



# METROLOGY for Semiconductor Manufacturing

**FRT GmbH**

[www.frtmetrology.com](http://www.frtmetrology.com)

# MicroProf® Series

manual operation or fully automated metrology



MicroProf® 300

MicroProf® MHU

MicroProf® FE

MicroProf® AP

identical technology – easy process transfer R&D → production

# Tool platform example

All-in-one device due to unique multi sensor philosophy



1. WLI PL (white light interferometer)
2. CWL 600  $\mu\text{m}$  (point sensor)
3. FTR (reflectometer layer thickness)
4. CWL FT (layer thickness sensor)
5. CWL 1 mm (point sensor)
6. High-resolution camera with pattern recognition
7. CFM DT (combi-sensor white light interferometer with 7x turret)
8. CFM DT (combi-sensor confocal microscope with 7x turret)
9. CWL 600  $\mu\text{m}$  (TTV point sensor), underside
10. FTR (reflectometer layer thickness), underside

**Fully automated multi sensor and hybrid metrology arrangement – 10 sensors, 1 recipe**

## measurement of

semiconductors Si, Ge,...

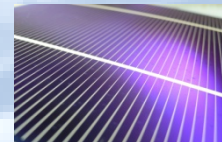
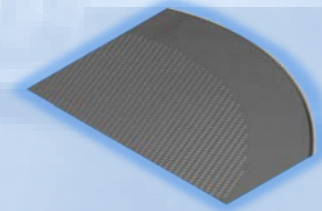
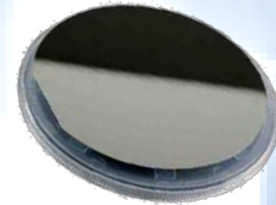
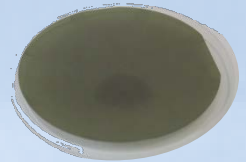
compound semiconductors GaAs, InP, SiC, GaN, ZnO...

special substrates LiNbO<sub>3</sub>, DLC,...

sapphire and glass wafer

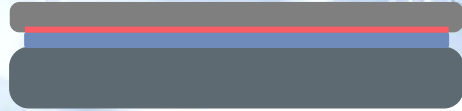
solar / PV mono-/poly-crystalline and amorphous Si

lens wafers

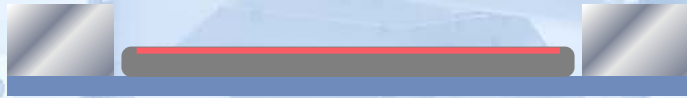


**solutions for all materials**

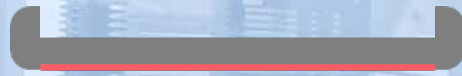
automated handling of



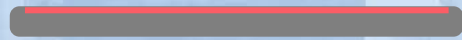
bonded wafers /wafer stack



wafer on tape in frame



Taiko wafer



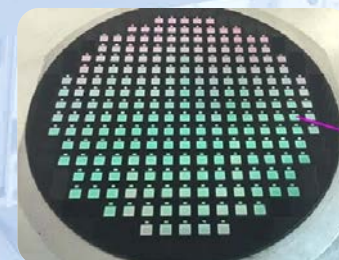
bare and  
thinned wafer  $> 50 \mu\text{m}$



SOI wafer



FO wafer



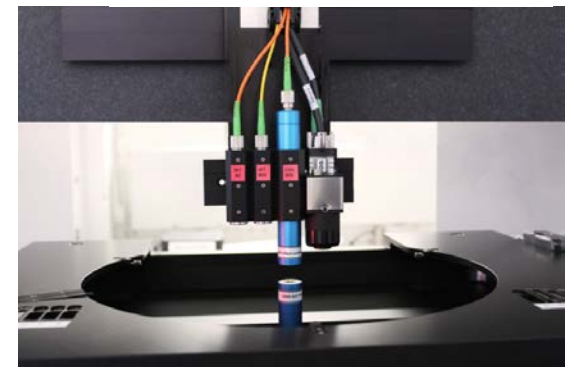
**solutions for all wafer types**

*photographs courtesy of DISCO HiTEC EUROPE GmbH, mechatronic systemtechnik gmbh and researchgate.net*



## wafer metrology tool for Advanced Packaging

- 300 mm wafer stage
- multi sensor configuration
- hybrid metrology
- simultaneous measurement on both wafer sides
- multiple applications
- fully automated handling and integration
- fast and accurate measurement
- high repeatability and reproducibility
- fully SEMI compliant



wafer metrology tool for Advanced Packaging

## Applications in Advanced Packaging

Trenches

Metal Contacts

TSV

Photo Resist

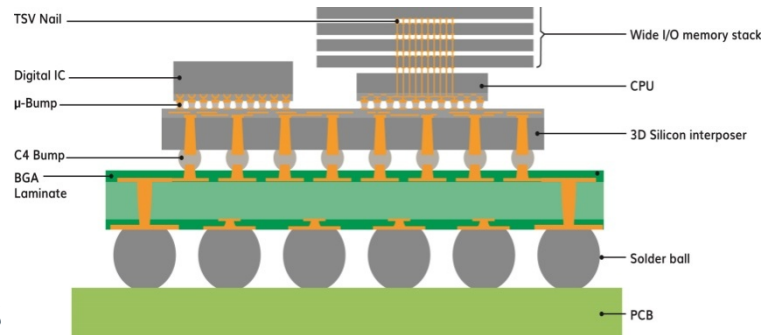
Interposer

RDL / UBM

Bumps /  $\mu$ -Bumps

BGA

Reflow soldering



Thin film measurement

Step height / width

Bump analysis

TSV / trench depth / width

CD / Overlay

T-dependent topography

Stress

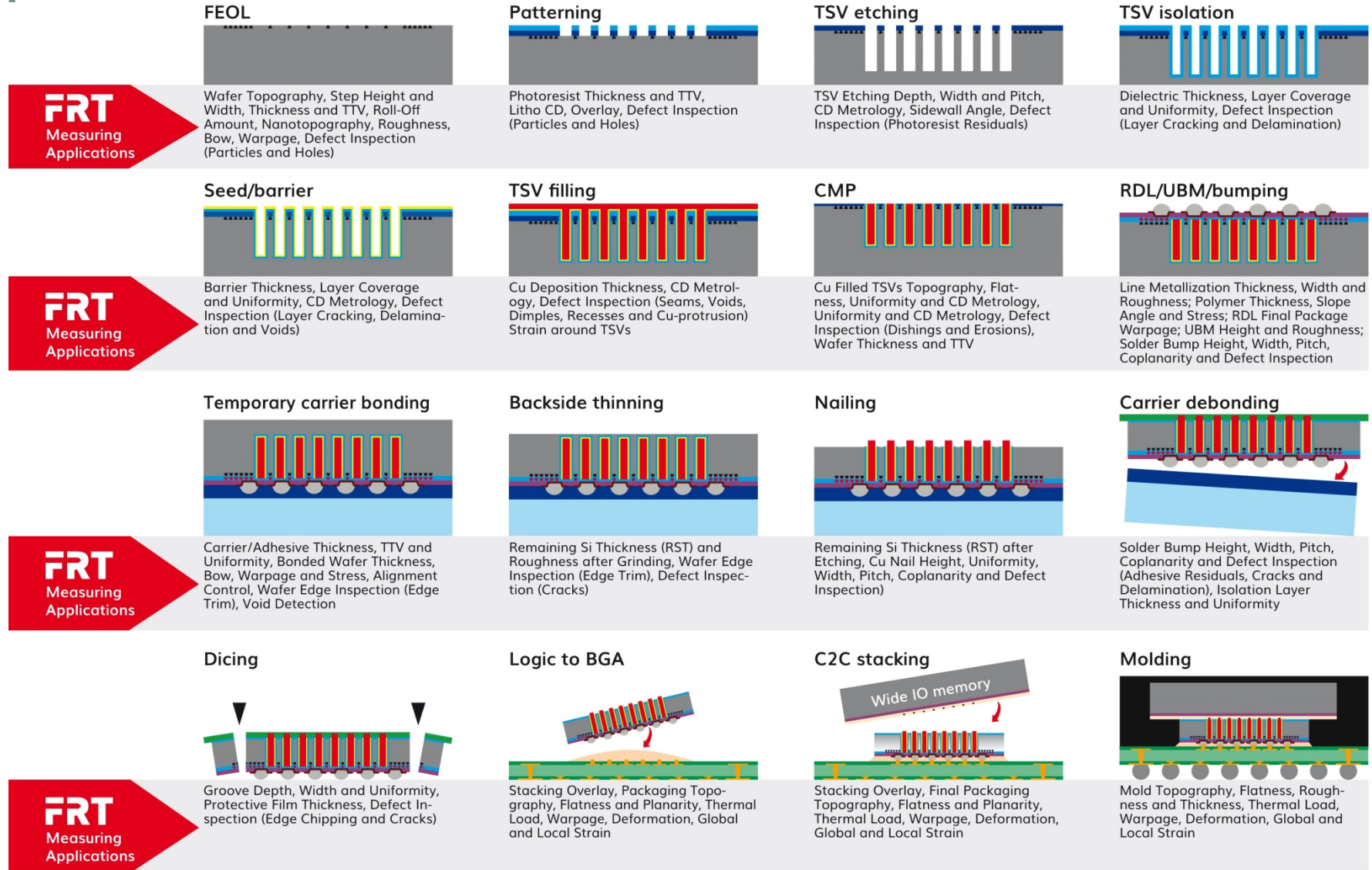
Bulk thickness

Backgrinding

multiple measurement applications in one tool

# 2.5D/3D IC Packaging

## process flow





## metrology applications for Advanced Packaging

- PI and PR film thickness, PI and PR opening
- CD and overlay
- TSV metrology, fill monitoring, trenches
- seed layer metal inspection
- plated Cu thickness
- flatness and uniformity after CMP
- UBM height and roughness
- RDL thickness, width and roughness
- bump and nail height, diameter and coplanarity
- bow and stress
- carrier, adhesive, bonded wafer thickness, and TTV
- final packaging topography and planarity
- stacking deformation after thermal load
- mold inspection



## Pros and Cons

- **People:** nice, good fit, reliable
- **Budgets:** like electrons, you never know where they really are
- **Regulations, sanctions, export, customs:** becoming a real problem
- **Market size:** small but existing
- **Political situation:** difficult from all sides, “normal” people can not really understand whats going on
- **FRTs benefits to Russia:** German, top notch technology, Russia friendly, nice people, good support, reliable
- **Music:** Cologne music sounds familiar to or Russian visitors ;-)

... Polka, Polka, Polka, vom Rhin bis an die Wolga,

Polka, Polka, Polka, der Pitter und die Olga...

(Brings)



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# **THANK YOU FOR YOUR ATTENTION**