Multisensor Metrology for MEMS Production

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www.frt-gmbh.com

Sales and Service Network

International Organization

- FRT successfully established a worldwide network of distinguished distributors and runs lean sales and service offices in high-priority regions.

- This results in efficient sales activities in all relevant international markets and industries. Furthermore, support and service agreements up to 24/7 with onsite support can be offered.

Distributors:
Around 20 in 18 countries

Industries

Target Markets

Automotive

Semiconductor / Micro Electronics/ LED + Sapphire

Solar

MEMS / Nano

Optics

Applications

Example Measurement Tasks

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➔ Different measurement tasks are available for all kinds of applications:

Topography, Profile

- roughness, waviness
- step height
- radius of curvature
- angle

Wafer Inspection

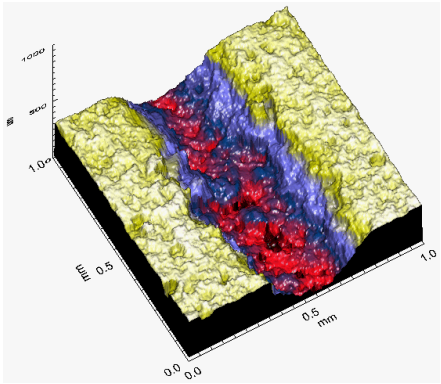
- TTV
- bow
- warpage

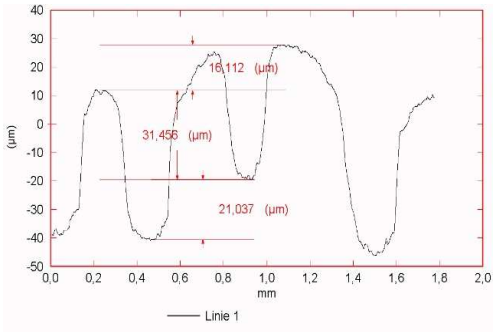
Film Thickness

- thin film
- thick film
- multi layer
- mapping of thickness

Image Processing

- diameter
- distance
- recognition of alignment marks

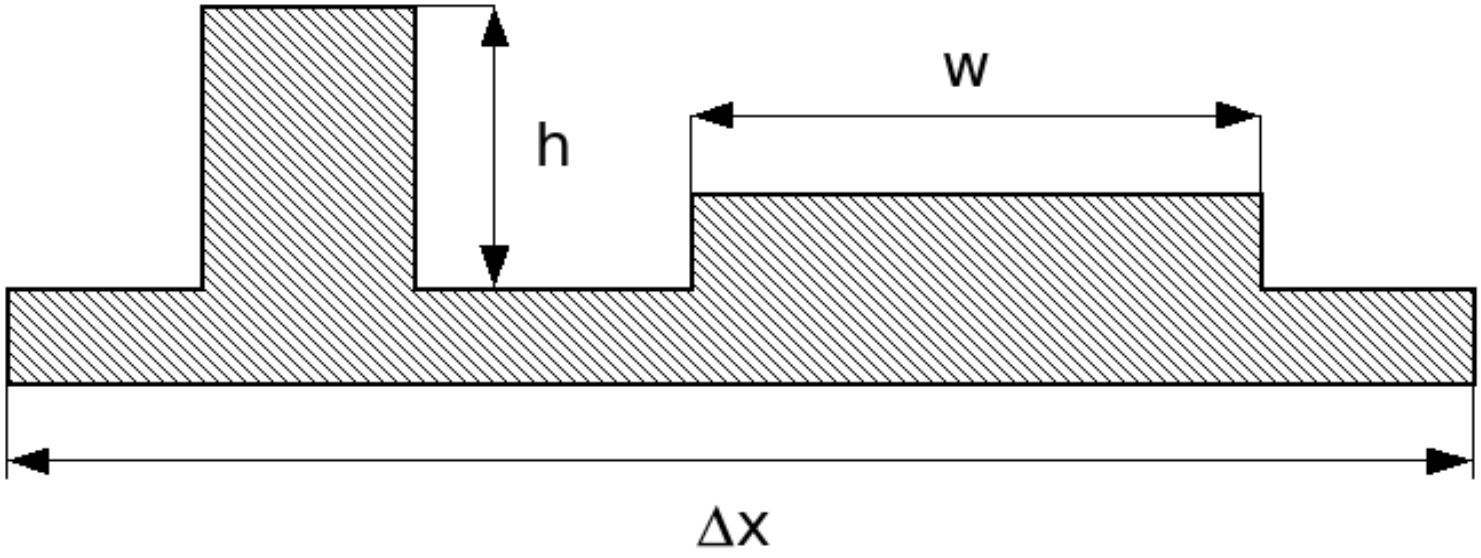




Ra:	1.257 µm
Rq:	1.527 µm
Rz(ISO):	9.082 µm
Rz(DIN):	8.371 µm
Rmax:	10.098 µm
Rp:	4.587 µm
Rv:	5.519 µm
Rt:	10.106 µm
Rsk:	0.403

Applications

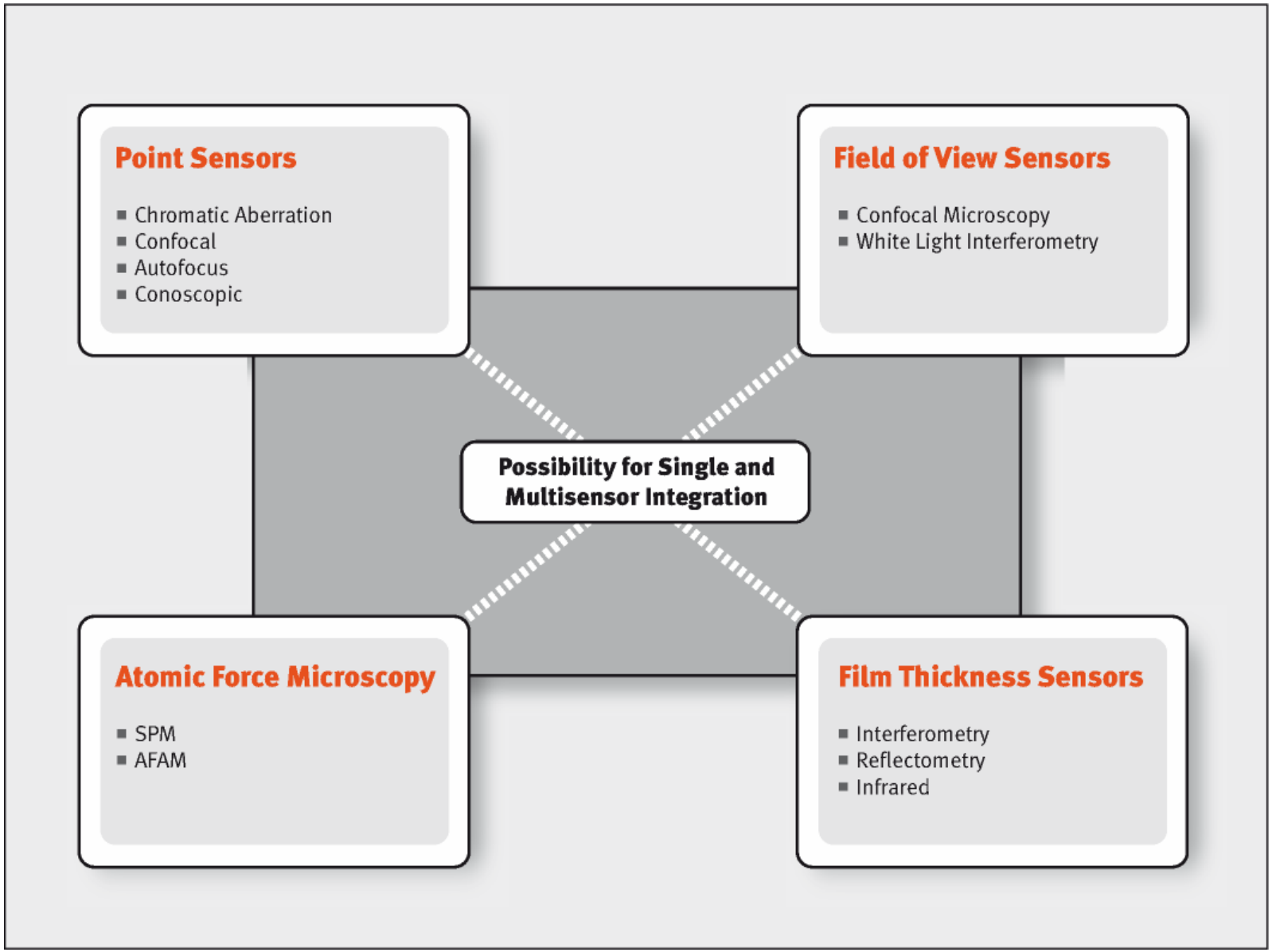
Dimensions of Measurement



Δx:	< 1	mm	...	>1000 mm
h:	1	nm	...	>10 mm
w:	≪ 1	µm	...	300 mm

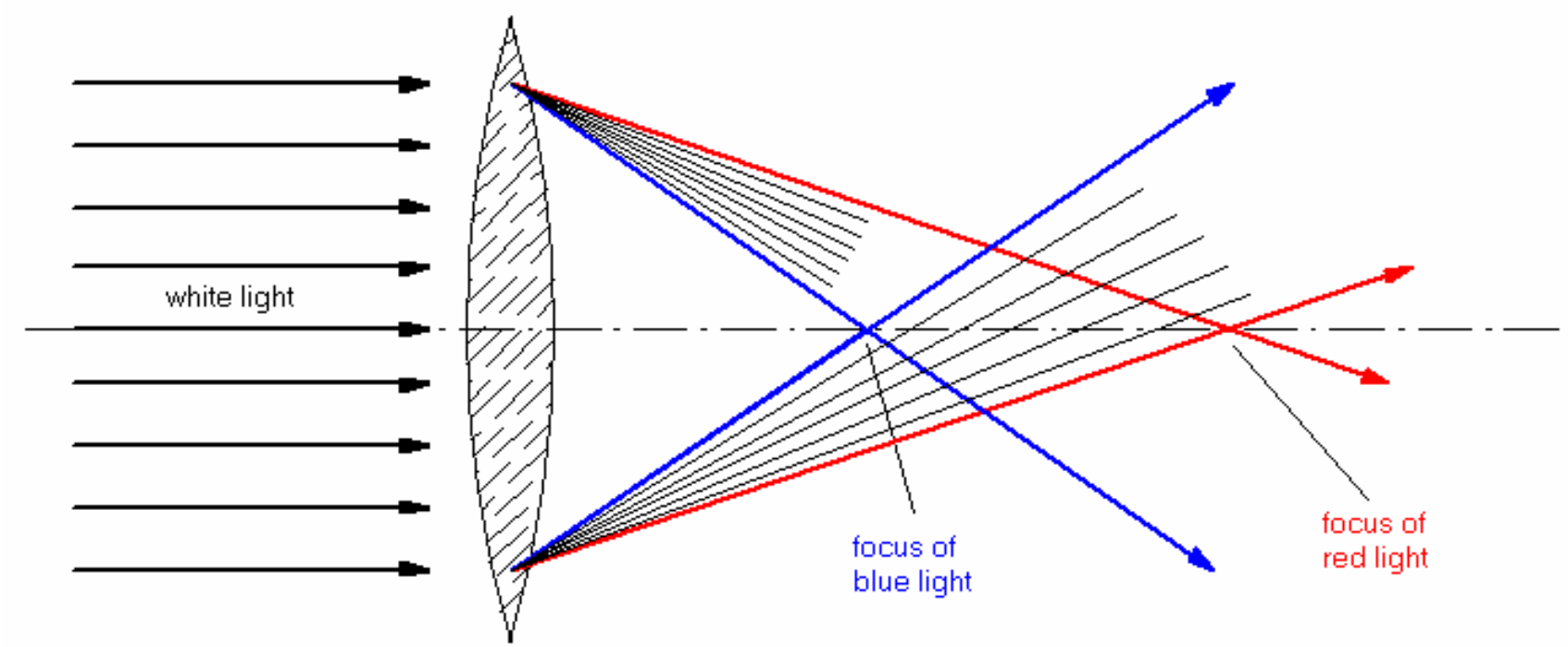
Multi Sensor Approach

FRT Sensors



Multi Sensor Approach

FRT CWL Sensors



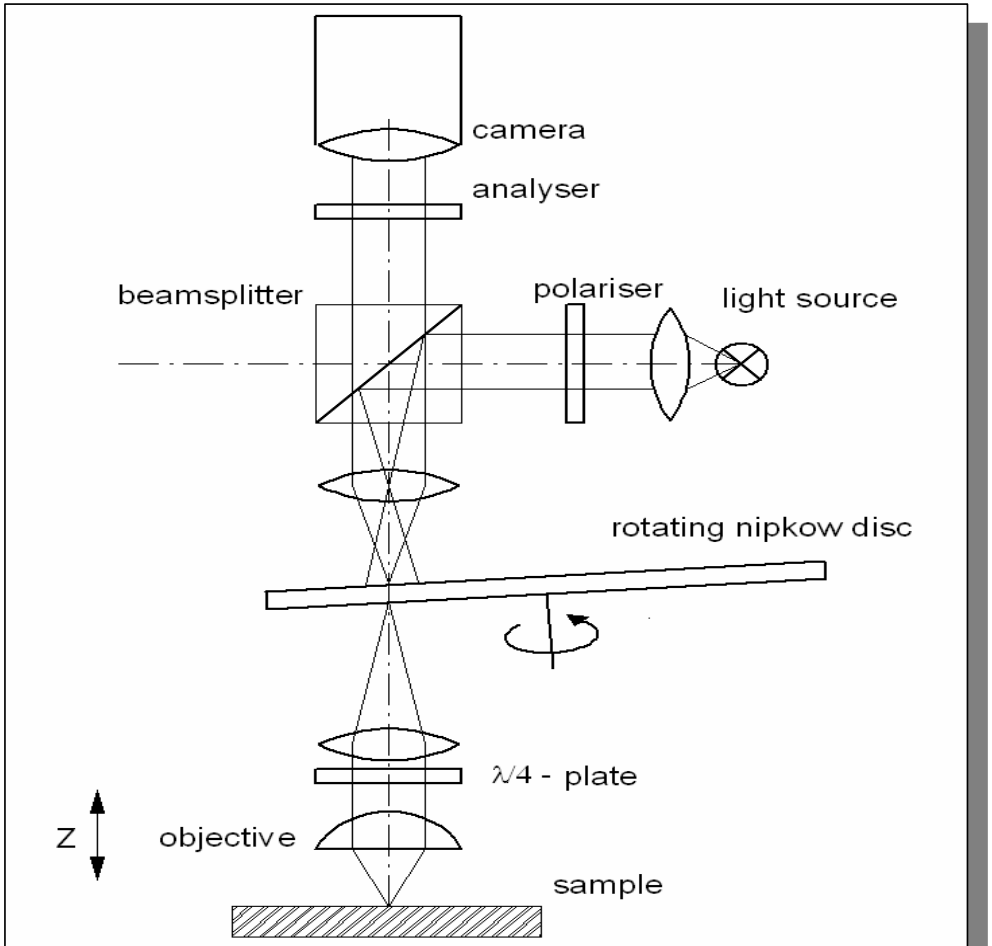
Focal length depends on wavelength due to dispersion

→ chromatic aberration in optical systems

→ distance measurement without moving a lens

Multi Sensor Approach

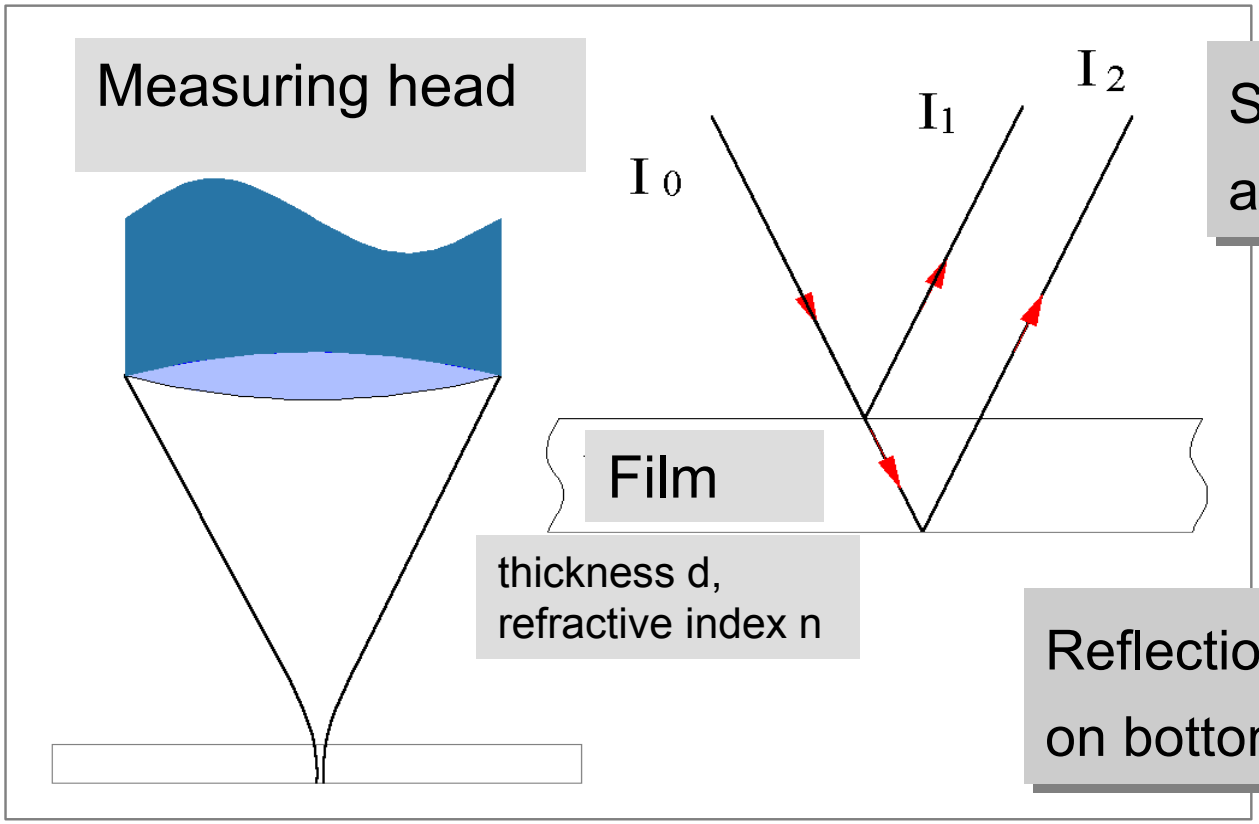
FRT CFM Sensors



- confocal point-to-point-to-point imaging
  → high z-resolution
- full area by rotating Nipkow disc with pinholes
- robust

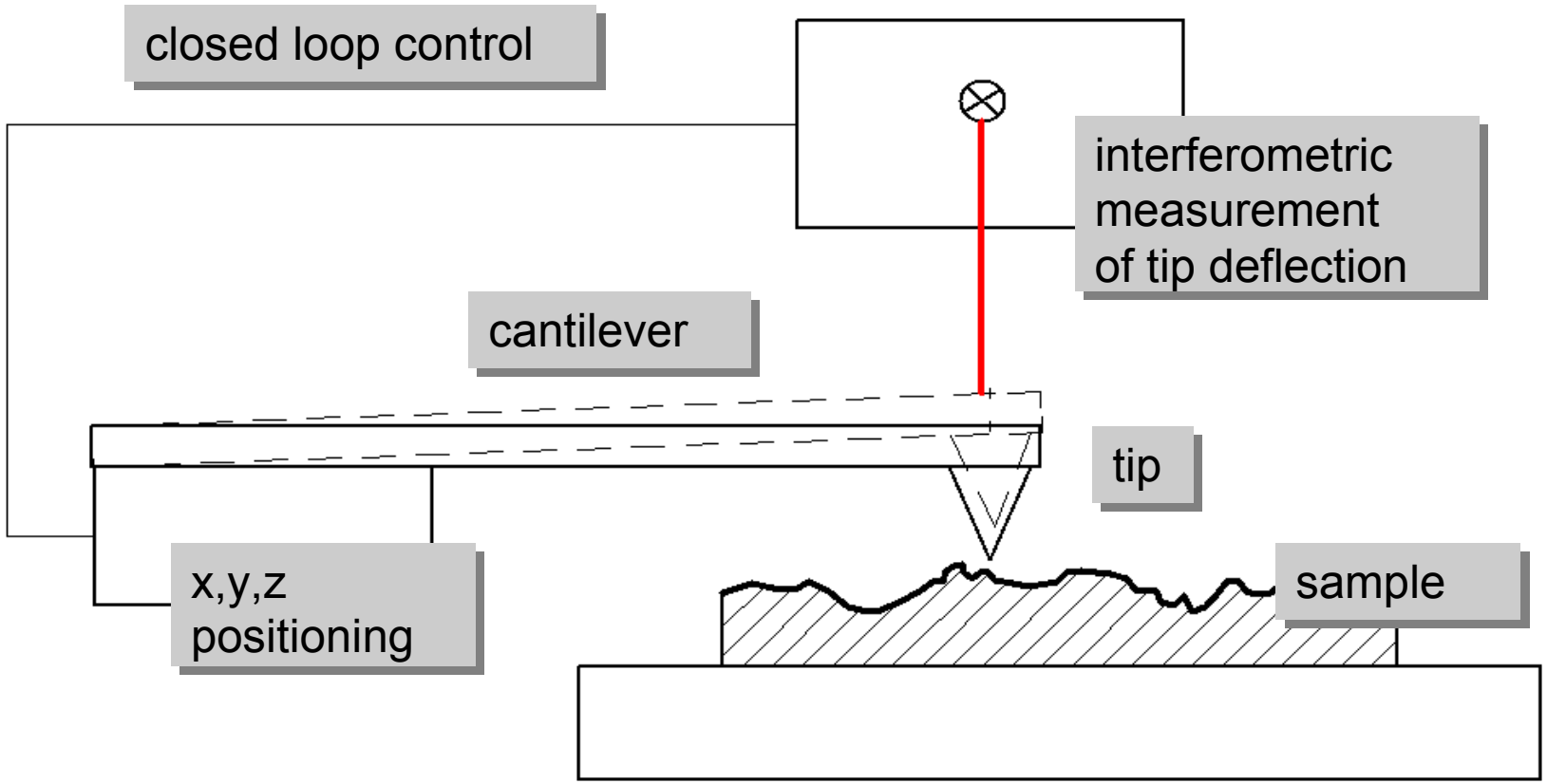
Multi Sensor Approach

FRT CWL FT and IR Sensors



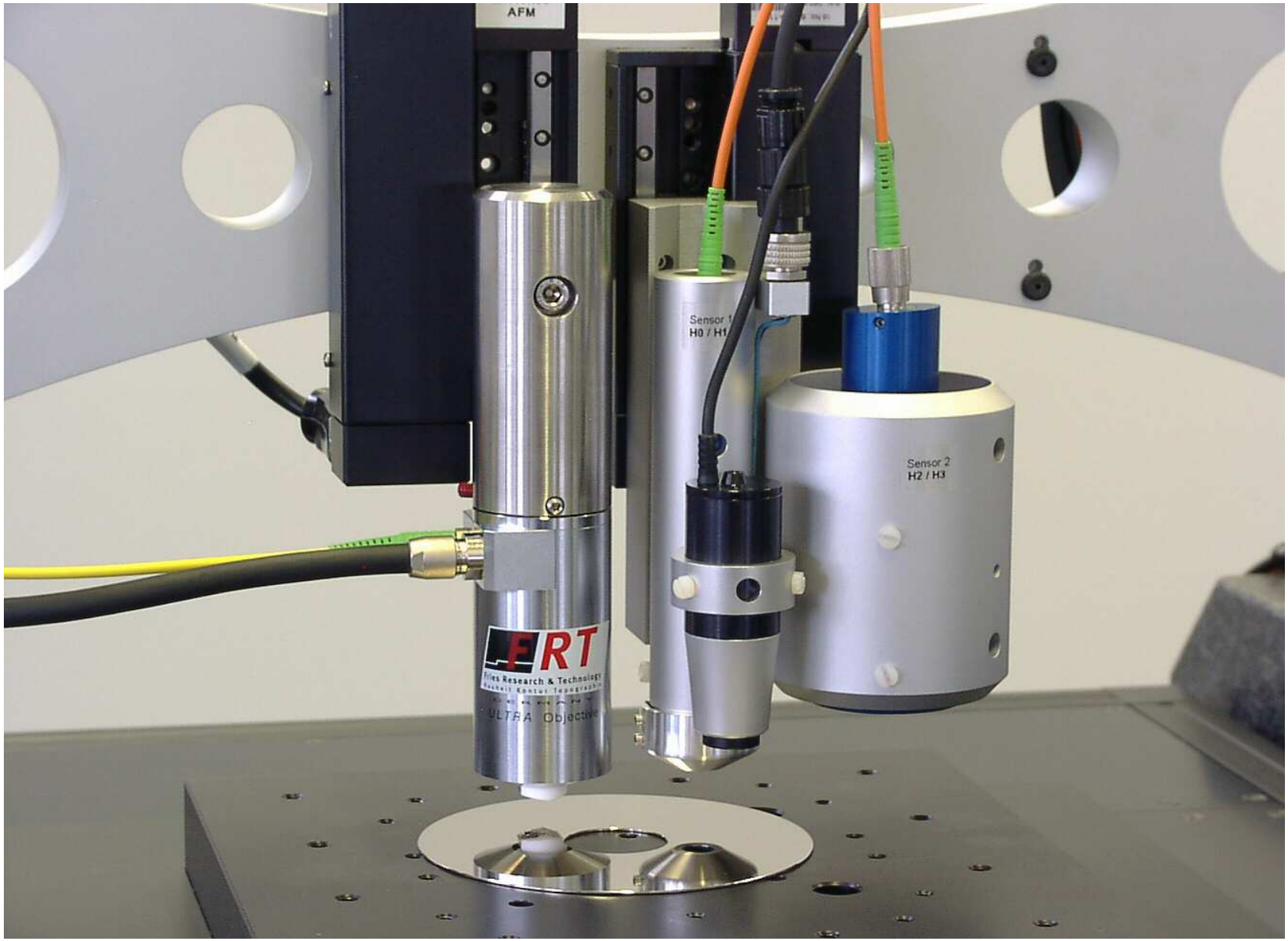
Multi Sensor Approach

FRT AFM Sensors



Multi Sensor Approach

FRT Sensors



Products

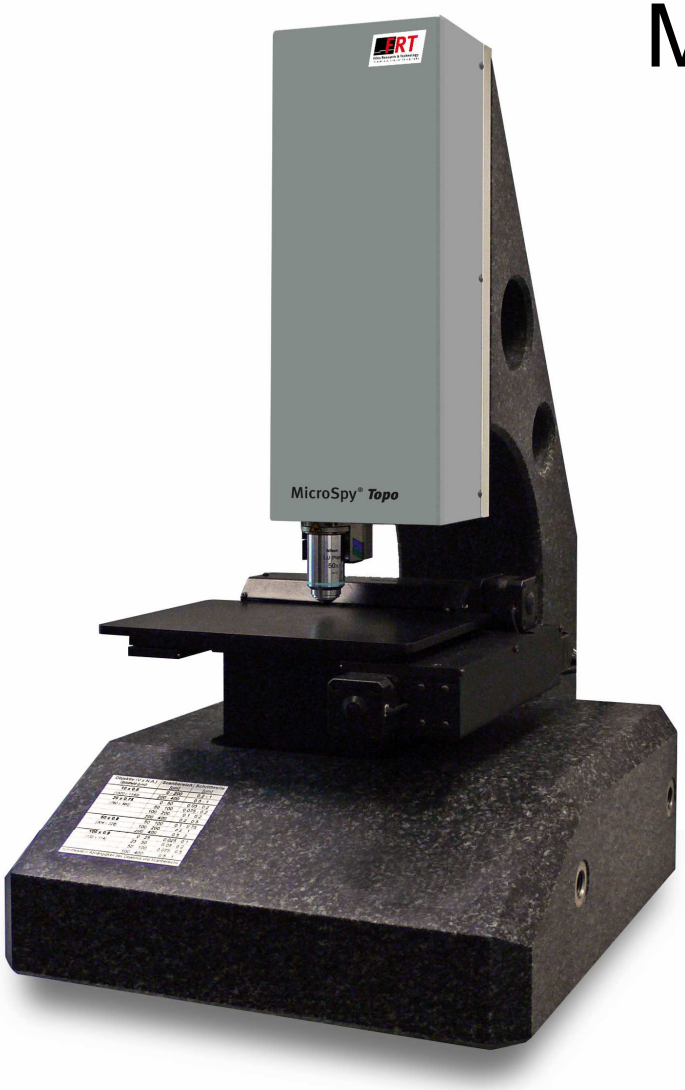
Technology

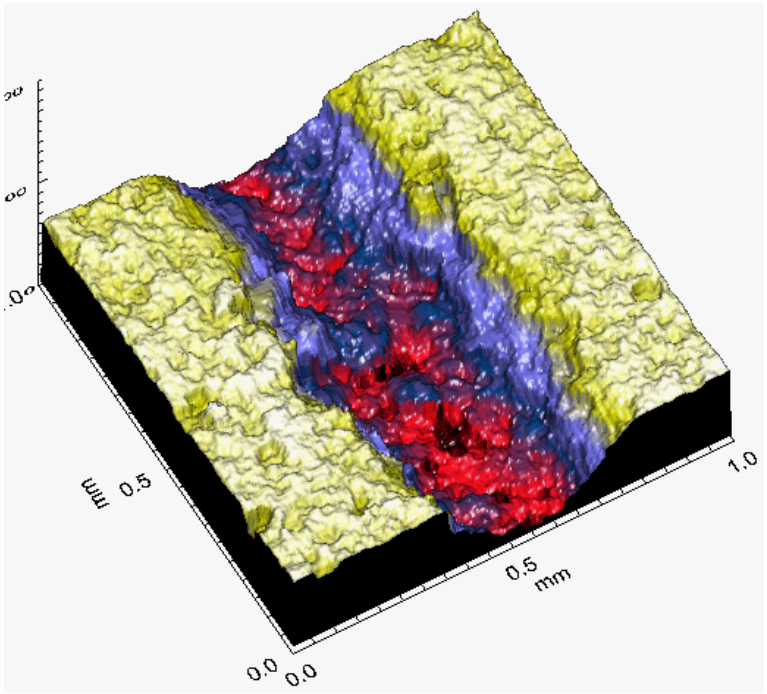
INDUSTRIE PREIS 2008

FRT the art of metrology™

- SOLAR
- MEMS
- AUTOMOTIVE
- OPTICS

MicroSpy®





Products

Technology

- SEMICON
- SOLAR
- MEMS
- AUTOMOTIVE
- OPTICS

MicroProf®

Products

Technology

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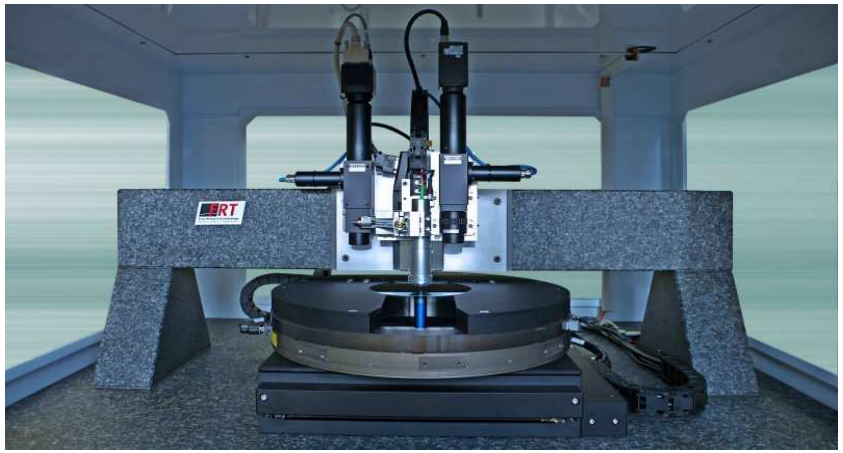
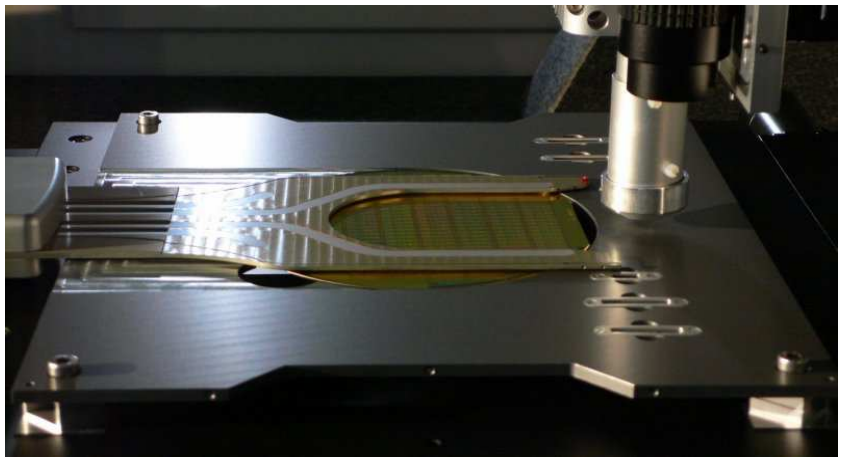
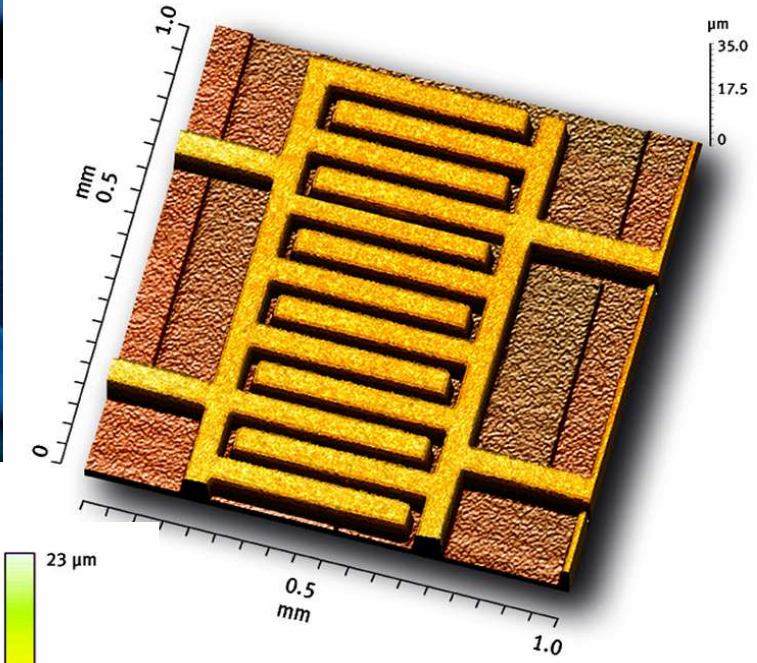
MicroProf® TTV

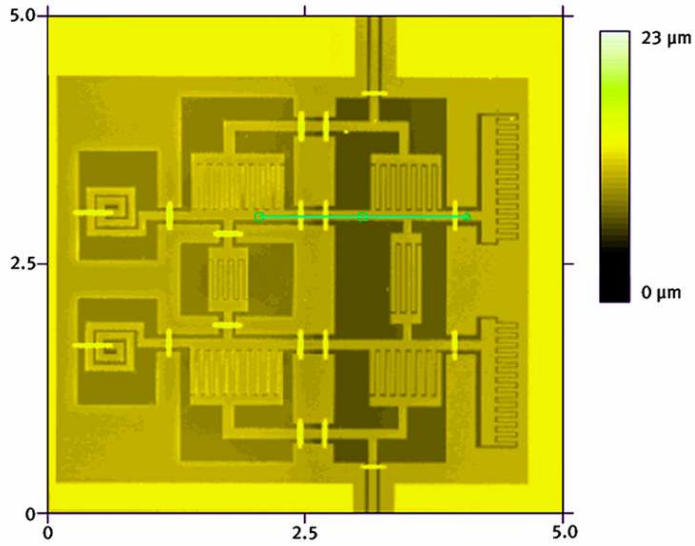
- SEMICON
- SOLAR
- MEMS





MEMS Applications

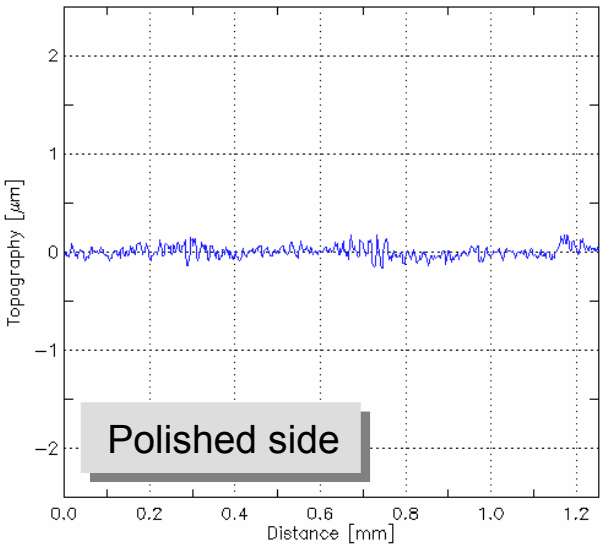


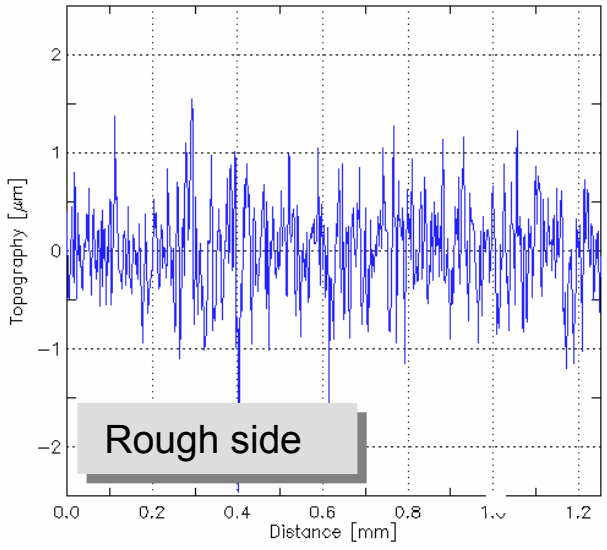


MEMS

Applications

Technology





Wafer	Ra / µm (polished side)	Ra / µm (rough side)
1	0,037	0,484
2	0,049	0,460
3	0,033	0,390
4	0,056	0,408
5	0,039	0,408
6	0,033	0,408
7	0,030	0,394
8	0,046	0,404
9	0,029	0,365
10	0,044	0,371

Roughness evaluation of solar wafer.

Wafer	Bow / µm	Warp / µm	Average thickness / µm	TTV / µm	TIR / µm	LTV / µm	PLTV / %
1	-7,50	65,30	496,70	3,89	3,28	1,16	97,5
2	5,51	59,53	505,90	5,15	4,09	1,24	95,8
3	7,98	62,57	498,41	3,30	2,91	0,95	100,0
4	6,91	58,83	500,34	4,64	3,48	1,10	98,3
5	-0,29	58,52	499,60	6,42	2,81	1,44	93,2
6	6,58	64,19	500,96	6,82	3,66	1,25	89,8
7	0,52	63,33	500,46	6,26	2,33	1,18	95,8
8	5,28	62,03	499,50	3,76	2,73	1,39	95,8
9	8,92	58,45	499,20	5,33	4,66	1,23	92,5
10	-5,46	59,27	497,92	4,26	3,76	1,17	94,2

Bow, Warp Thickness and Flatness evaluation

Applications

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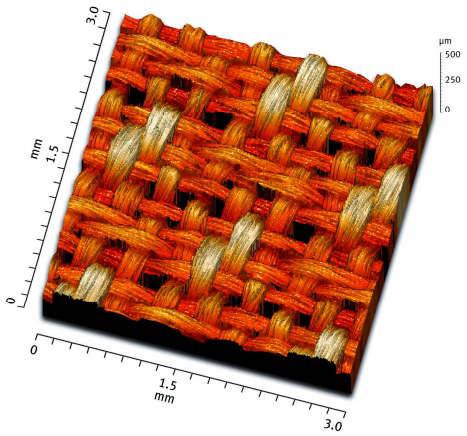
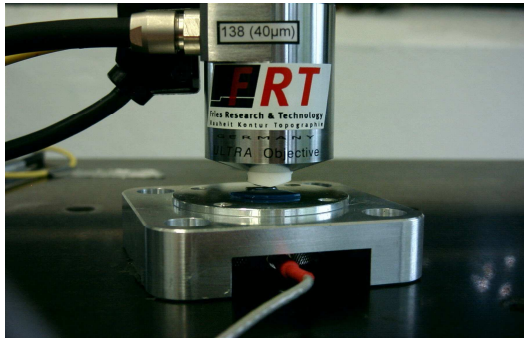
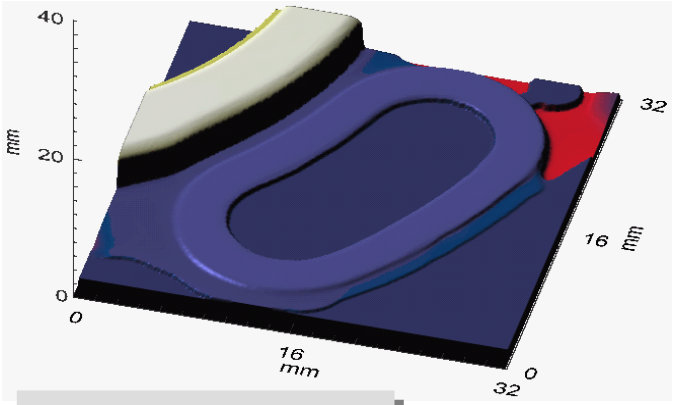
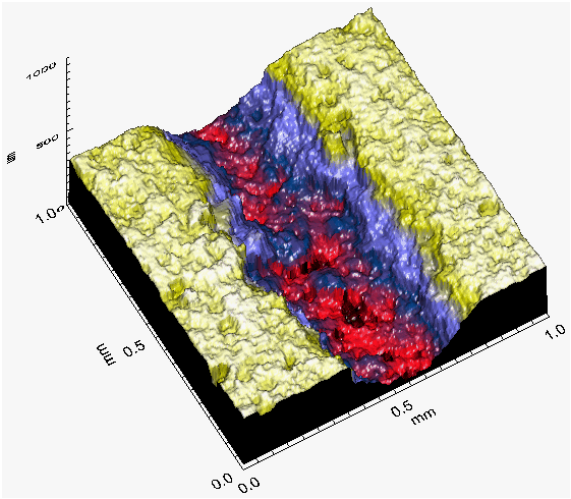


fibre structures

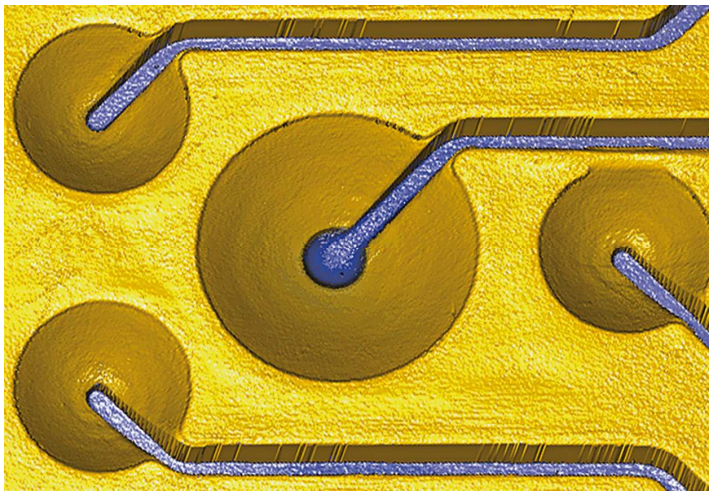




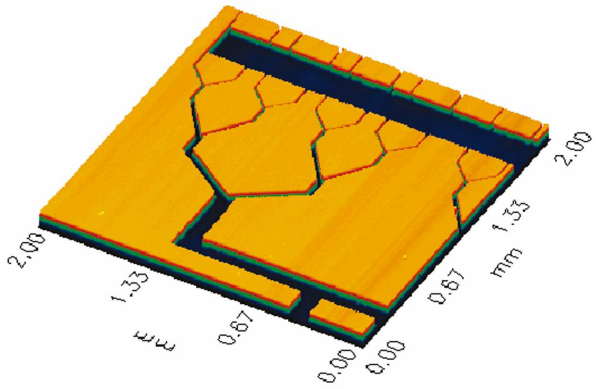
pump housing



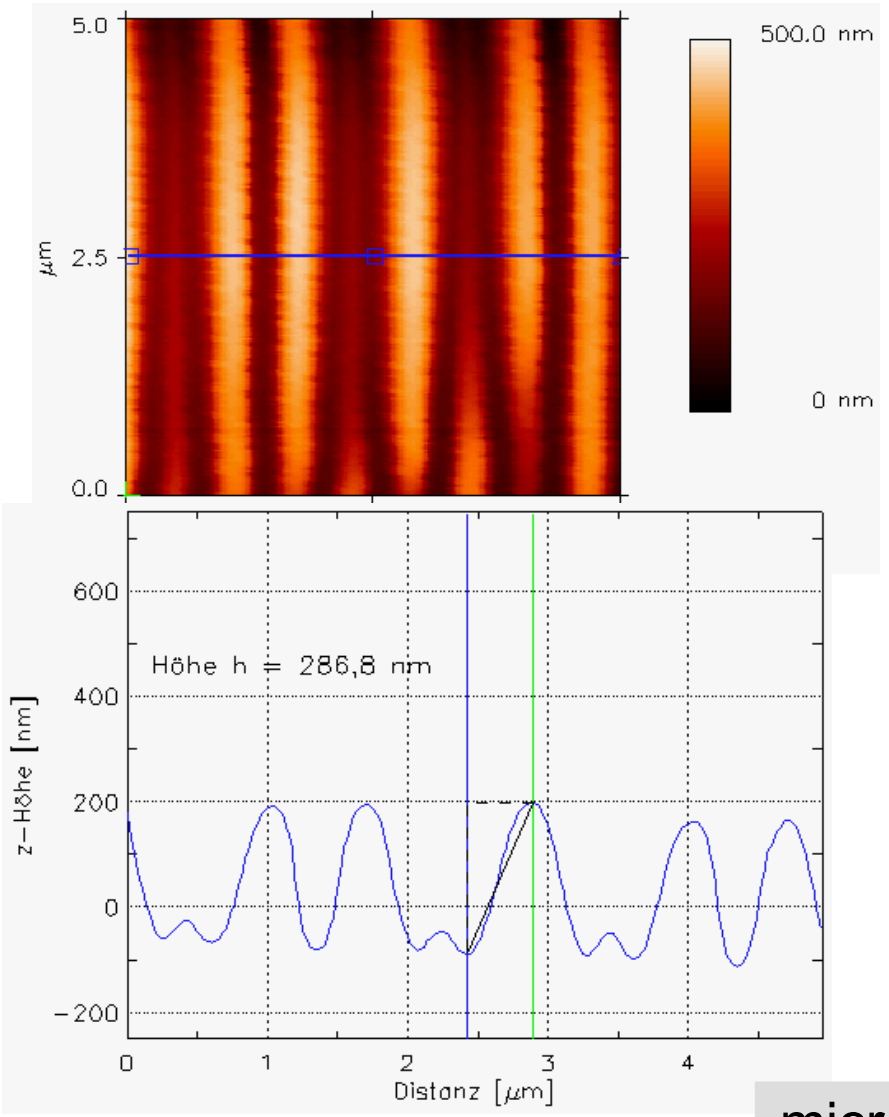
machining



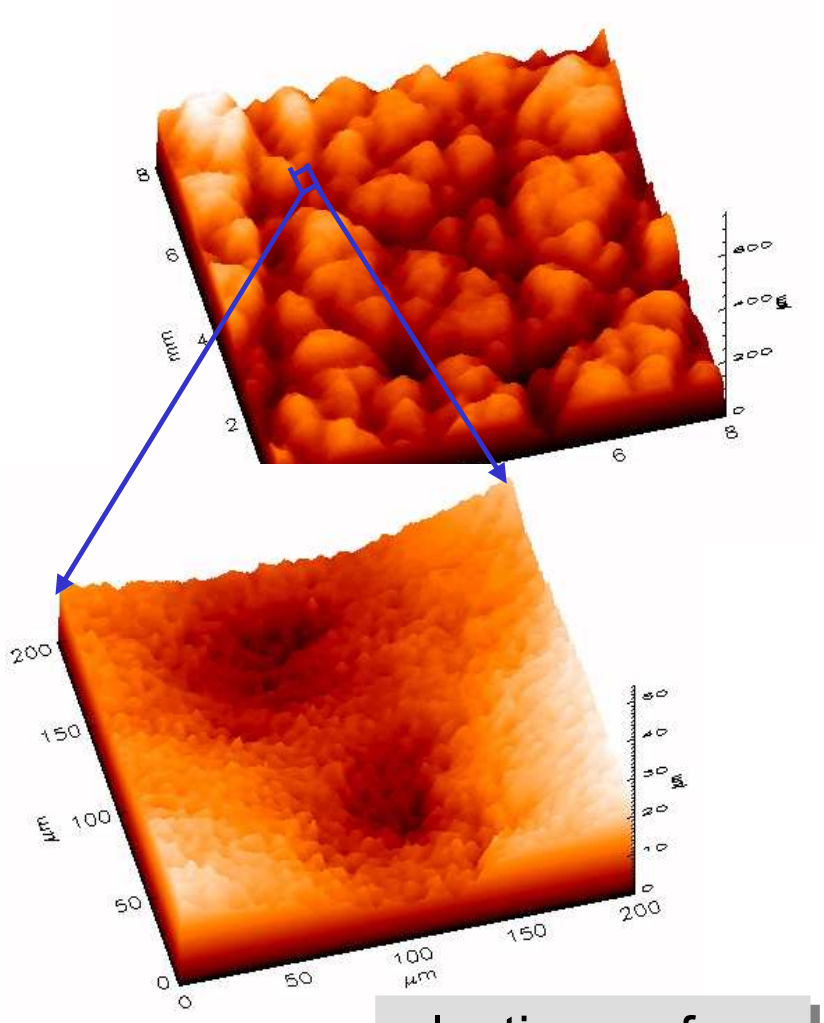
micro fluidics



Applications



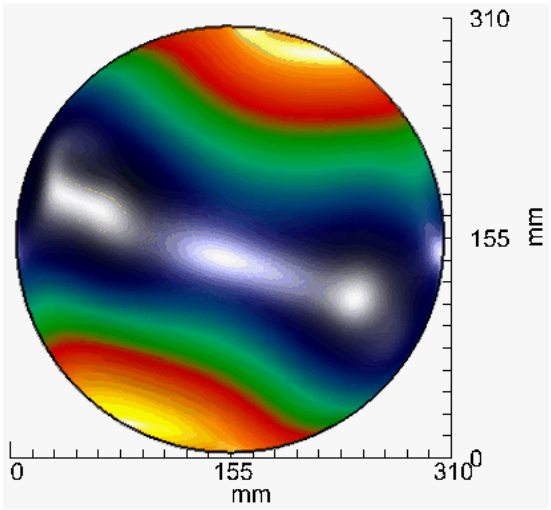
micro lenses



plastics surface

Applications

Technology

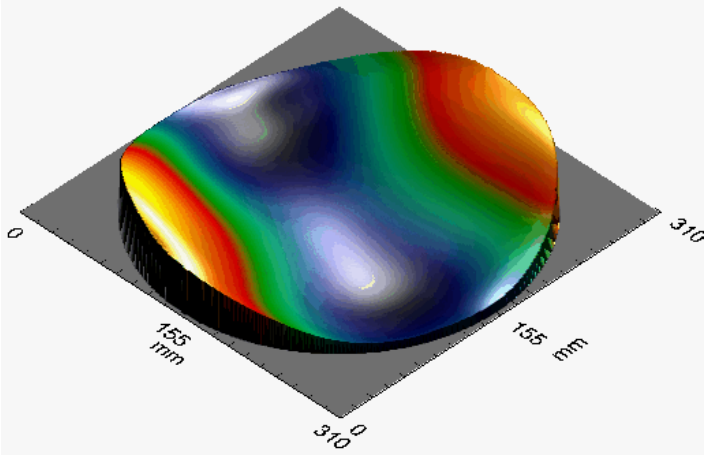


12 inch semiconductor wafer, example can also be applied to PV

Wafer No.	Parameter										Thickness		
	TTV	TIR	LTV	PLTV	LTIR	PLTIR	LFPD	PLFPD	WARP	BOW	Min	Mean	Max
1	2,746	2,719	2,525	100,0	2,515	62,7	-1,472	32,1	1,517	-3.995	607	609	611
2	4,741	4,706	2,746	82,6	2,671	62,7	-1,298	60,9	1,083	6.346	599	603	605
3	15,040	12,866	4,116	0,0	4,109	0,0	3,557	12,7	1,386	-8.540	638	643	655

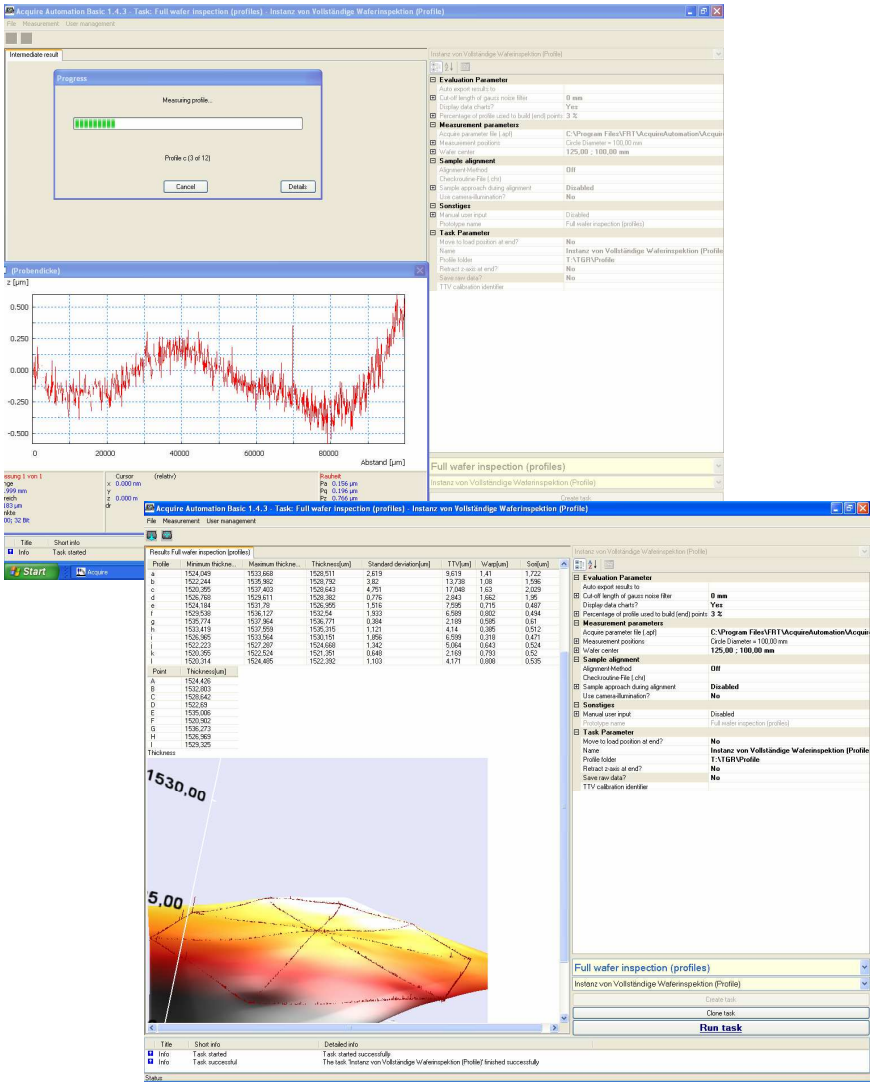
All values in µm

bow, warp, TTV, flatness, thickness



Applications

Automation



The geometry of a wafer can be described by different parameters:

- material (substrate type, dopant)
- shape (diameter, flat, notch)
- thickness (mean thickness, thickness variation, local thickness)
- distortion (flatness, curvature, bow, sag, local flatness)
- roughness (Ra, Rz, Rmax, …)

The FRT Acquire Automation “TTV Package” measures and analyzes Thickness, Thickness variation, Flatness, Warp, Bow, Sag according to SEMI and ASTM standards.

MEMS Production

where FRT metrology is needed

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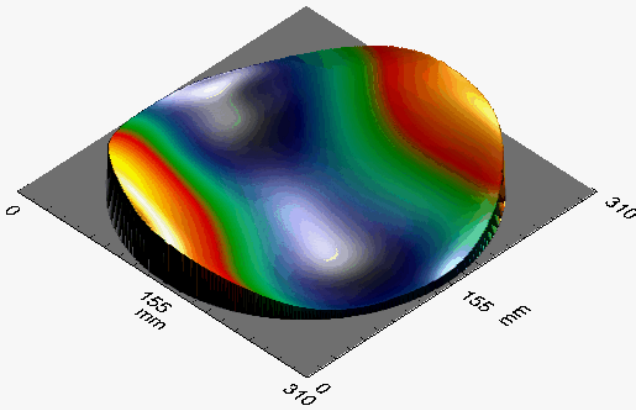
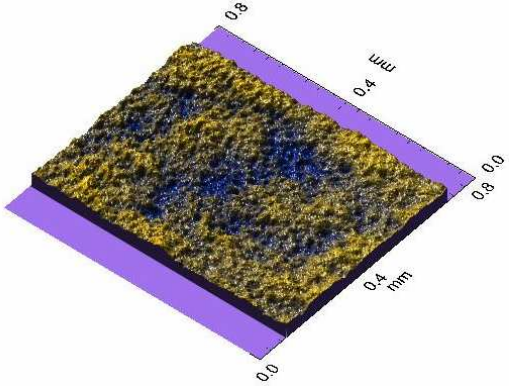
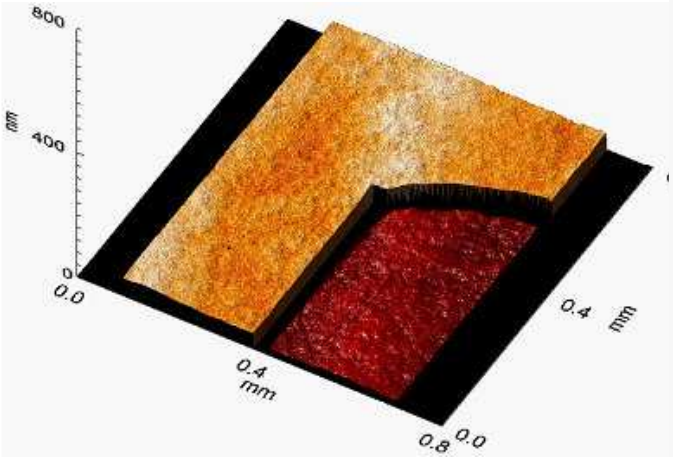


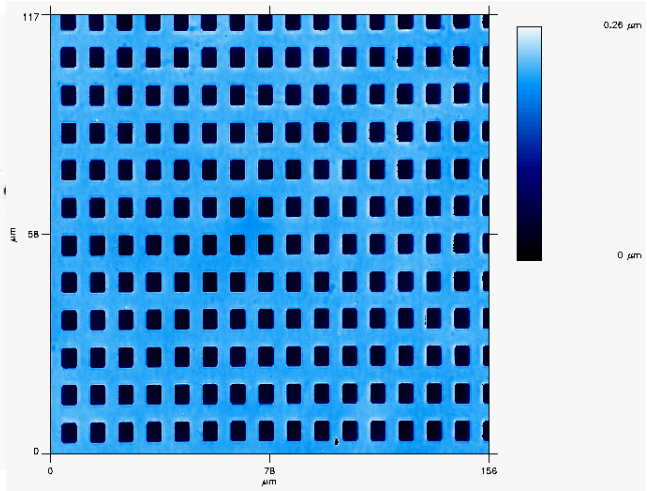
TTV, Bow, Warp



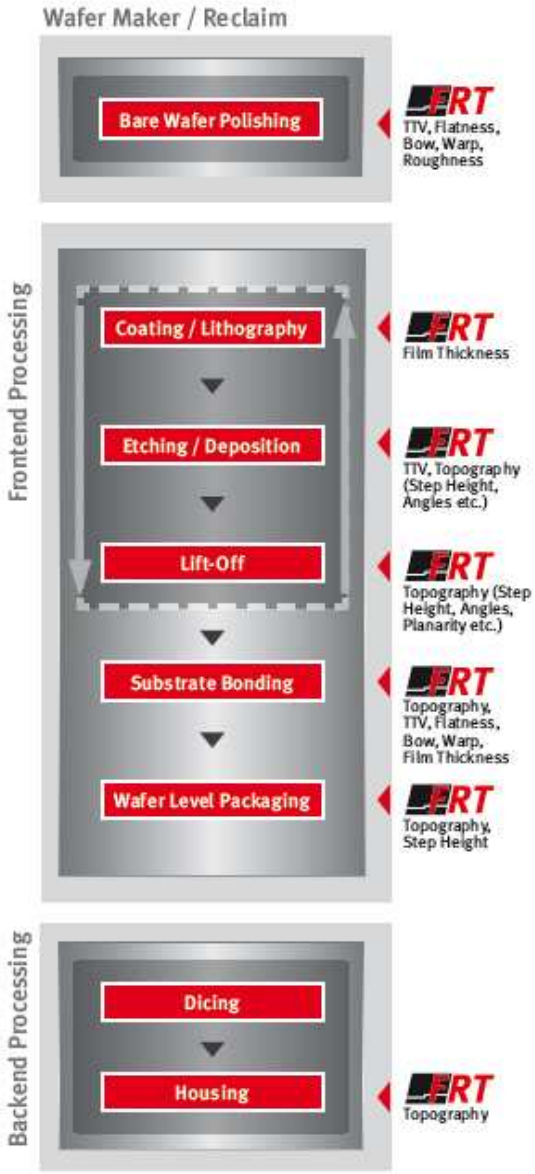
Roughness, Planarity



Film Thickness



Step Height



References

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