Report APP/OCCTB

Surface analysis of a metal sample using the FRT MicroGlider®

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Introduction

For the company OEC desino test measurements were performed on a metal sample using the FRT MicroGlider®. The aim of this report is to demonstrate the capability of the MicroGlider® as a suitable analysis system for your upcoming equipment requirement. This report shows the measurements of the sample especially with regard to topographical overviews flatness and roughness.

Method of measurements

The sample was investigated with the FRT MicroGlider® with the chromatic sensor (CWL) and the atomic force microscope (AFM). Different xy-stages are available which enable the investigation of samples in a maximum scan range of 600 mm × 600 mm.

Chromatic sensor (CWL)

The chromatic sensor illuminates the sample by white light source and measures the wavelength-dependent (chromatic) distribution of the reflected light and determines the absolute height information. Since no mechanical parts are set in motion in the vertical direction, measurements can be performed very quickly. Variations in the light intensity, which can be caused for example by different surface roughness, do not affect the measurements. Due to its large working distance the sensor works non-destructively.

Various chromatic sensors with different working distances and x,y,z-resolutions are available (see table 1a). For these tests a sensor with a vertical measuring range of 600 µm was used.

Measuring range z	300 µm	600 µm	3 mm
Working distance	4,5 mm	6,5 mm	20 mm
Resolution z	3 nm	6 nm	30 nm
Resolution x,y	1-2 µm	1-2 µ m	5-6 µm

Tab. 1a: CWL sensor heads

With this measuring method, the surface topography is obtained as a quantitative data array, allowing the evaluation of heights, lengths and angles as well as roughness, waviness and flatness on the sample.

Atomic Force Microscope (AFM)

Atomic force microscopes allow to measure very small areas with very high resolution in x,y and z. For these tests we used an AFM with a max. scan range of 80 µm × 80 µm laterally and 6 µm vertically (more heads see table 1b). The AFM can be driven in contact or non-contact mode, obtaining not only topography surface data but also phase, amplitude of field contrast simultaneously.

Scan range	20 µm × 20 µm	40 µm × 40 µm	80 µm × 80 µm
range z	min. 2 µm	min. 4 µm	Min. 6 µm
Detection principle	optic fiber interferometer	optic fiber interferometer	optic fiber interferometer

Tab. 1b: AFM-heads

The basic AFM contains the „contact-mode“, additional the following modes are available:

- non-contact mode
- phase / amplitude mode
- elasticity mode / differential field mode
- friction / lateral force mode
- magnetic / electrostatic force mode
- AFAM (Atomic Force Acoustic Microscopy)
- Kelvin probe mode
- for special uses a liquid head for measurements in water or liquids is available

Measurements

The sample was mounted onto the xy-table of the MicroGlider® and was measured without any further preparation. The measuring time of images is only a few minutes The CWL sensor allows the measurement of 2D-profiles within a few seconds. The actual measuring time is dependent on the scan range and the number of data points. Evaluation was performed by the powerful FRT Mark III analysis software.

Metal sample

Image 1a shows the topography of the metal sample in a 20 mm × 20 mm area. The color table is chosen in that way so that lower structures appear dark and higher structures appear bright. The 3D view (fig. 1b) shows the pseudo-realistic view of the surface and can be rotated through several angles in the vertical and horizontal directions for illustration purposes. (Using a virtual light source the contrast of the surface structures can be enhanced).

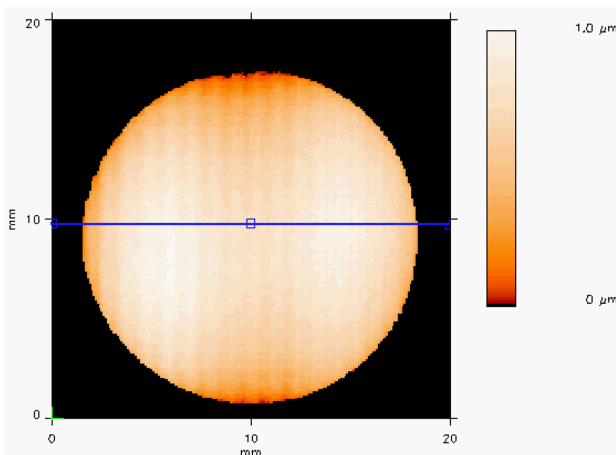

Fig. 1a: Top view of the **metal sample**, 20 mm × 20 mm × 1 µm

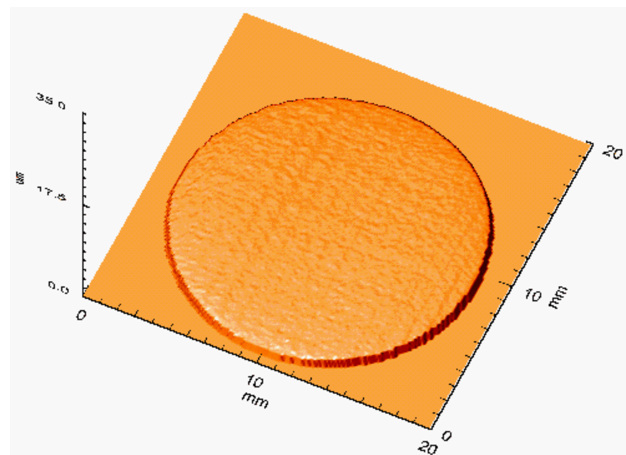

Fig. 1b: 3D view of the metal sample 20 mm × 20 mm × 35 µm

Flatness

For the calculation of the flatness only the top most structure is important. So we have to remove the edges. Therefore the flatness function “cuts” the edges (deletes the data) in a lateral range of ± 0,2 mm from the edge. The flatness value TIR of the metal sample is:

TIR: 1,040 µm

With the FRT MicroGlider® it is also possible to measure 2D-profiles. The following figure 2a shows a profile of the metal sample (see blue line in fig. 1a).

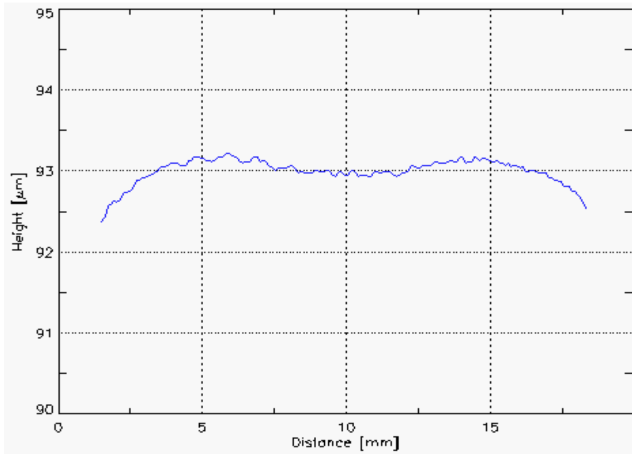

Fig. 2a: Profile of the **metal sample** (see blue line in fig. 1a).

Roughness

The following figure 3a to 3b show the top view and the 3D-view of an atomic force microscope measurements of the metal sample.

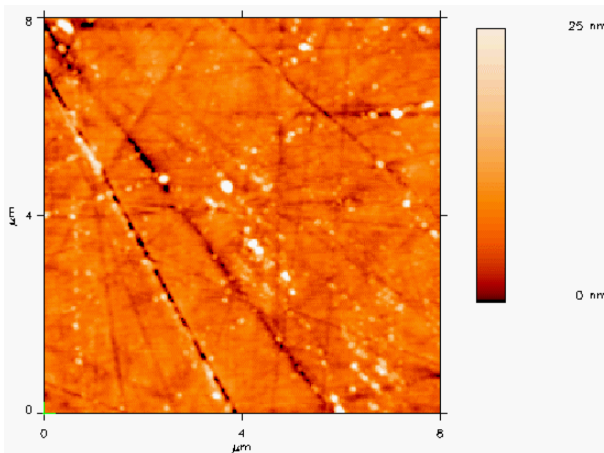

Fig. 3a: Detail of **metal sample (AFM),** 8 µm × 8 µm × 25 nm

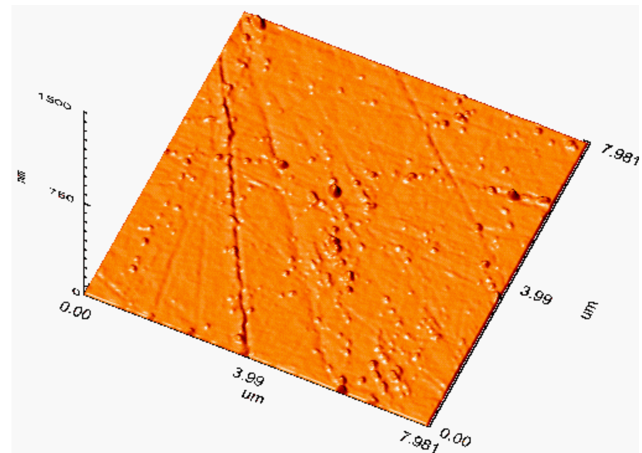

Fig. 3b: 3D-view of **metal sample (AFM),** 8 µm × 8 µm × 1500 nm

With the FRT Mark III analysis software you can also calculate roughness parameters according to DIN EN ISO standards. Here in fig. 3c, the roughness parameters of fig. 3a are displayed:

sRa:	1.590 nm
sRq:	2.799 nm
sRz(DIN):	48.167 nm
sRmax:	60.719 nm
sRp:	50.785 nm
sRv:	12.423 nm
sRt:	63.207 nm
sRsk:	5.125
sRku:	62.577
sRk:	4.107 nm
sRpk:	5.930 nm
sRvk:	2.367 nm
sMr1:	11.125 %
sMr2:	89.627 %
sV0:	0.123 nm^3/nm^2

Fig. 3c: Surface roughness values from fig. 3a
(Lc = 1,14 µm)

These surface parameters are determined according to DIN EN ISO standards, which are defined for profile measurements only. Surface parameters are therefore determined based on the existing standards. Please note, that the surface values are obtained from one topography only. Therefore they do not constitute a statistically derived result using several measurements.

Summary

For the company OCC desino test measurements were performed on a metal sample. The aim of this report is to demonstrate the capability of the MicroGlider® as a suitable analysis system for your upcoming equipment requirement. This report shows the measurements of the sample especially with regard to topographical overviews flatness and roughness.

From the documented measurements and analysis it can be stated that the FRT MicroGlider® with CWL and AFM is the ideal system for the requirement as the samples/applications were measured on the one unit without any specific set-up or adjustment. The CWL allows the non contact (no sample damage) investigation of surfaces in a large range, e. g. to evaluate the flatness of the sample. The AFM enables high resolution measurements, to determine small structures. The MicroGlider® with CWL and AFM is very suited for the applications as shown here and also for the analysis of other surfaces with similar dimensions.

The MicroGlider® allows the combination of the AFM with optical sensors. So measurements in the mm range (with CWL) to nm range (with AFM) are possible in one single instrument.