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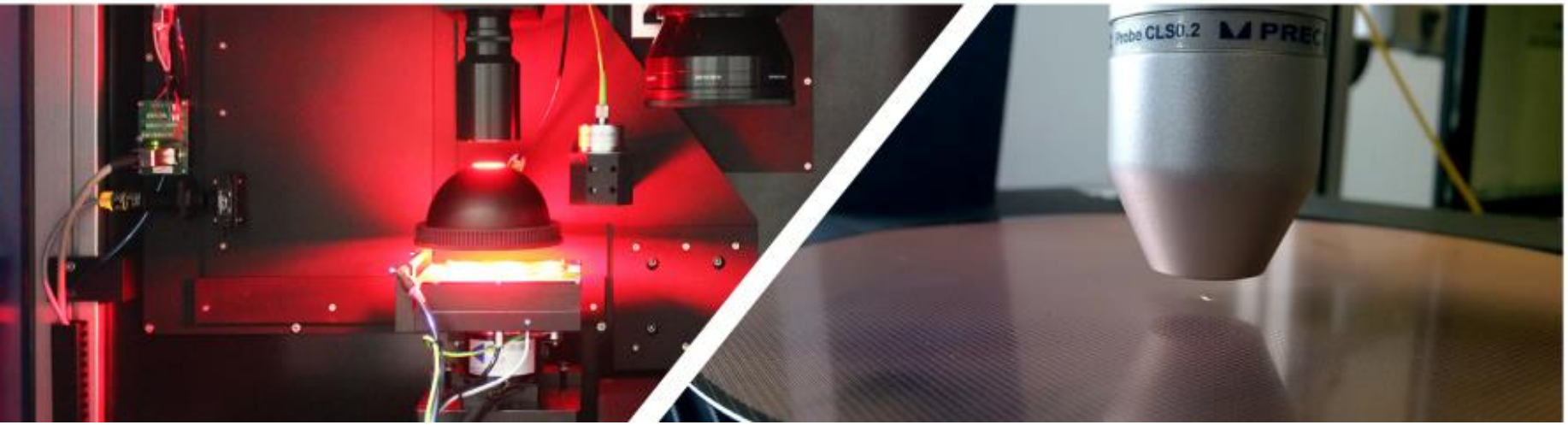

Grinding Disk Surface Analysis

May 3rd 2021

Precitec:

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Report done by Oleg Nikiforov

MICRONISE

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Grinding Disk Surface Analysis

Sample Description and Goal

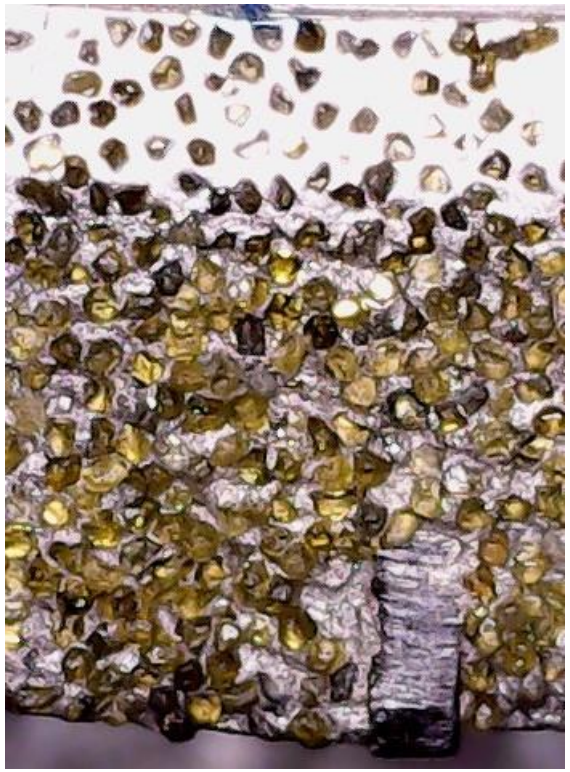
- Our goal is to inspect the surface properties and to determine the number of diamond particles of the Kapp Niles grinding disk sample at the marked position.

- Sample ID: KAPP NILES 2.760.82.043.13 NR. D 10206, mn=0,9-1,4 EW=20°.

- As desired by customer, the sensor **CHRocodile C** is used. It allows for accurate measurements of the surface area. Thanks to its low price and high accuracy, this sensor is our most economical solution.

- The **chromatic confocal** method allows to measure higher surface slopes than the **interferometric method** due to higher numerical aperture (NA) of the probes. This ability is crucial in presence of diamond particles.

- The CHR-C has a range of 5 different probes in order to meet various needs. According to the expected profile height, we choose the probe with 500 µm range.



Picture of the sample

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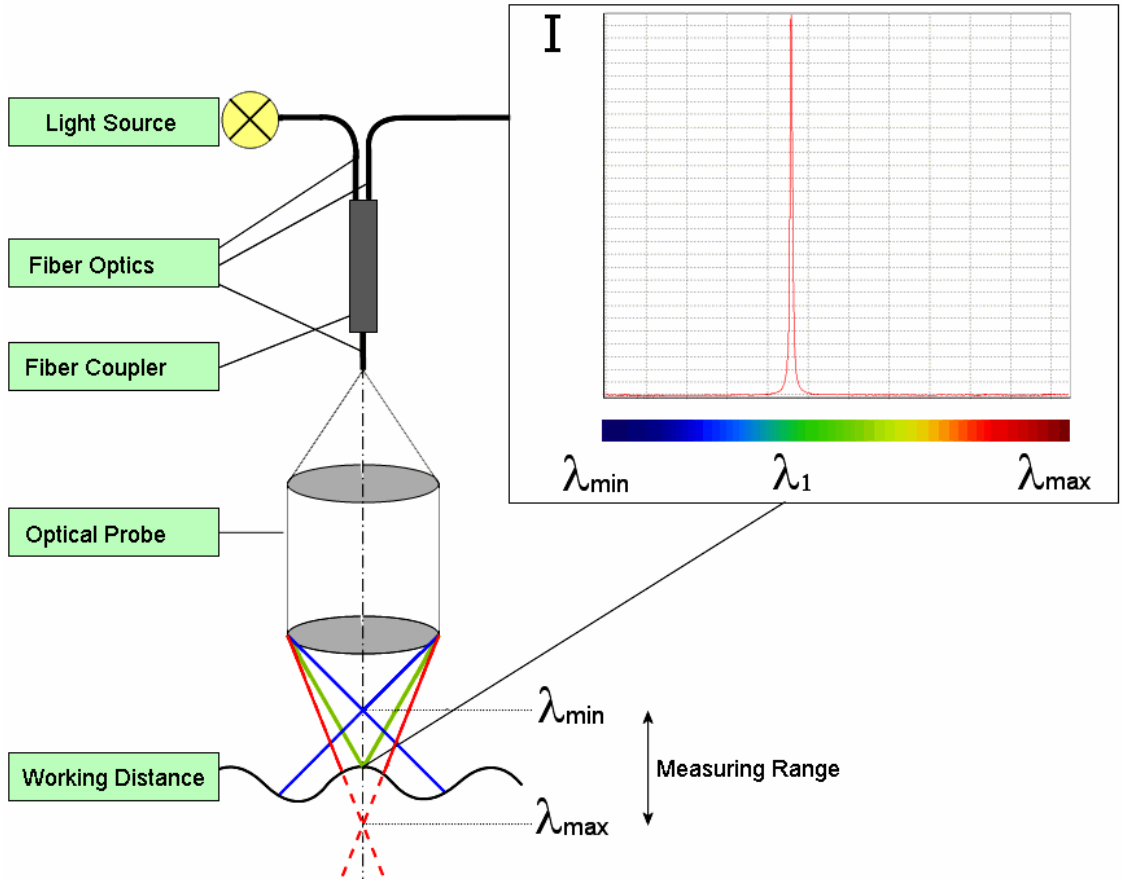
Grinding Disk Surface Analysis

Theory of Chromatic Confocal Distance Measurements

White light travels via fiber from the CHRocodile control unit to an optical probe which focuses the different wavelengths with different focal lengths. An object reflects light back into the probe, but only light of the wavelength that is in focus on the surface is perfectly imaged back into the fiber and reaches the detector.

The optical probe determines the measuring range, or focal depth of the spectrum. Because of the high numerical aperture of the probes and dynamic range of the sensor, it is possible to measure nearly all materials.



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GRINDING DISK SURFACE ANALYSIS

CHROCODILE C

The ultra compact CHRocodile C sensor with its robust and integrated design offers high precision distance and thickness measurements.

CHRocodile C is specially suited for industrial inline use and easily integrable into any kind of inspection machine.

The extraordinary high dynamic range and the outstanding signal-to-noise ratio of the CHRocodile sensors ensure the best measuring results on any kind of surfaces.

Thanks to its compact dimensions and excellent performance/price ratio, CHRocodile C is the ideal alternative to classical laser triangulation sensors.

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Grinding Disk Surface Analysis

Technical Equipment

CHRocodile C

Maximum frequency	Technology	Interface	Light source	Dimensions without probe (l x w x h)	Weight
4 kHz	Chromatic confocal	Ethernet/RS424/RS232	LED	99 mm x 65 mm x 47 mm	430 g

500 µm Probe

Measuring range	Working distance	Axial resolution	Lateral resolution	Measurement angle to surface	Length	Diameter
500 µm	12.7 mm	20 nm	2.5 µm	90° +/- 45°	56.2 mm	43 mm

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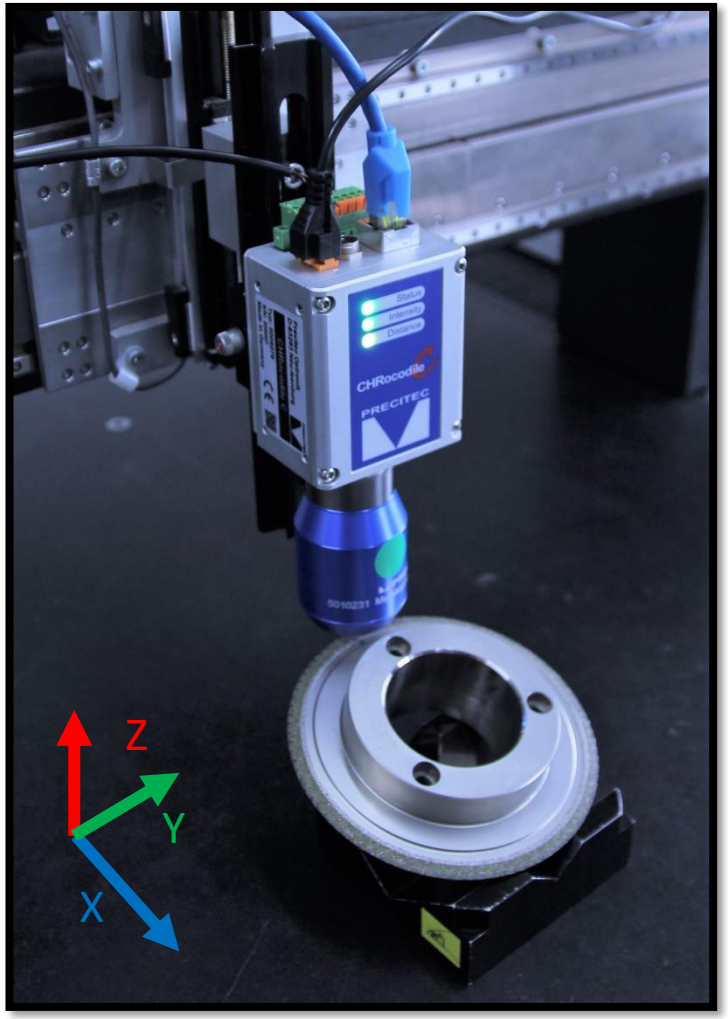
Grinding Disk Surface Analysis

Measurement Description and parameters

- Probe: 0.5 mm
- Frequency: 4000 Hz → 4000 pixels measured every second
- Raster: 2 x 2 µm
- Area: 5 x 5 mm
- With an X and Y directions stage, the sensor can record a topography of a defined area.



CHR-C measuring the sample

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Grinding Disk Surface Analysis

Evaluation Description

- Valid topography data is extracted from 98,7% of all pixels.
- Data measured at the edges of the diamonds and the surfaces with very high slope is invalid.
- Topography data is leveled to remove tilt.
- Surface analysis is performed without interpolation for missing data points:
  - Surface roughness,
  - Abbott-Firestone curve,
  - Size and distribution of diamond particles.

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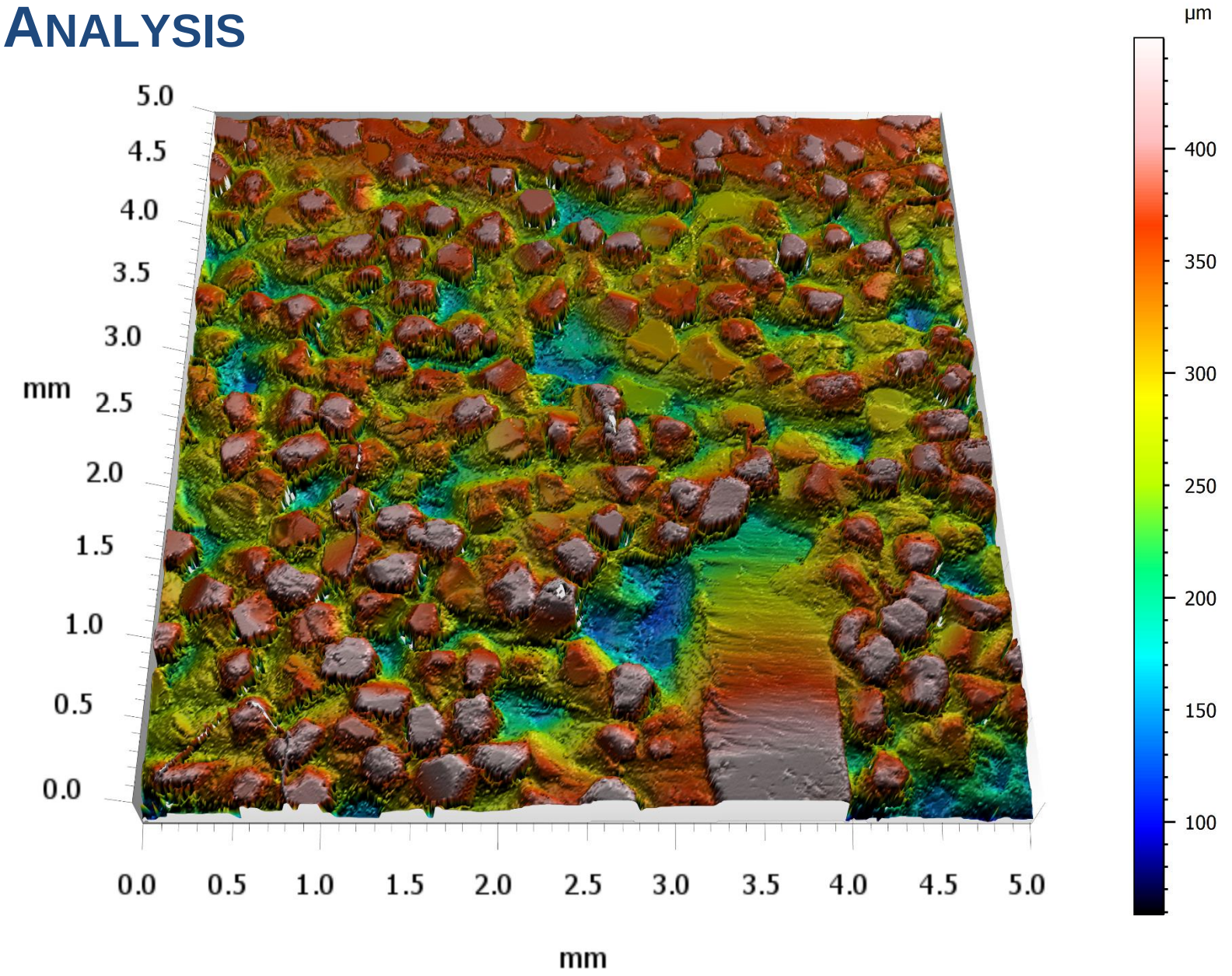
Grinding Disk Surface Analysis

Three-dimensional View

- False color representation of the disk topography
- Values are in µm



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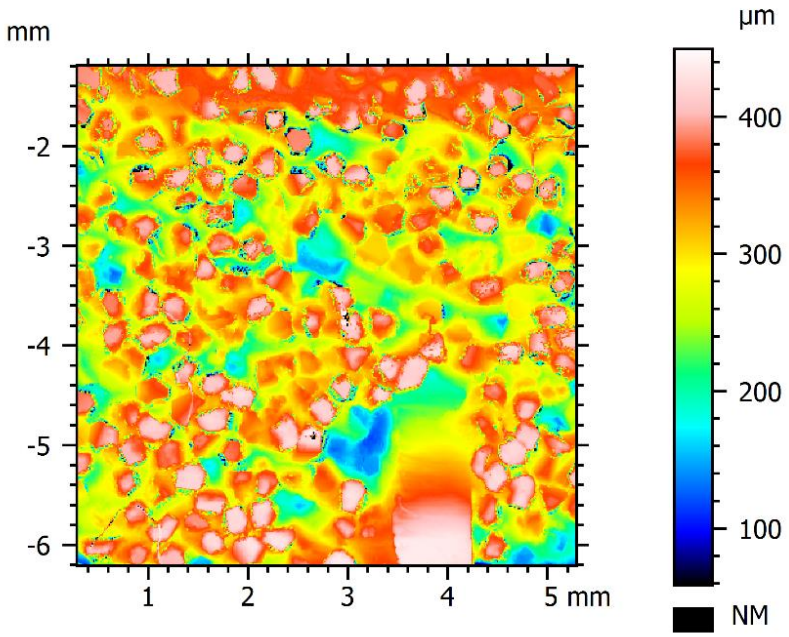
GRINDING DISK SURFACE ANALYSIS

SURFACE ROUGHNESS



- Raw data provides good and reliable basis for calculations
- Missing data interpolation and low-pass filtering yields no significant difference to results from the raw data

ISO 25178 - Band-pass (S-L)	Raw data		
F: [Workflow] Leveled (LS-plane)			
S-Filter: Gaussian, 0.008 mm			
L-Filter: Gaussian, 2.5 mm			
Height parameters			
Sq	57.97	µm	*Root-mean-square height*
Sa	46.43	µm	*Arithmetic mean height*
Feature parameters			
S10z	349.9	µm	*Ten point height*
S5p	136.4	µm	*Five point peak height*
S5v	213.5	µm	*Five point pit height*
Information			
The studiable contains non-measured points. The results are calculated on measured points only.			

ISO 25178 - Band-pass (S-L)	Interpolated and smoothened data		
F: [Workflow] Leveled (LS-plane)			
S-Filter: Gaussian, 0.008 mm			
L-Filter: Gaussian, 2.5 mm			
Height parameters			
Sq	54.39	µm	*Root-mean-square height*
Sa	43.17	µm	*Arithmetic mean height*
Feature parameters			
S10z	327.7	µm	*Ten point height*
S5p	137.4	µm	*Five point peak height*
S5v	190.3	µm	*Five point pit height*

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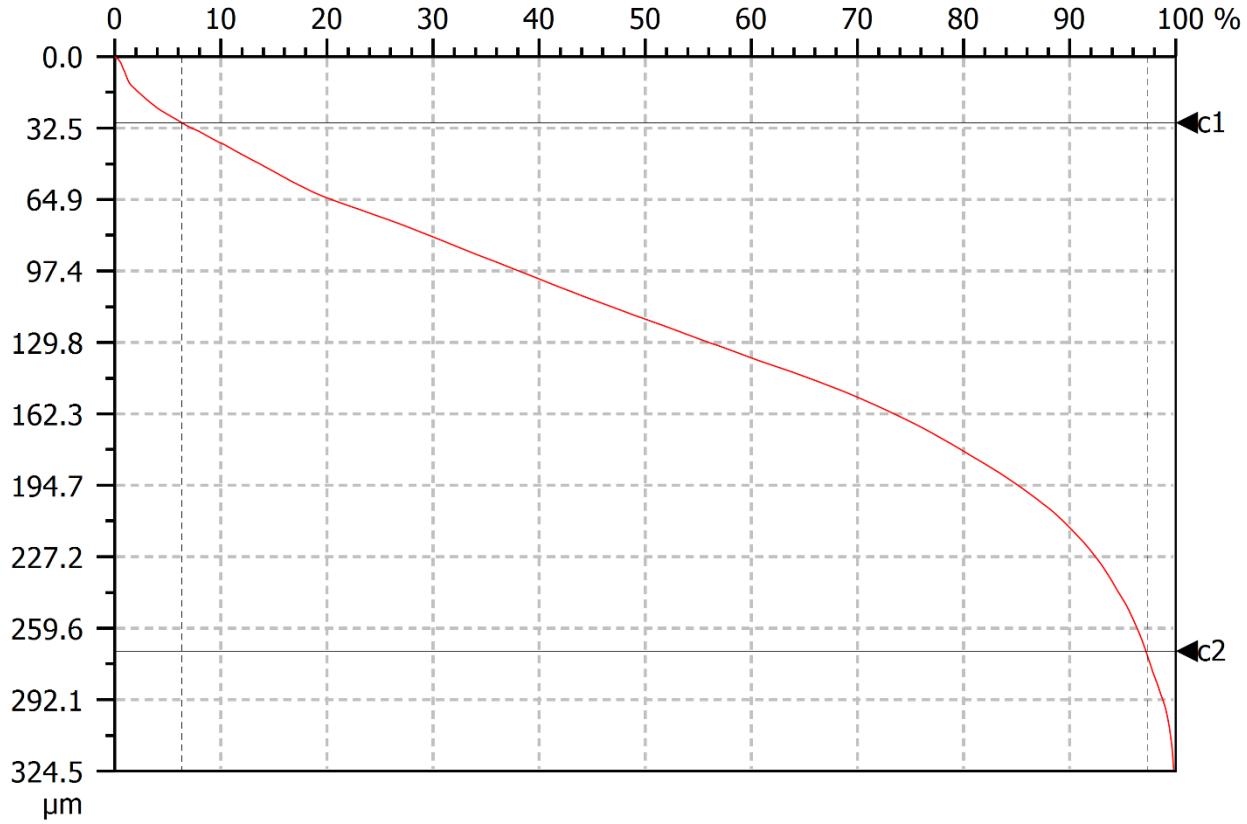
Grinding Disk Surface Analysis

Abbott-Firestone Curve

- Raw data provides good and reliable basis for calculation of this bearing area curve
- Missing data interpolation and low-pass filtering yields no significant difference to results from the raw data



Parameters	Value	Unit
c1	30.00	µm
c2	270.0	µm
c2 - c1	240.0	µm
Smr(c1)	6.314	%
Smr(c2)	97.32	%
Smr(c2) - Smr(c1)	91.01	%

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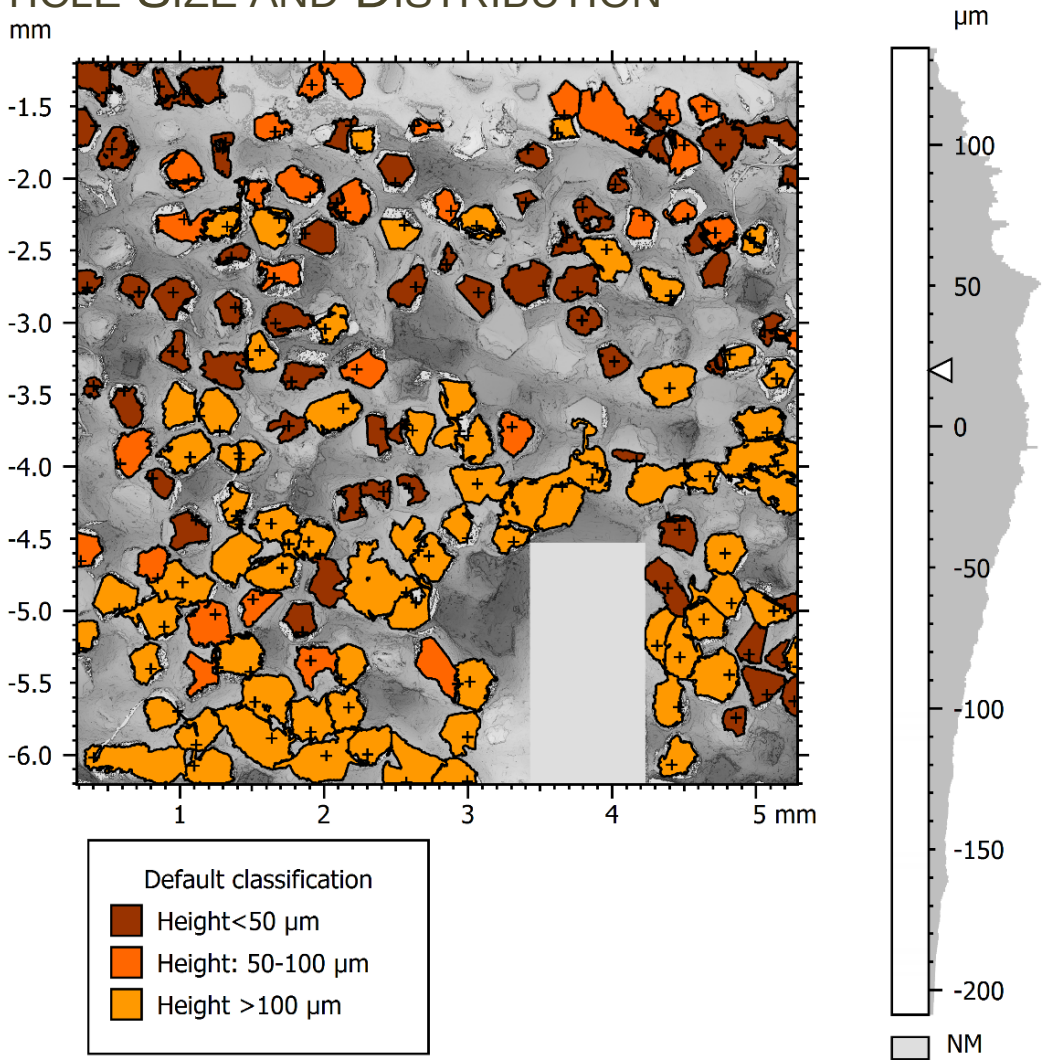
Grinding Disk Surface Analysis

Particle Size and Distribution



Information			
Method	Threshold detection		
Reference	Mean plane		
Threshold 1	20.00	µm	
Number of particles	173		
Coverage	30.8	%	
Density	6.895	Particles/mm²	

Parameters	Projected area	Mean diameter	Volume of material	Z-maximum
Unit	mm²	mm	µm³	µm
Mean	0.04471	0.2266	2046848	95.68
Std dev	0.02538	0.06392	1475274	22.79
Min	0.01056	0.1110	110069	41.89
Max	0.1488	0.4378	6661755	134.2

- Best particle detection method is the threshold detection in reference to the mean plane of the surface.
- Evaluation results depend on the threshold level and the minimal and maximal expected particle areas.

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Grinding Disk Surface Analysis

Conclusion

- The CHRocodile C is well suited for this kind of surface analysis.
- The 500 µm probe allows a fast measurement at 4kHz with a very high accuracy.
- The evaluation of the raw data is performed by MontainsMap 8.0.
- Raw unfiltered data with some missing points provide a good basis for surface analysis.
- The calculated results are consistent to the expected values.
- Particle analysis results depend on the detection threshold level and the set expected particle size.
- Note: If a faster measurement is requested, the Confocal Line Sensor would allow to measure about 200 time faster thanks to a simultaneous point measurements, where the detecting points are arranged into one line.

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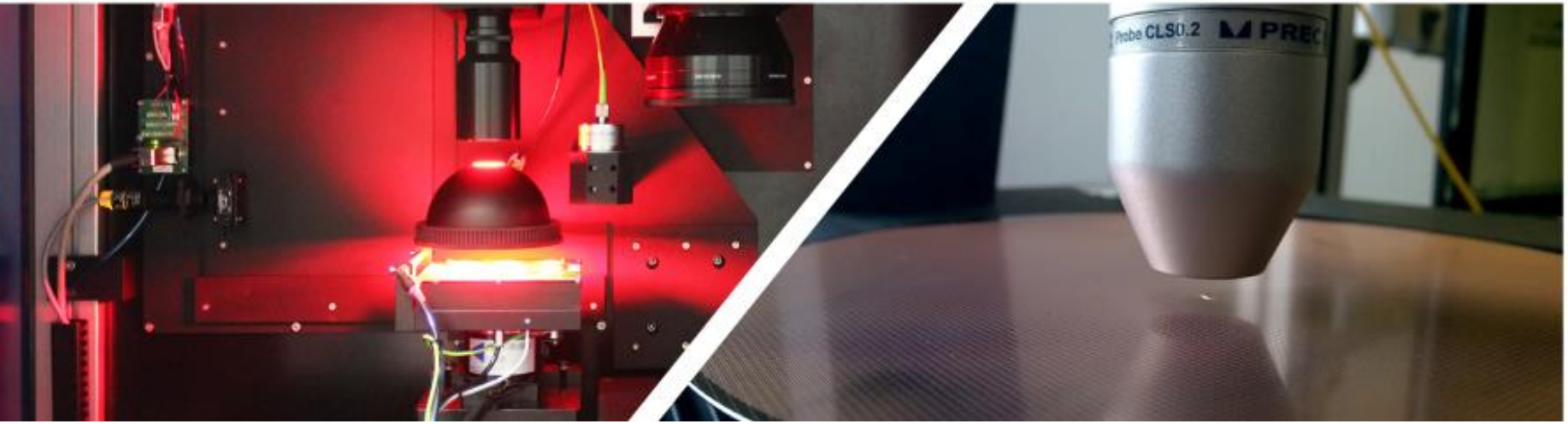

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