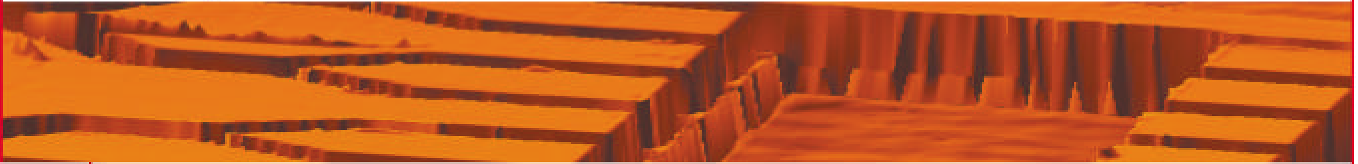
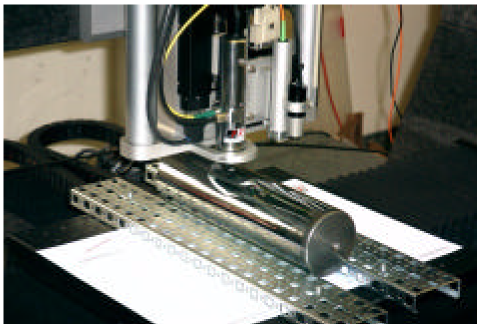
Application Note

FRT
Fries Research & Technology
Rauheit Kontur Topographie



Bridging the gap between nanometer and meter

The measuring task:
The investigation of structure and roughness of surface is gaining more and more technological relevance. The demands on components and finished surfaces have increased dramatically over the last past years. This development also leads to smaller dimensions at surface level, may it be only in height, or also in lateral dimensions. Of course, this means metrology methods also have to meet these dimensions. But still, the classical dimensions, microns or millimeters, must be involved. Otherwise the interface between the nano-world and the usual dimensions of surfaces cannot be investigated.

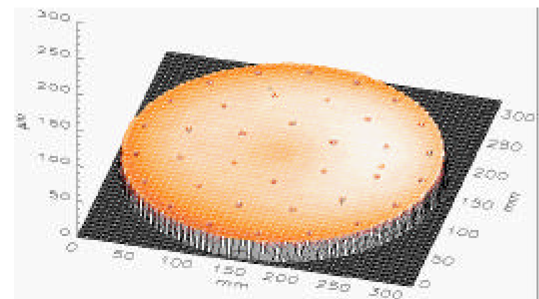


Picture 1: A large and heavy sample under the AFM

Challenges:
The solution for high performance measurements in the nanometer regime is atomic force microscopy (AFM). But even with the high performance of the AFM and having solved all the problems in the nano regime, there is still one point that restricts the application of AFM to research labs and some high tech companies.

The gap of the dimensions from state-of-the-art industrial metrology and the nano range cannot be bridged by AFM solely.

The solution:
The FRT solution combines two sensors, which allows investigation of large ranges with lower resolution as well as smaller ranges with very high resolution. The instrument is equipped with a chromatic optical sensor and an AFM, both permanently mounted. Without changing the measuring device, complete component parts for industrial purposes (e.g. quality control) can be measured using the chromatic optical sensor. But also the AFM allows the investigation of the surface at specific positions with nanometer resolution.

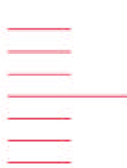


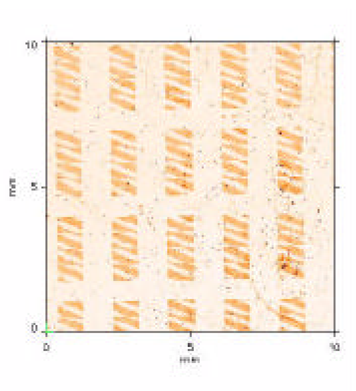
Picture 2: A complete 300 mm measurement for flatness and warpage investigation

The optical sensor allows rapid and accurate topography measurements on sample sizes ranging from 200 µm x 200 µm up to 600 mm x 600 mm. The x,y resolution of this sensor is 1 – 2 µm. The z range may be chosen from 300 µm up to 3 mm without moving the sensor in z direction. The resolution in height is down to 3 nm. The optical sensor is complemented by a positioning camera, which works as an optical microscope and enables the scanning area to be defined

The AFM is available with maximum scanning ranges from 20 µm x 20 µm

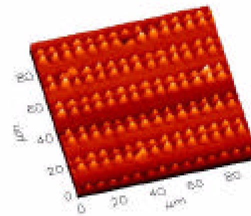
to 80 µm x 80 µm. The z range is from 2 µm to 6 µm. The AFM resolution is better then 1 nm in all three axes.





Picture 3: A 10 mm measurement out of a 300 mm wafer for structure and rougness

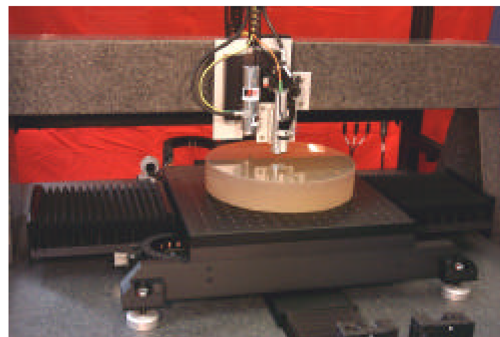
The AFM may be equipped with all measuring modes like magnetic force, lateral force, force modulation, phase shift, liquid compatibility and also atomic force acoustical microscopy (AFAM). This mode allows the investigation of mechanical properties and elastic modulus of surfaces.



Picture 4: A 80 µm high resolution measurement on the same wafer for getting details on single features

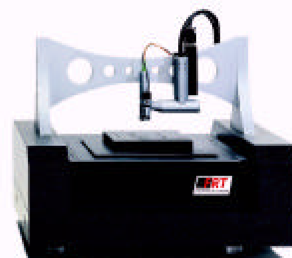
The sample positioning in AFM mode is performed, using either the camera or a previous optical measurement scan. In this way, the point of investigation for AFM is always found quickly and precisely.

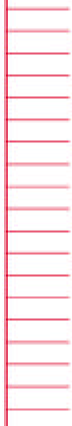
The following FRT instruments may be used with the combination AFM/chromatic sensor:



The MicroProf®: all versions

The MicroGlider®: all versions





By deducting a reference plane, a height repeatability of better than 100 nm, over a 350 mm x 350 mm measuring range is achieved.

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