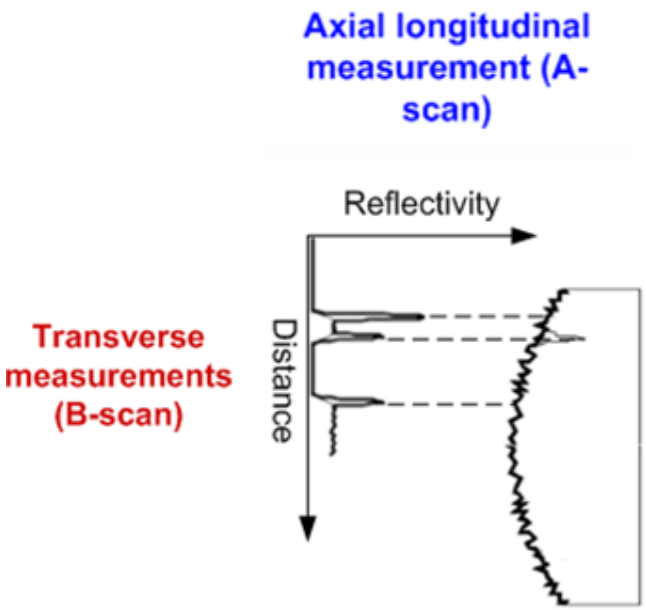
Source: Zeiss Meditec

Advantages:

- high penetration depth (1 mm)
- high depth resolution (1µm)

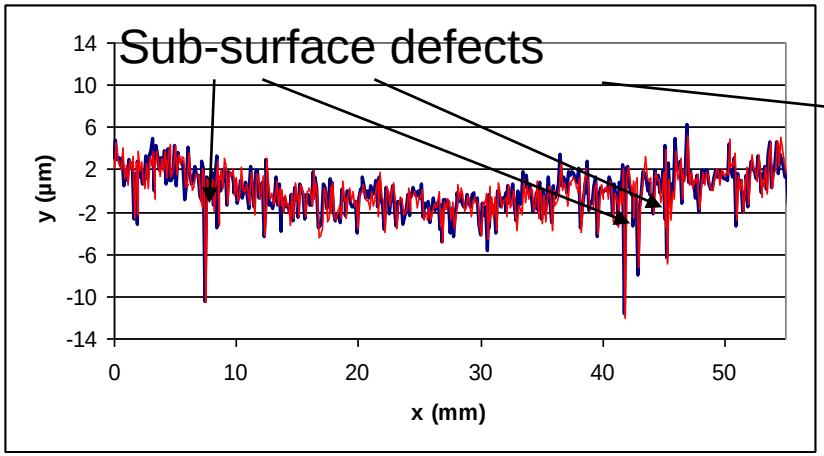
Principle scheme

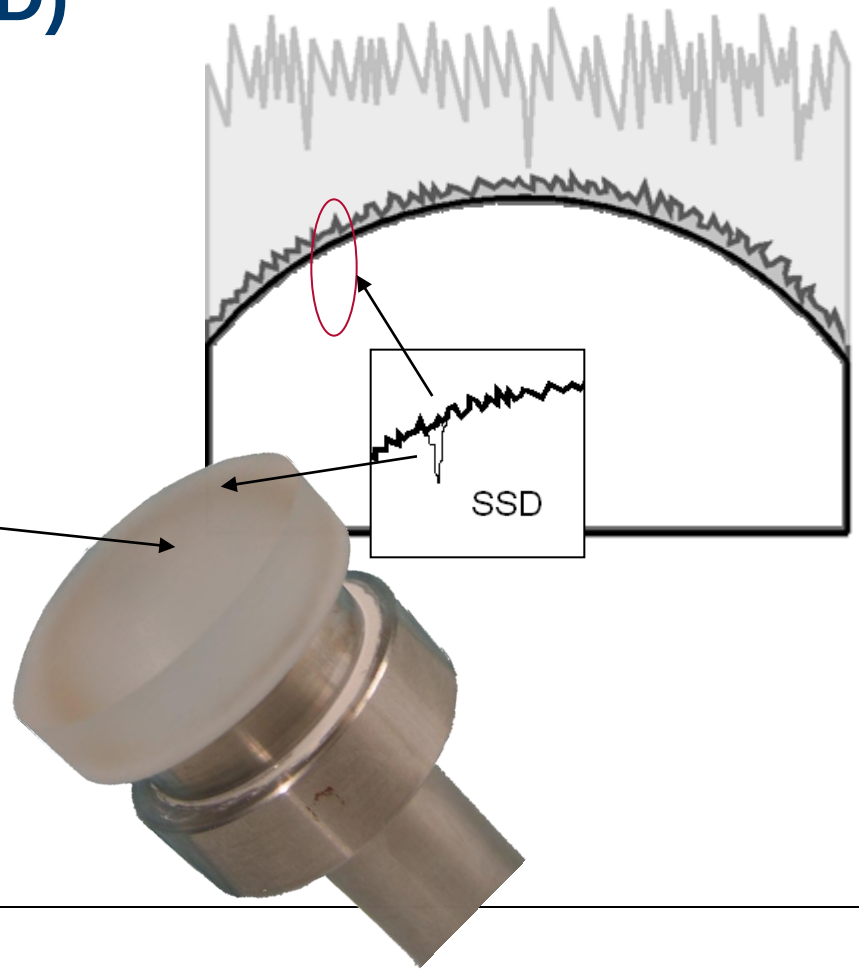




New application OCT – Measurement of subsurface damage (SSD)

- Non destructive measurement
- Cracks with width ≥ 4 µm and depth up to 100µm can be detected





Conclusion after the 1st year

- Optical coherence tomography is a promising technique for optimization of the grinding process;

Goals for the 2nd year

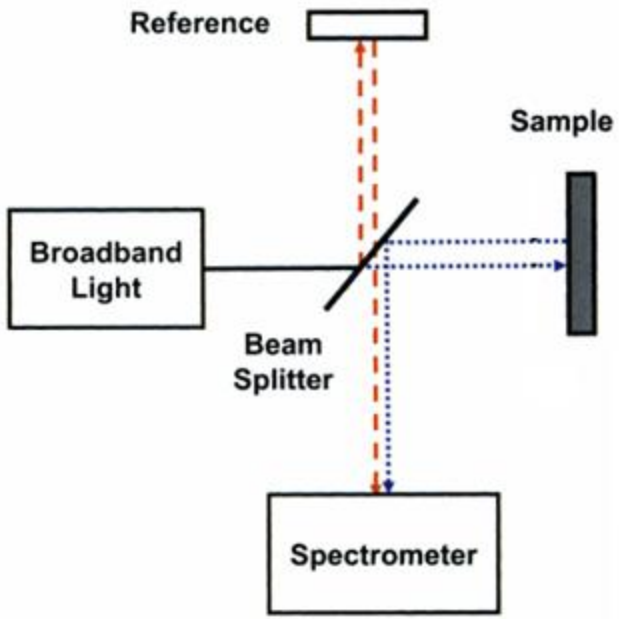
1. Workshop up to 10 min (Time domain to Frequency domain);

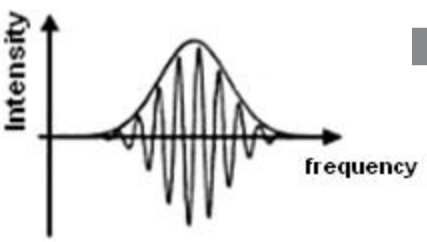
2. Industrial testing;

FD-OCT

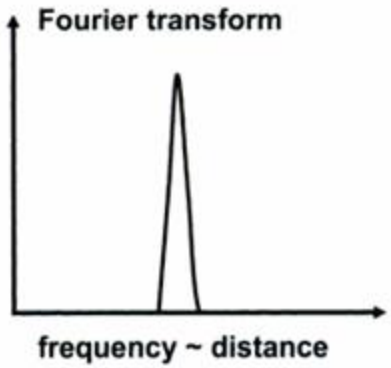
Principle scheme

Software!

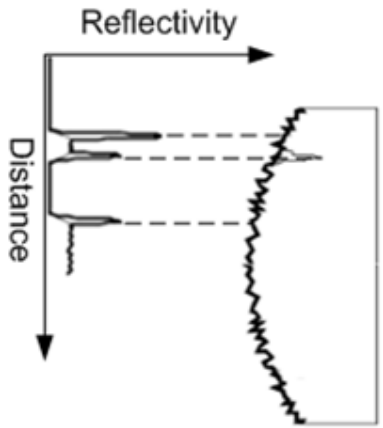




Axial longitudinal measurement (A-scan)

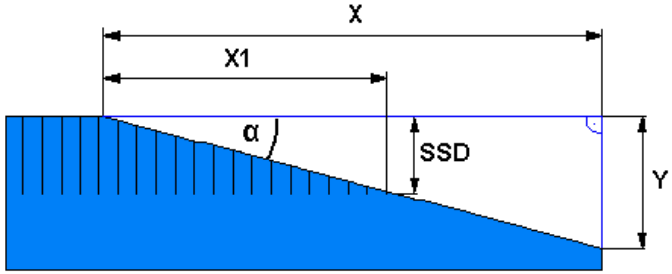


Transverse measurements (B-scan)



Wedge method

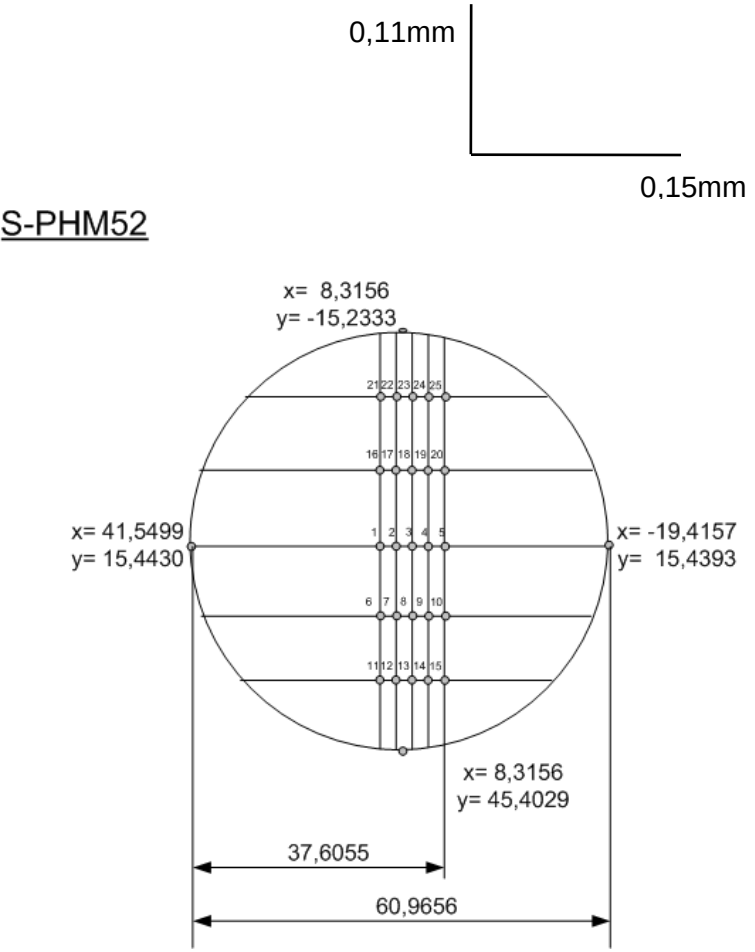
Wedge method

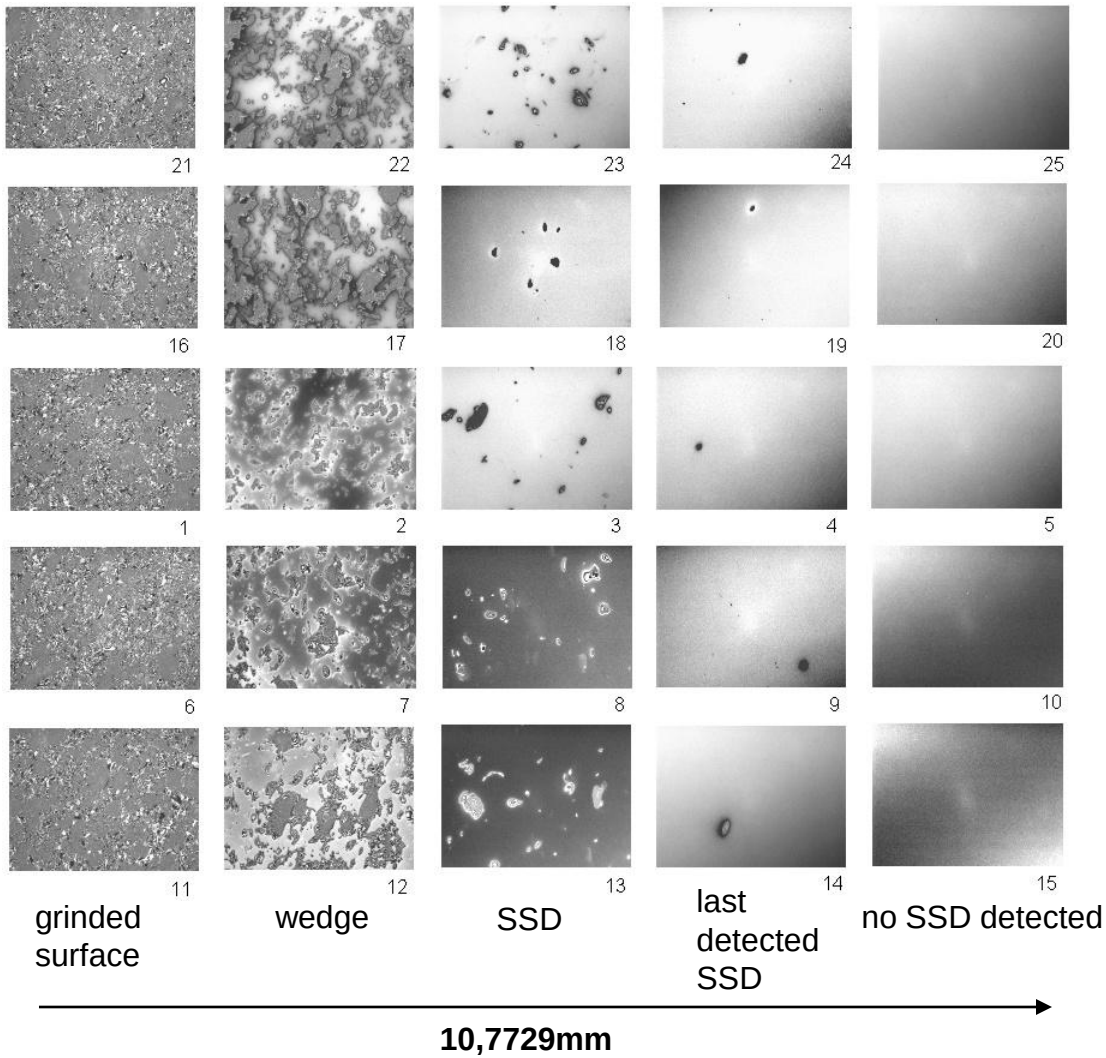


X = Länge des Keils
X1 = Strecke bis zum Rand der SSD
Y = Tiefe des Keils
SSD = Tiefenschädigung
α = Keilwinkel

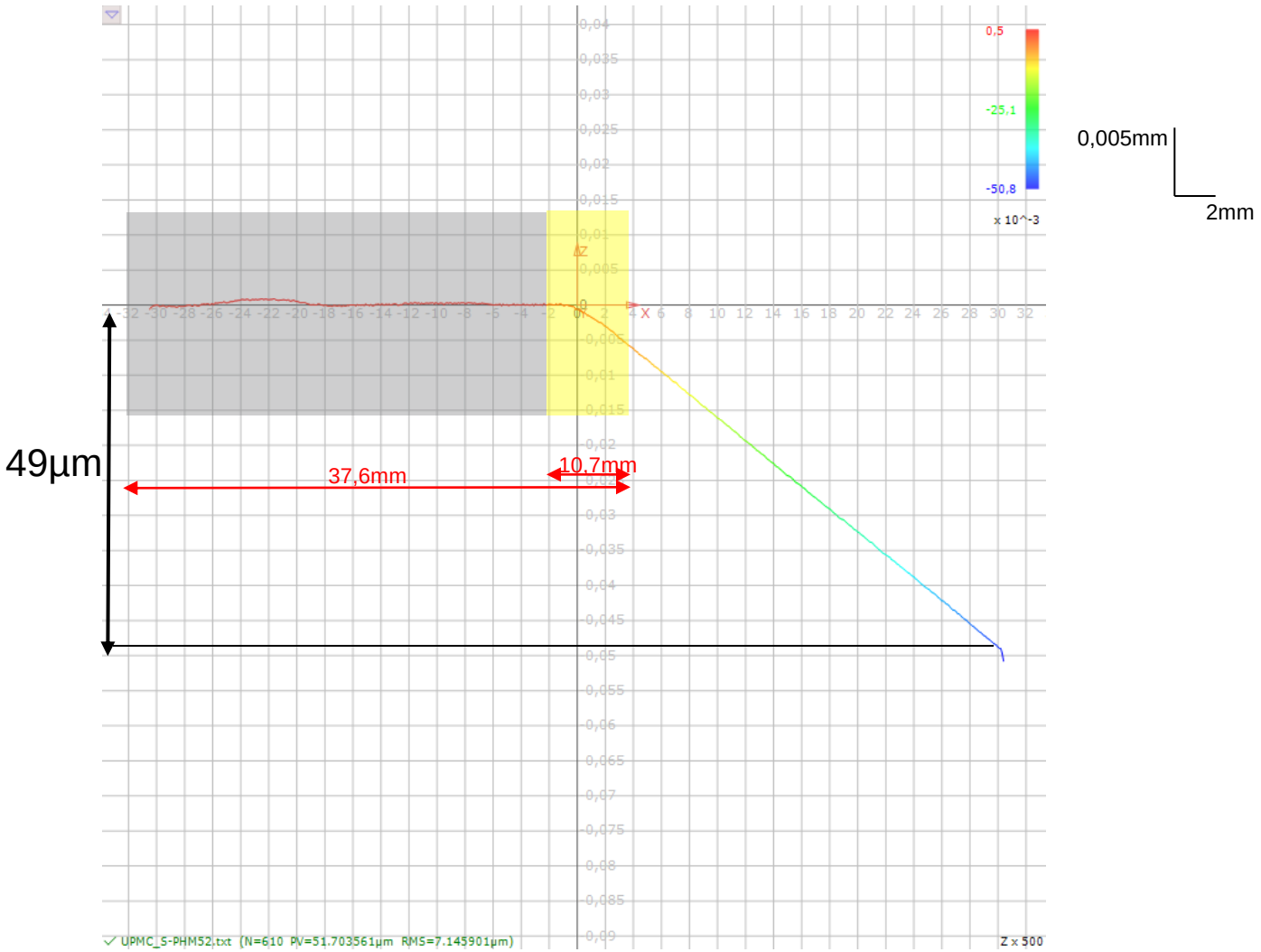
Wedge method	
Sort of the glass	SSD (µm)
Quarz	3,4
N-SF57	9,85
N-FK5	10,5
N-FK51	19
N-BK7	12,15
S-PHM52	15,406
S-BSM16	16
N-LAK8	10,812

Microinterferometer (Mirau 40x)



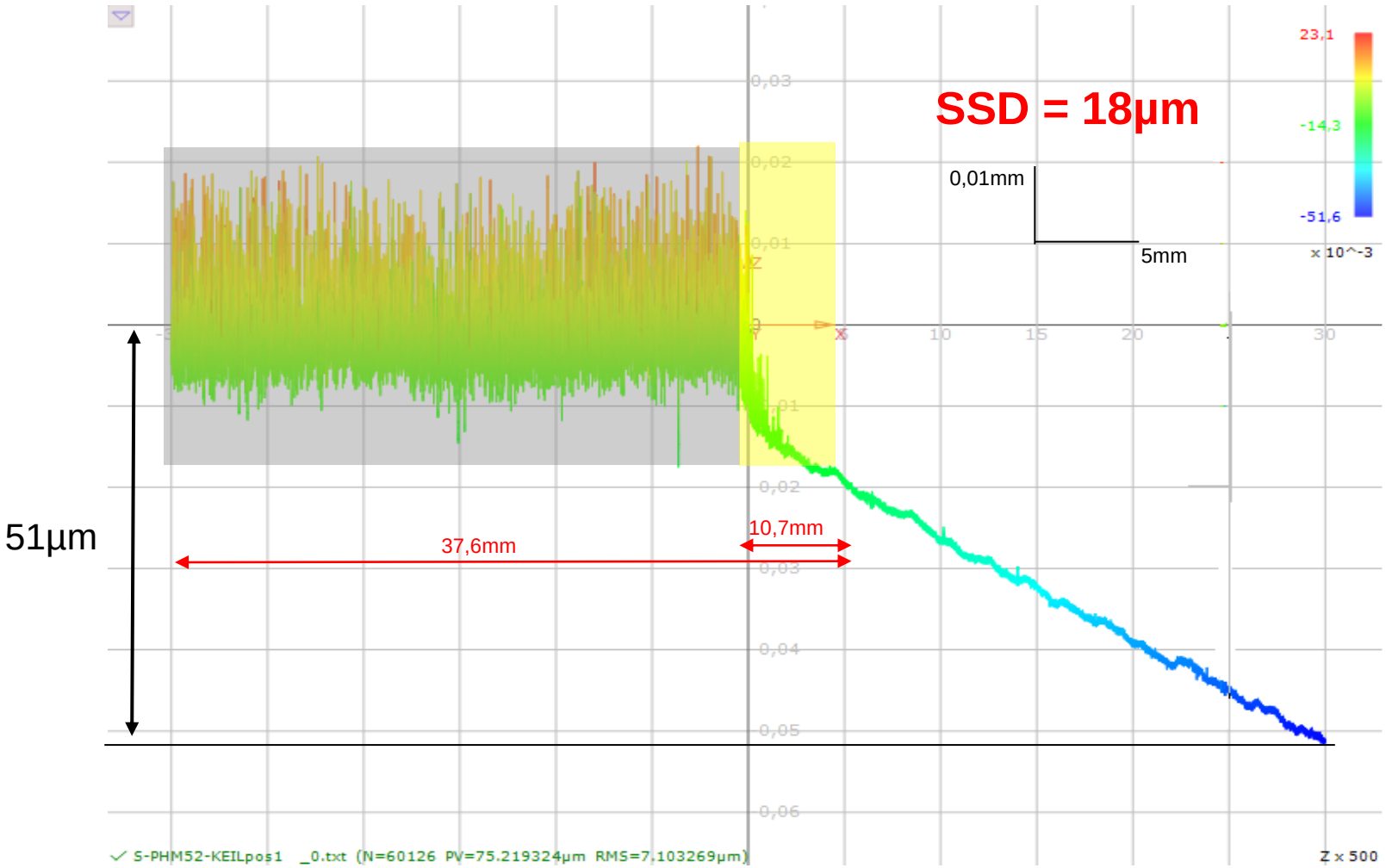


UPMC

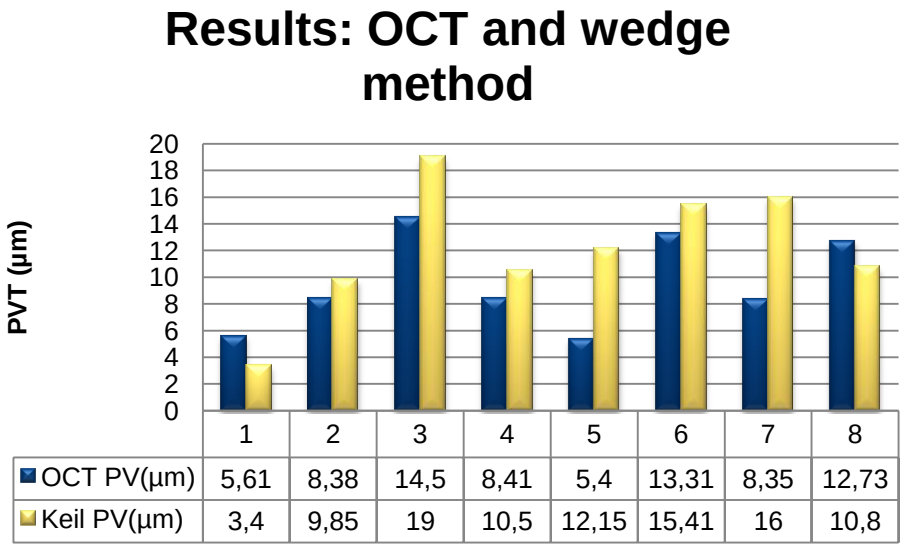

0,5
-25,1
-50,8
x 10^-3
0,005mm
2mm
49µm
37,6mm
10,7mm
UPMC_S-PHM52.txt (N=610 PV=51.703561µm RMS=7.145901µm)
Z x 500

Hochschule Aalen

OCT

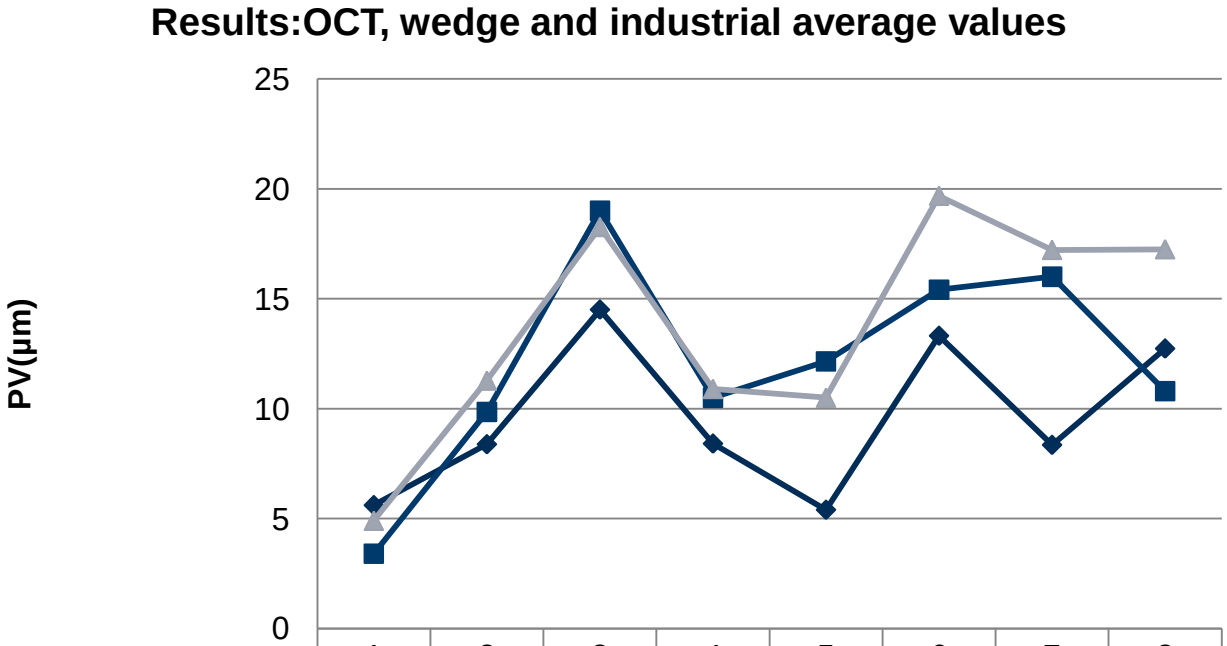


Wedge method



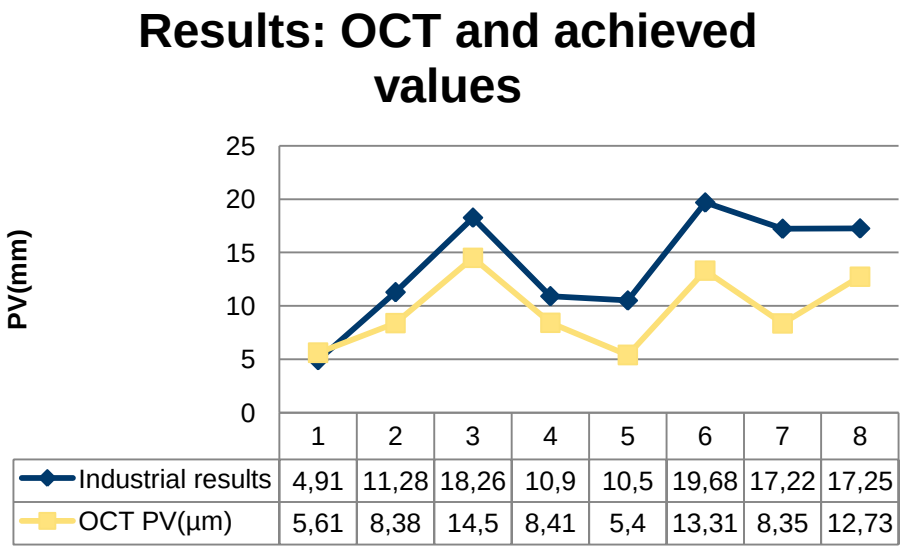
	Glass
1	Quarz
2	N-SF57
3	N-FK51A
4	N-FK5
5	N-BK7
6	S-PHM52
7	S-BSM16
8	N-LAK8

96 grinded samples



	1	2	3	4	5	6	7	8
OCT	5,61	8,38	14,5	8,41	5,4	13,31	8,35	12,73
wedge	3,4	9,85	19	10,5	12,15	15,41	16	10,8
Industrial results	4,91	11,28	18,26	10,9	10,5	19,68	17,22	17,25

96 grinded samples



Conclusion/ next steps

- Optical coherence tomography is a very promising non-destructive method to detect SSD for grinding optimization process;
- The results obtained with OCT show a good agreement with industrial ones;

- During the 3rd year the main focus will be on the FD-OCT setup

Thank you for your attention!!!

Zentrum für Angewandte Forschung

ZAFH – **PHOTON^{n}** **PHOTON**ische Verfahren in neuen Dimensionen

OCT prototype: Project funded by Europe Union European Regional Development Fund and the state of Baden-Württemberg

gefördert durch die Europäische Union
Europäischer Fonds für regionale Entwicklung
und das Land Baden-Württemberg