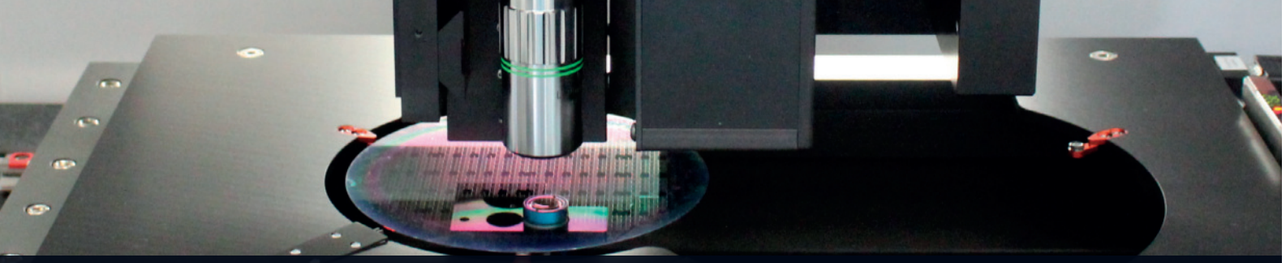
MULTI-SENSOR METROLOGY FOR FOUNDRIES

FRT THE ART OF METROLOGY™

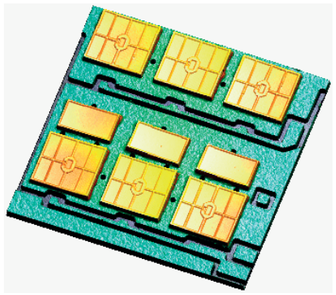
MicroProf® FS

Automated hybrid metrology for semiconductor fabrication

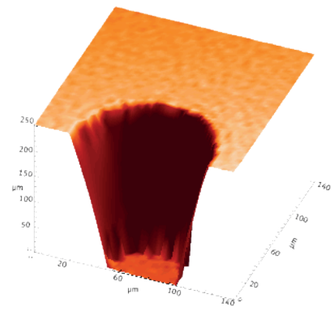


MEASURING TASKS

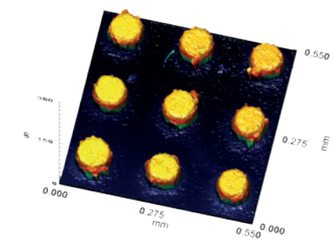
Roughness *Step Height* *Film Thickness* *Profile* *Bow* *3D Map*
Roll-off Amount *TTV* *Thickness* *Warp* *Waviness* *Membrane Bow*
Layer Stacks *Defect Size* *Topography* *Flatness* *Vias / TSV* *Bumps*
Coplanarity *Angle* *Critical Dimension* *Slope* *Nanotopography ...*



Assembled electronic substrate
Reference: Danfoss Silicon Power GmbH



Topography of a single through silicon via



Bumps (height, diameter, pitch)

MULTI-SENSOR MEASUREMENT FOR HIGHEST METROLOGY FLEXIBILITY

The MicroProf® FS is a fully automated wafer metrology tool, configurable for a wide range of applications in the wafer foundry, using both – standard and customized solutions. With its huge universality, MicroProf® FS becomes a real "Jack of all Trades" in any state-of-the-art foundry's shop floor. This is why we call it the Foundry Star!

Flexibility and versatility are keywords when it comes to metrology solutions for nowadays silicon foundry applications. MicroProf® FS provides a modular approach to create a fully automated multi-sensor tool that can solve all the required measurement tasks.

For its core component, the metrology part, a well proven MicroProf® 300 multi-sensor metrology tool is used to allow both, the measurement of different products and – by using a hybrid metrology concept – to enhance the precision of measurements on samples where a single sensor or measuring principle is just not enough.

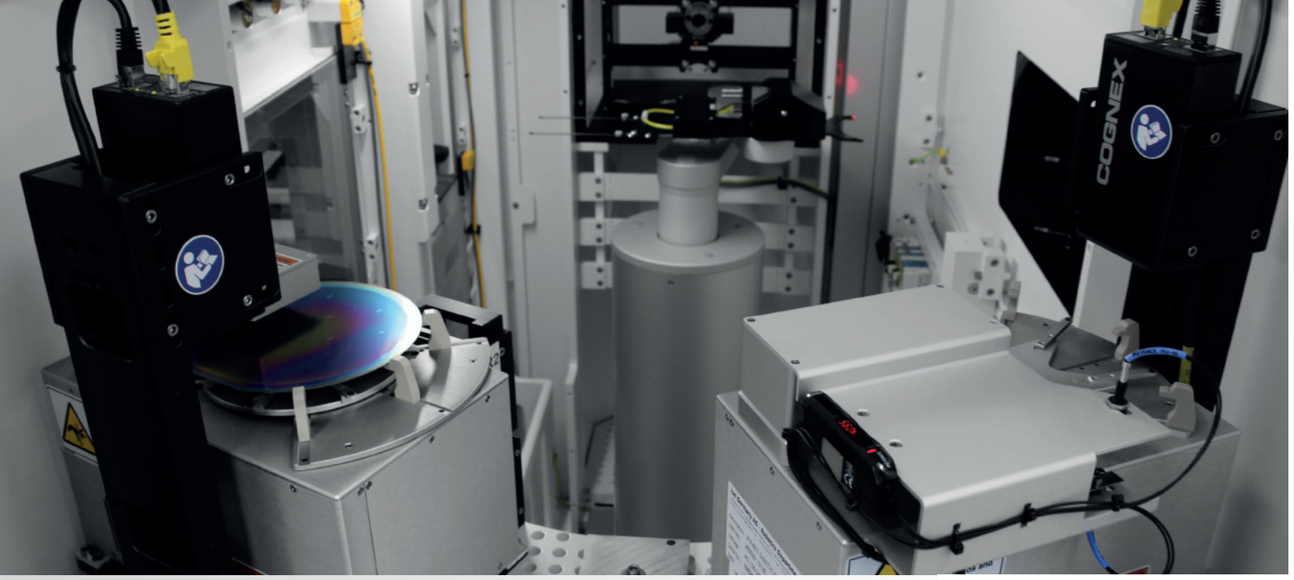
The measurement system of the MicroProf® FS is equipped with a granite base setup, with a three point sample fixture or a vacuum chuck.

HANDLING CAPABILITY OF VARIOUS SUBSTRATE TYPES

Also on the automation part, flexibility is written in capital letters. The included robot handling unit can be configured for 300 mm, 200 mm, and 150 mm wafers, both exclusive or as a bridge tool allowing the handling of two wafer sizes within one system. Moreover, it can be also configured for the handling of non SEMI-standard wafers, such as highly warped wafers or thin wafers. The handling unit features a single arm robot with end-effector, two load ports including mapper and RFID reader, pre-aligner and if needed OCR reader stations. The MicroProf® FS is equipped with filter fan units (FFU) providing ISO class 3 clean room conditions within the tool.

MicroProf® FS –

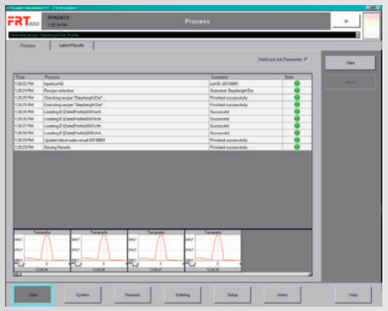
FULLY AUTOMATED TOOL FOR METROLOGY IN SEMICONDUCTOR FABRICATION



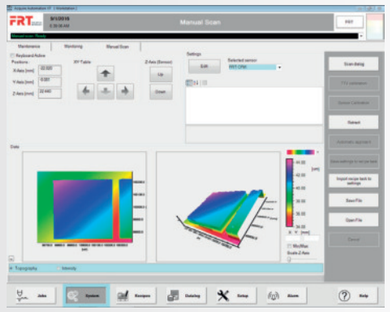
POWERFUL SOFTWARE FOR FULLY AUTOMATED WAFER METROLOGY

The tool is run by the SEMI-compliant FRT Acquire Automation XT software. This software allows recipe based measurement and data analysis of structured and unstructured wafers. Choose the suitable measurement and evaluation routine for your measuring task from a variety of packages.
For recurring structures, a layout wizard with a graphical user interface (GUI) can support you in teaching the measuring positions. In addition, fine sample alignment via pattern recognition is available as an option.

This software provides comprehensive capabilities, from manual measurement on the device to fully automated measurement with one-button operation and integration into production control systems, e.g. via a SECS/GEM interface.
You can easily configure various measurement tasks using different sensors to run consecutively as a measurement sequence. This includes the execution of measurements, processing and analysis using intelligent algorithms, output and visualization of results in the form of reports and the export of results in various data formats.



Automated measurement process sequence
FRT Acquire Automation XT



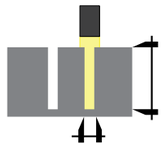
Data View
FRT Acquire Automation XT

TYPICAL APPLICATIONS

MicroProf® FS

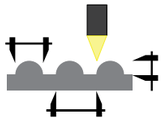
- coated wafers
- structured wafers at various lithographic process steps, measurement of conductor tracks, bumps, etc.
- MEMS product wafers featuring acceleration sensors, pressure sensors, micro optics, etc.
- wafers at different 3D packaging process steps, e.g. with through silicon vias or trenches after etching
- thin film layer stacks

VIAS / TRENCHES



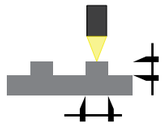
Measurement of vias and trenches with high aspect ratio

BUMPS / COPLANARITY



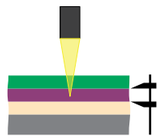
Measurement of bump dimensions and coplanarity

STEP HEIGHT / WIDTH



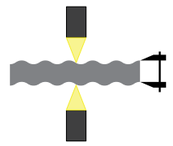
Measurement of step height and step width on structured wafers

FILM THICKNESS / LAYER STACK



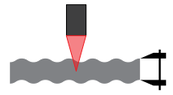
Measurement of transparent layers and layer stacks

WAFER THICKNESS / TTV



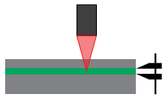
SEMI-compliant measurement of wafer thickness and TTV

WAFER THICKNESS TTV



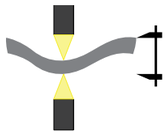
Measurement of wafer thickness and layer thickness/total thickness of IR-transparent stacks, e.g. bonded wafers

BOND LAYER



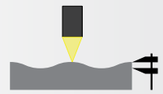
Measurement of bond layer thickness (stacked wafers), voids and defects

BOW / WARP



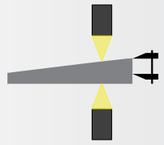
SEMI-compliant bow and warp measurement

FLATNESS



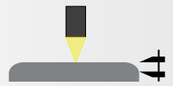
Measurement of wafer flatness

TAPER



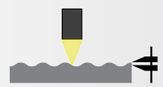
SEMI-compliant measurement of wafer taper

ROLL - OFF AMOUNT



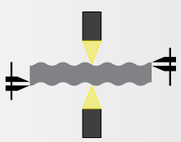
SEMI-compliant measurement of roll-off amount

TOPOGRAPHY



Standard topography measurement

TOPOGRAPHY (TOP & BOTTOM)

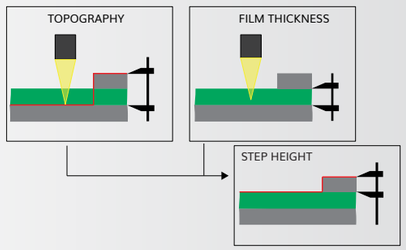


Topography measurement on both wafer surfaces, simultaneously

STRESS

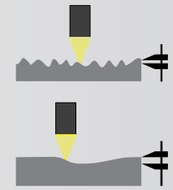
Measurement of wafer stress e.g. induced by layer deposition

HYBRID TECHNOLOGY



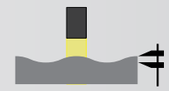
Post processing calculation of sample properties using individual results generated by different sensors/measurement principles

ROUGHNESS / WAVINESS



DIN/ISO-compliant measurement of surface roughness and waviness on bare and structured wafers

NANOTOPOGRAPHY



SEMI-compliant measurement of Nanotopography on ground and polished wafers

Metrology Capabilities

CONFIGURE YOUR MICROPROF® FS

METROLOGY UNIT	
MicroProf® 300	
Chromatic point sensors FRT CWL	
TTV Setup	
Film thickness sensor FRT CWL FT/IRT	
Thin film sensor FRT FTR	
Chromatic line sensor FRT SLS	
Confocal microscope FRT CFM/CFM DT	
White light interferometer FRT WLI FL/WLI PL	
Standard positioning camera with illumination	
High resolution camera with illumination	
Brightfield IR illumination + IR camera for inspection	
Pattern recognition software	
3-point fixture for 1 or 2 wafer sizes	
Fully supporting wafer fixture with vacuum for one or two wafer sizes	
Thermo unit (controlled hot & cold chuck)	

EFEM ENCLOSURE	
ISO Class 3 clean room conformal housing	
2 filter fan units, one for handling and one for metrology area	

WAFER HANDLING UNIT	
Single arm robot unit	
Pre-aligner	
2 load ports for open cassette SEMI-standard	
> for 150 mm (6 inch) wafers	
> for 200 mm (8 inch) wafers	
> for 300 mm (12 inch) wafers	
> Bridge tool option	
RFID reader	
Vaccum end-effector handling	
Edge grip handling	
Handling of warped wafers (e.g. eWLB)	
Bernoulli-handling (non-contact)	
OCR reader (front/back)	
Ionizer bar	

SOFTWARE	
FRT Acquire Automation XT incl. one evaluation package + additional packages (if needed):	
> Step Height and Film Thickness	
> TTV, Bow, Warp	
> Bumps	
> Wafer Geometry	
> Roughness and Waviness	
> Saw Marks	
> Customized Evaluation Package	
> Nanotopography	
SECS/GEM Interface (standard or customized)	
Analysis software FRT Mark III	
Measurement software FRT Acquire	