

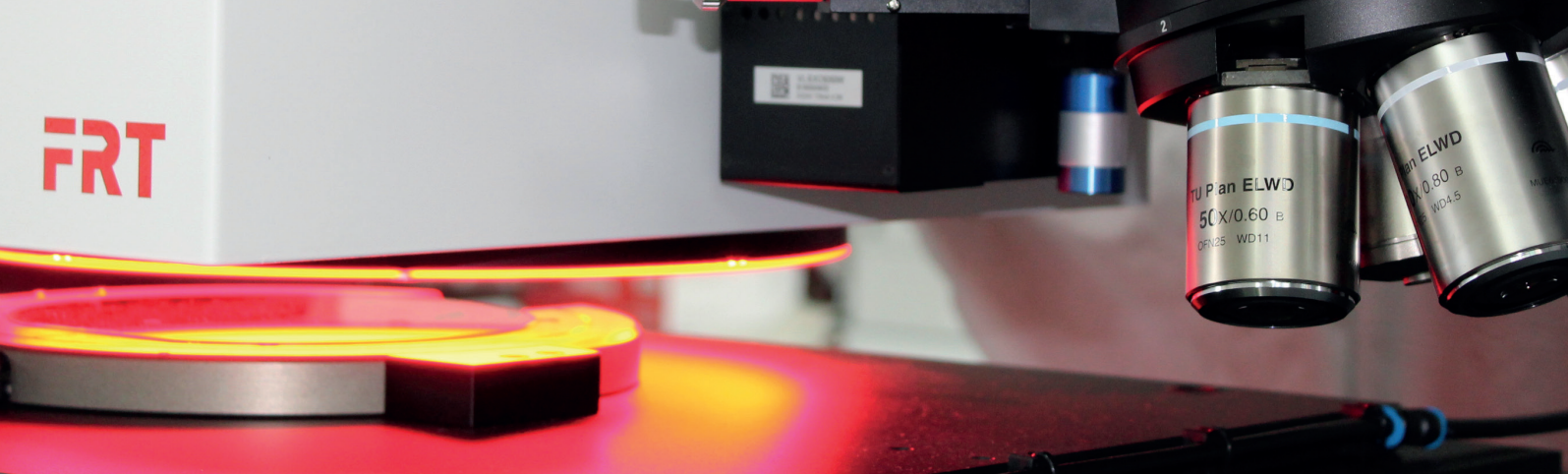
FULLY AUTOMATED
MEASUREMENT SYSTEM FOR
HVM IN SEMI AND MEMS

FRT
THE ART OF
METROLOGY™

MicroProf® DI

inspection and metrology
in one flexible tool





FULLY AUTOMATED WAFER INSPECTION FOR SEMICONDUCTOR AND MEMS INDUSTRIES

Packaging technologies are fast evolving in the semiconductor industry to achieve the functionality, speed and form factor required for the mobile market with its state-of-the-art electronic products. Wafer Level Packaging (WLP) is leading the way in High Volume Manufacturing (HVM), with 3D IC stack devices directly behind it. The numerous process steps mean a high level of stress on the wafers which often results in quality problems. The complexity of these new packaging technologies require cost-effective inspection and metrology solutions during the entire process to ensure product quality and high yield.

The optical inspection tool **MicroProf® DI** enables to inspect structured and unstructured wafers during the entire manufacturing process. By combining 2D inspection and metrology, the **MicroProf® DI** provides measurement solutions for a variety of applications, including defect inspection and wafer-level metrology for micro-bumps, RDL, overlay and through silicon via (TSV) in a single measuring tool.

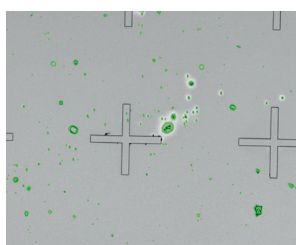
The **MicroProf® DI** includes several modules that can be flexibly combined on the same tool platform, covering all wafer surfaces at high throughput for efficient process control. The modules include optical inspection and classification of defects via single-shot and step camera module, review of defects via a high-precision microscope and comprehensive multi-sensor

metrology with different topography and layer thickness sensors. For the optical, non-contact and non-destructive analysis of hidden structures and inclusions in the wafer, interferometric layer thickness sensors with infrared light source and an IR microscope are also available as well.

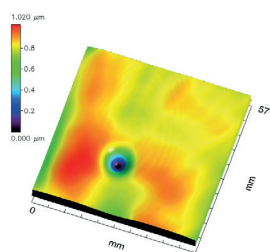
Designed to merge the boundaries between dark field micro inspection and bright field macro inspection, the **MicroProf® DI** provides automated inspection of defects for quality control in the front, mid and back end in various illumination methods. The 2D imaging technology enables fast and reliable inspection of defects down to the micrometer range.

For an inspection of defects down to sub- μm range the setup can be extended with a high-precision review microscope. It offers a motorized turret for up to 5 objectives, fast autofocus, bright and dark field inspection, differential interference contrast (DIC), fluorescence microscopy (FL) and POL 2-Beam inspection.

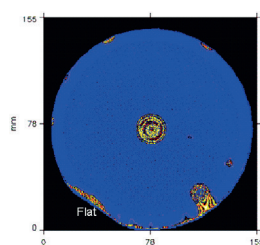
The **MicroProf® DI** offers a reliable platform technology, including highly flexible software with an unprecedented level of usability. The powerful FRT software quickly turns defect data into feasible process control, improves classification and reduces process times. It enables our customers to reliably develop and analyze new processes and simultaneously reduce the delivery time of their new products until market launch.



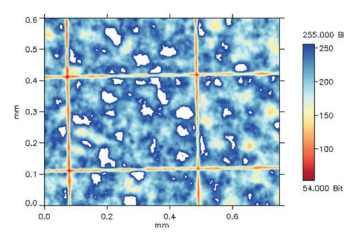
Defect detection of a Si wafer with voids



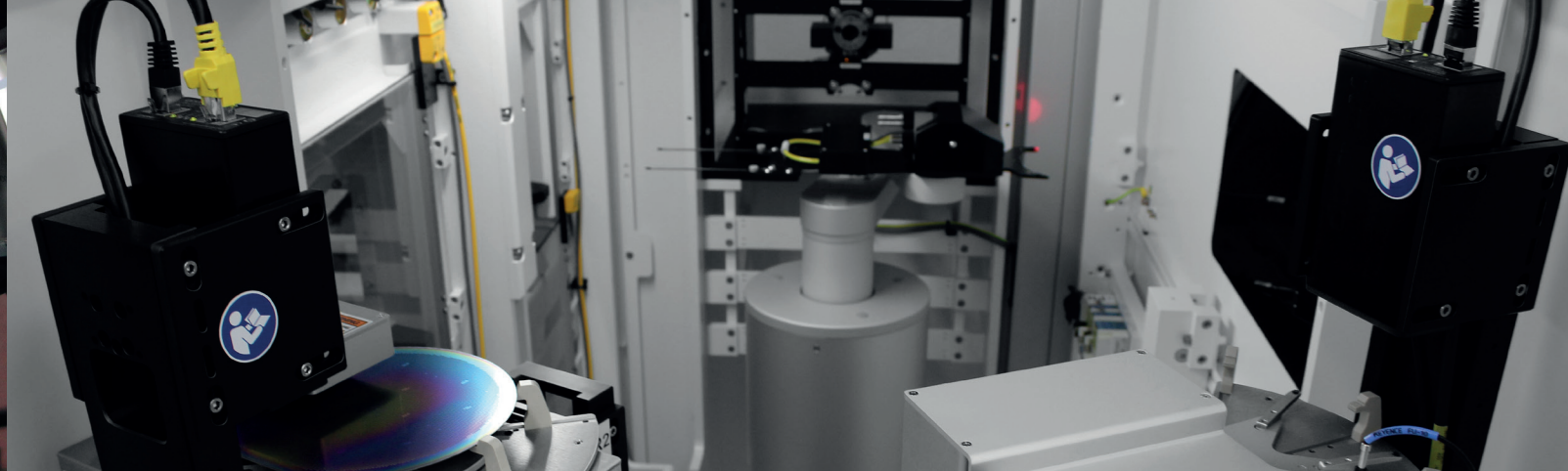
3D topography of a dimple on a Si wafer



Detection of voids in the bond layer interface



Stealth laser grooves in a bare Si wafer using IR microscope



WAFER INSPECTION WITH AUTOMATED HANDLING

The core component is the worldwide established multi-sensor tool **MicroProf® 300**. It allows both the measurement of wafers at different process steps and – by using hybrid metrology – to enhance the precision of measurements on samples where a single sensor or measuring principle is just not enough. Depending on the measuring task, these measurements can be carried out with different inspection modules and can be flexibly combined with various topography and (layer) thickness sensors, which are fully automated by a single recipe.

With a wafer handling system within an Equipment Front End Module (EFEM) and almost maintenance free hardware components, the **MicroProf® DI** provides high throughput and perfectly fits in any HVM wafer fab. The system can be configured for 12", 8" and 6" wafers, both exclusively or as a bridge tool that allows the handling of two wafer sizes in one system. The handling unit features a single-arm robot with end effector, two load ports including mapper and RFID reader, pre-aligner and, if required, OCR reader stations. The EFEM is equipped with Filter Fan Units (FFU), which ensure ISO class 3 clean room conditions within the tool. For integration into the shop floor automation, the tool is equipped with a SECS/GEM data interface. Measurement tasks are then triggered by the host and the measurement results are transferred automatically to the fab control system.

POWERFUL SOFTWARE FOR FAST DEFECT CLASSIFICATION

Our intelligent defect inspection software detects and classifies defects in seconds based on user-defined criteria. Regions of interest (ROIs) can be defined and defects located within these regions can be classified. It meets the defect analysis requirements of semiconductor fabs and provides the user with a number of functions for checking and displaying inspection data generated by the **MicroProf® DI**.

For structured wafers a die-based evaluation method can be used. Defects are detected by a threshold approach, marked in the input image and exported into the KLARF format. For unstructured wafers, a wafer-based evaluation method is available, which is based on the contrast of the pixel gray values using blob analysis. Our defect inspection software provides effective visualization, versatile processing and fast generation of wafer maps as well as precise quantification and comprehensible documentation of defects. The software enables the user to display different views of a selected data set, e.g. wafer map and defect list with number, position, size and grey value of the respective defects. The defects are assigned according to user-defined criteria and synchronized with the defect list.

TYPICAL APPLICATIONS

MicroProf® DI

- > bare wafer inspection (e.g. particles, holes, pits, micro scratches, micro roughness, growth defects, inclusions)
- > layer defects (e.g. particles, holes, layer cracking, delamination, voids, residuals)
- > filling defects (e.g. seams, voids, dimples, recesses, protrusion)
- > polishing defects (e.g. dishings, erosions)
- > wafer edge inspection (e.g. cracks, chippings, edge trim)
- > stacking and molding defects (e.g. warpage, deformation, global and local strain, dimples, holes)
- > wafer-level metrology for micro-bumps, RDL, overlay and through silicon via (TSV)

CONFIGURE YOUR MicroProf® DI

INSPECTION/METROLOGY UNIT	X/✓
MicroProf® 300	
Single-shot inspection module with various illumination methods	
Step inspection module (DIUSM)	
Review microscope with motorized 5-fold objective revolver	
Chromatic point sensor CWL	
TTV setup	
Film thickness sensor CWL FT / IRT	
Thin film sensor FTR	
Chromatic line sensor SLS	
Confocal microscope CFM / CFM DT	
White light interferometer WLI FL / WLI PL	
Pattern recognition software	
3-point wafer fixture	
Fully supporting wafer fixture with vacuum	
Thermo unit (controlled hot and cold chuck)	
In-plane deformation sensor	

WAFER HANDLING UNIT	X/✓
Manual without load ports	
Robot unit	
Pre-aligner	
1 load port for 300 mm FOUPs/FOSBs SEMI-standard	
1 load port for open cassette SEMI-standard	
> for 150 mm (6 inch) wafers	
> for 200 mm (8 inch) wafers	
> for 300 mm (12 inch) wafers	
RFID reader	
Vacuum end-effector	
Edge grip handling	
Handling of warped wafers (e.g. eWLB) and panels	
Non-contact wafer handling	
OCR reader (front/back)	
Ionizer bar	



EFEM ENCLOSURE	X/✓
ISO class 3 clean room conformal housing	
2 filter fan units, one for handling and one for inspection/metrology area	

FRT SOFTWARE	X/✓
Acquire Automation XT incl. one evaluation package + additional packages (if needed):	
> Defect Inspection	
> TTV, Bow, Warp	
> Bumps, Vias, Trenches	
> Critical Dimension, Overlay	
> Roughness, Waviness, Flatness	
> Step Height	
> Saw Marks	
> Film Thickness	
> Wafer Stress	
> Angle Evaluation	
> Nanotopography	
> Fine Alignment	
SECS/GEM interface (standard or customized)	
Analysis software Mark III	
Manual measurement software Acquire	

Talk to an expert!

Headquarter

FRT GmbH

+49 2204 84-2430
+49 2204 84-2431
info@frt-gmbh.com

FRT Shanghai Co., Ltd.

+86 21 3876 0907
+86 21 3876 0917
info@frt-china.cn

FRT of America, LLC (West)

+1 408 261 2632
+1 408 261 1173
info@frtofamerica.com



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www.frtmetrology.com

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