CONFIGURE YOUR MicroProf® AP

FILM THICKNESS / LAYER STACK
- Measurement of transparent layers and top layers

CRITICAL DIMENSION
- Measurement of critical dimensions of features

OVERLAY
- Measurement of overlay parameters such as height and rotation

WAFER THICKNESS / IR
- Inspection of defects

TOPOGRAPHY
- Topography measurement on the surfaces and on the tops and bottoms

DEFECT INSPECTION
- Bumps / Coplanarity

BUMP LAYER
- Wafer thickness (IR)

TOPOGRAPHY (TOP/BOTTOM)
- Critical dimension overlay

STEP HEIGHT / WIDTH
- Step height/width measurement

HYBRID TECHNOLOGY
- Wafer taper measurement

TOPOGRAPHY
- Measurement of topography

ROUGHNESS / WAVINESS
- Measurement of surface roughness and waviness on bare and structured wafers

STRESS
- Measurement of wafer stress e.g. wafer, bump, and coplanarity

WAVER THICKNESS / TTV
- Film thickness sensor CWL FT / IRT

SAMPLE THICKNESS / TTV
- Film thickness sensor CWL FT / IRT

DEFECT INSPECTION
- Film thickness sensor CWL FT / IRT

STEP HEIGHT / WIDTH
- Step height/width measurement

HYBRID TECHNOLOGY
- Wafer taper measurement

TOPOGRAPHY
- Measurement of topography

ROUGHNESS / WAVINESS
- Measurement of surface roughness and waviness on bare and structured wafers

STRESS
- Measurement of wafer stress e.g. wafer, bump, and coplanarity

WAVER HANDLING UNIT
- Film thickness sensor CWL FT / IRT

WEAR HANDLING UNIT X / Y
- Film thickness sensor CWL FT / IRT

NANOTOPOGRAPHY
- SEM-compliant measurement of wafer surface

THERMAL LOAD
- Taper parameter measurement

Hybrid metrology
- Wafer taper measurement

...
**FULLY AUTOMATED Wafer METROLOGY FOR ADVANCED PACKAGING**

As wafer level packaging (WLP) and heterogeneous inte-
mation progresses, it becomes more evident to meet the needs. The addition of 2.5D and 3D heterogeneous inte-
mation, and with it creative technologies, challenges the device industry. This tool offers fully automated wafer metrology for a range of applications at different 3D packaging steps, e.g. for the measurement of photonics (PP) coatings and structuring, through silicon vias (TSV) or trenches after etching, µ-bumps. The dawn of fan-out (FO) processes both at the wafer and also for transparent materials. Furthermore it can be used for hybrid bonding and Micro Electro Mechanical Systems (MEMS), included in consumer electronics, automotive, telecom, medical and industrial markets. MEMS are manufactured in processes similar to semi-
ciconductor production.

The core component is the world-wide established multi-sensor metrology tool MicroProf®. It allows both the measurement of wafers at different process steps and - by using a hybrid metrology concept - to enhance the precision of measurements on samples where a single sensor or measuring principle is not enough. Depending on the measuring task, these measure-
ments can be carried out with different topography and layer thickness sensors, which are fully automated by a single recipe. Controlled by software, developed in-house, these sensors act as one to combine automa-
tically different data and thereby generate new informa-
tion that is not directly accessible.

With a wafer handling system within an Equipment Automatic Hands-on tool (EFM) and almost maintenance-free hardware components, the MicroProf® AP provides high throughput and perfectly fits in any WLP 3D IC fab.

The measurement system of the MicroProf® AP is equipped with a granite base setup, with six three point sample fixtures or a vacuum chuck. Besides the standard configuration, the tool can be equipped with numerous additional features, which can also be retrofitted on site later. The MicroProf® AP enables for keeping pace with fast progress in advanced packaging.

It also provides comprehensive measurement solutions for backside processing (backgrinding, metallization) for power semiconductors such as MOSFET or IGBT, as well as for the control of different substrates, e.g. bulk Si, SOI, copper SQI compounds such as GaAs, InP, SiC, GaN, SiC and also for transparent materials. Furthermore it can be used for hybrid bonding and Micro Electro Mechanical Systems (MEMS), included in consumer electronics, automotive, telecom, medical and industrial markets. MEMS are manufactured in processes similar to semi-
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This tool is run by the SEMi-compliant Acutra Automation XT software. This software allows recipe based measure-
ment and data analysis of structured and unstructured wafers. Choose the suitable evaluation method and evaluation routine for your measuring task from a variety of packages. For recieving structures, a layout zipped with a graphical user inter-
face (GUI) can support the user in teaching the measuring positions. In addition, the sample alignment via pattern recognition is available.

This software provides comprehensive capabilities, from manual measurement on the device to fully automated mea-
surements with one-button operation and automation into production control sys-
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**POWERFUL RECIPES FOR EVERY PROCESS STEP**

**WAFER METROLOGY WITH AUTOMATED HANDLING**

The MicroProf® AP is designed for fully automated processing of 300 mm FLUCU, FSQBs and 300 mm/200 mm 150 mm open cavities. Also, the tool can be also configured for processing frame cos-
ses and handling of panels. The handling of parts is robust with effect-free, two load ports including mapper and RFID reader, pre-aligner and optional OCK reader stations. The system is able to handle SOI standard wafers, highly warped wafers (e.g. LULW), bonded wafers, wafers on tape, TAIKO, bare and thinned wafers and even CoWafer.

The EFM is equipped with filter units for FTU providing ISO class 5 clean room conditions within the tool. The system can be configured e.g. as a single 200 or 300 mm tool or as 200/300 mm bridge tool. Further options are thin wafer handling capability and an ionizer bar. For integration into the shop floor automa-
tion, the tool is equipped with a SECS/GEM data interface. Measurement tasks are then triggered by the host and the mea-
surement results are transferred automati-
cally to the fab control system.

**TYPICAL APPLICATIONS**

- PI and PR film thickness, PI and PR opening, CD and CDL
- TSV metrology, fill-monitoring, trenches
- void layer metal inspection
- plated Cu thickness
- resistors and uniformly coated COP
- UBM height and roughness
- RDL thickness, width and uniformity
- complement and enhance the performance of auto-
  mated bump inspection systems
- bump and via height, dim-
  ension and coplanarity
- lens and stress
- carrier, adhesive, bonded wafer thickness, and TSV
- final packaging topography and planarity
- validating orientation under thermal load
- wafer inspection
WAFER METROLOGY WITH AUTOMATED HANDLING

The MicroProf® AP is designed for fully automated processing of 300 mm FLCU/PFCUs and 300 mm/200 mm/150 mm open configuration tools. The tool can also be configured for processing frame setups and handling of panels. The handling part features a robust and efficient tool which can be extended to a high-end automatic processing of panels, etching a high demands to the tool's performance.

The MicroProf® AP enables for the measurement of wafers, carriers, and carriers in different process steps 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. Depending on the measuring task, these measurement tasks can be handled by different sensors or a combination of sensors. The MicroProf® AP is equipped with different sensors to run consecutively within a measurement sequence. Measurements tasks are then triggered by the host and the measurement results are transferred automatically to the fab control system.

The tool is run by the SEMI-compliant Automet Acometer XT software. This software allows remote measurement and data analysis and enables the tool to control the process of wafer processing. The tool can also be configured for processing frame setups and handling of panels. The handling part features a robust and efficient tool which can be extended to a high-end automatic processing of panels, etching a high demands to the tool's performance.

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FULLY AUTOMATED WAFER METROLOGY FOR ADVANCED PACKAGING

As wafer level packaging (WLP) and heterogeneous integration (HI) approaches gain more relevance, metrology processes begin to creep into back-end process control, where measurement becomes trickier and more diverse. The demand of fan-out (FoCuS) processes both at the wafer and the die level adds more diversity to metrology needs. The addition of 2D and 3D heterogeneous integration, and now chiplet technologies further expand the diversity of applications. PRT offers integrated solutions for these challenging tasks. We are able to accommodate measurement requirements for the most advanced processes and to handle wafers and panels, thinned and bonded wafers, and also film frames.

The MicroProf® AP is a fully automated wafer metrology tool for a wide range of applications at different 3D packaging process steps, e.g. for the measurement of photostitch (PR) coatings and structuring, through silicon via (TSV) or trenches as etching, bump and Cu pillars, as well as for the measurement in thinning, bonding and stacking processes. With its multi-sensor concept, the flexible and universally usable MicroProf® AP measurement tool is ideally suited to perform a variety of metrology tasks in advanced packaging.

It also provides comprehensive measurement solutions for backside processing (backgrinding, metallization) for power semiconductor systems such as MOSFET or IGBT, as well as for the control of different substrates, e.g. bulk Si, SOI, cavity SOI compounds such as GaAs, InP, SiC, GaN, ZnO, and also for transparent materials. Furthermore it can be used for hybrid bonding and Micro Electro Mechanical Systems (MEMS), included in consumer electronics, automotive, telecom, medical and industrial markets. MEMS are manufactured in processes similar to semiconductor production.

The core component is the worldwide established multi-sensor metrology tool MicroProf® 300. It utilizes both the measurement of wafers at different process steps 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. Depending on the measuring task, these measurements can be carried out with different topography and layer thickness sensors, which are fully automated by a single recipe. Controlled by software, developed in-house, these sensors act as to combine automatically different data and thereby generate new information that is not directly accessible.

With a wafer handling system within an Equipment Front End Module (EFEM) and almost maintenance-free hardware components, the MicroProf® AP provides high throughput and perfect fit in any HVM 3D IC fab.

The measurement system of the MicroProf® AP is equipped with a granite base setup, with three point sample fixture or a vacuum chuck. Besides the standard configuration, the tool can be equipped with numerous additional features, which can also be retrofitted on site later. The MicroProf® AP enables for keeping pace with fast progress in advanced packaging.

WAFER METROLOGY WITH AUTOMATED HANDLING

The MicroProf® AP is designed for fully automated processing of 300 mm FC/ECO, FC/FZ and 300 mm 200 mm 250 mm open cavity wafers. In addition, the tool can also be configured for processing frame cassette and handling of panels. The handling part features a robot with end-effectors, two load ports including mopper and RFID reader, pre-aligner and optional OCK reader stations. The system is able to handle Si-only standard wafers, highly warped wafers (e.g. GLW), bonded wafers, wafers on tape, TAIKO, bare and thinned wafers and even-heat OCP wafers.

The EFEM is equipped with filter units for particle-free ISO class 5 clean-room conditions on the tool. The system can be configured e.g. as 8 x 250 or 300 mm load port as in 100 or 200 mm single bridge tool. Further options are thin wafer handling capability and an ionizer bar. 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 RECIPES FOR EVERY PROCESS STEP

The tool is run by the SEMI-compliant Acquis Automation XML 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 recieving structures, a layout wizard with a graphical user interface (GUI) can support the user in teaching the measuring positions. In addition, the tool allows one to view and analyze the relevant inspection results.

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 within a measurement sequence. This includes the execution of measurement, 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.
## META-MEASUREMENT FOR ADVANCED PACKAGING

### FRT Metrology for Advanced Packaging

**MicroProf® AP**

**Product Highlights**
- Flexible multi-sensor metrology for every process step
- Advanced packaging metrology
- Single or multi-sensor metrology

**Capabilities**
- **Metrology Unit**
- **WAFER HANDLING UNIT**
- **Wafer Inspection**
- **Software**

**Metrology Unit**

<table>
<thead>
<tr>
<th>Sensor</th>
<th>XMM</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
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<td>XMM</td>
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**WAFER HANDLING UNIT**

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<td><strong>Roll-off Amount</strong></td>
<td>Handling of warped wafers (e.g. eWLB) and panels</td>
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<tr>
<td><strong>Non-Contact Wafer Handling</strong></td>
<td>Acquire Automation XT</td>
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</tbody>
</table>

**Wafer Inspection**

- **Defect Inspection**
- **Surface Topography**
- **Film Thickness and Layer Stack**
- **Critical DimensionOverlay**
- **Step Height/Width**
- **Roughness/Waviness**
- **Flatness**
- **Bumps/Co-planarity**

**Software**

- **Acquire**
  - Manual measurement software (standard or customized)
  - SECS/GEM interface
  - Fine Alignment
  - Angle Evaluation
  - Nanotopography
  - Fine Alignment

FRT reserves the right to change technical specifications. 03/2019