

Surface Metrology for Advanced Packaging Applications

FRT GmbH a FORMFACTOR company www.frtmetrology.com

November 17, 2020



FRT – the art of metrologyTM

Art – that is the interaction of craft, knowledge, experience, creativity and passion.

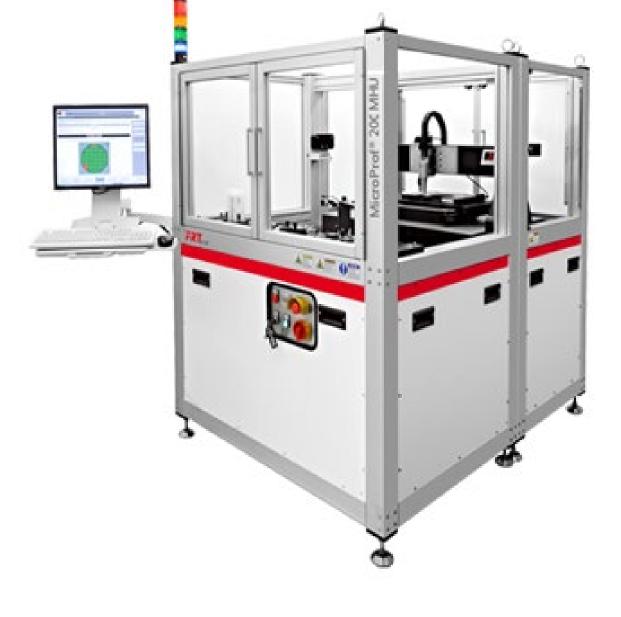
- Optical 3D surface metrology
- Measurement of roughness, topography, layer thickness etc.
- Defect Inspection
- Multi-sensor technology
- Modular hardware configuration
- Fast and accurate measurement
- High repeatability and reproducibility
- In-house sensor development
- In-house software development
- Contract measurements





MicroProf® Series









MicroProf® 300 MicroProf® MHU MicroProf® FE MicroProf® AP



Contact free measurement

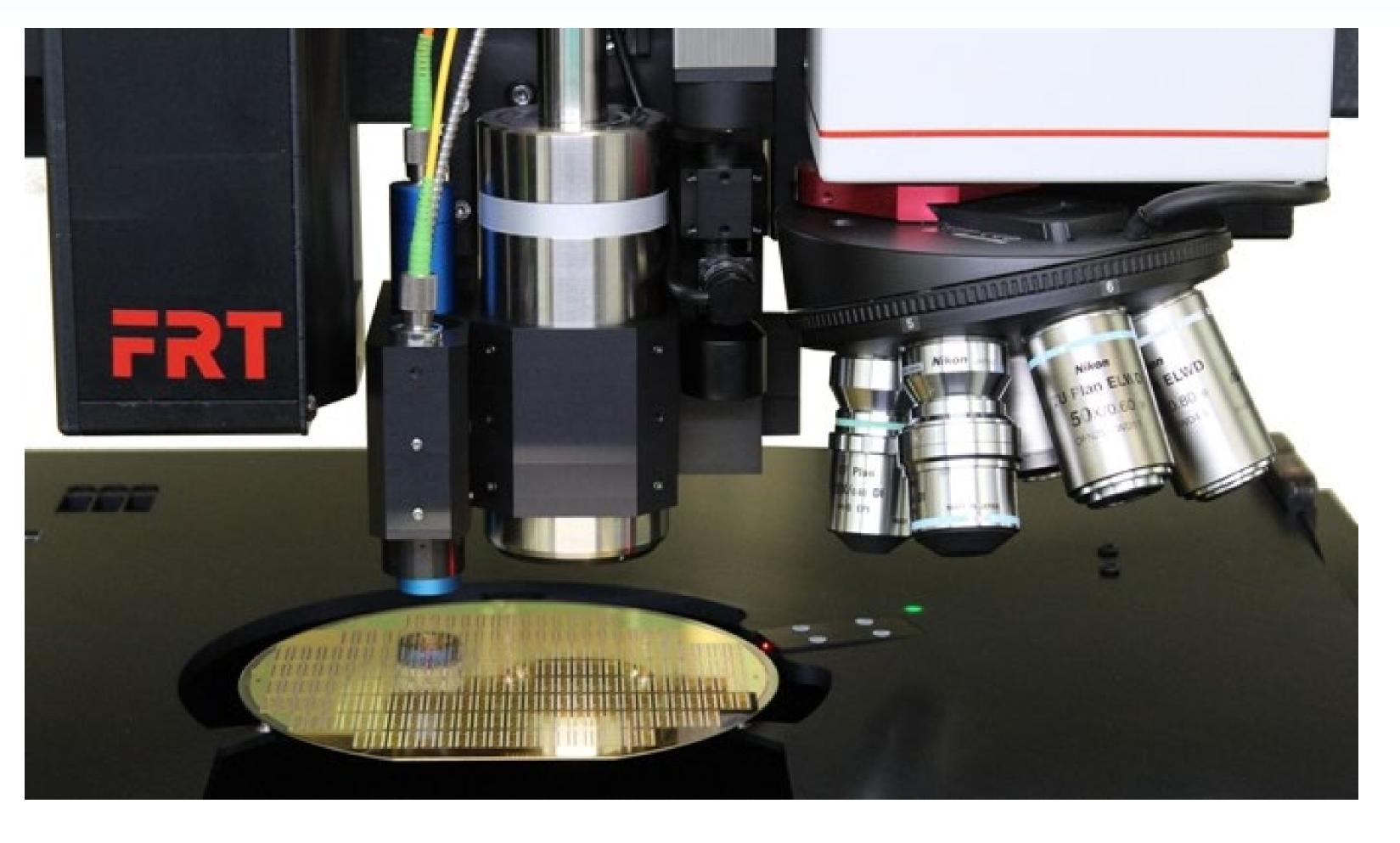
compact — multi-sensor — modular — standardized





Contact free measurement

compact – multi-sensor – modular – standardized



An example of multi sensor configuration including topography point sensors, field of view and film thickness sensors



MicroProf® AP

wafer metrology tool for Advanced Packaging

Applications in Advanced Packaging

Trenches

Metal Contacts

TSV

Photo Resist

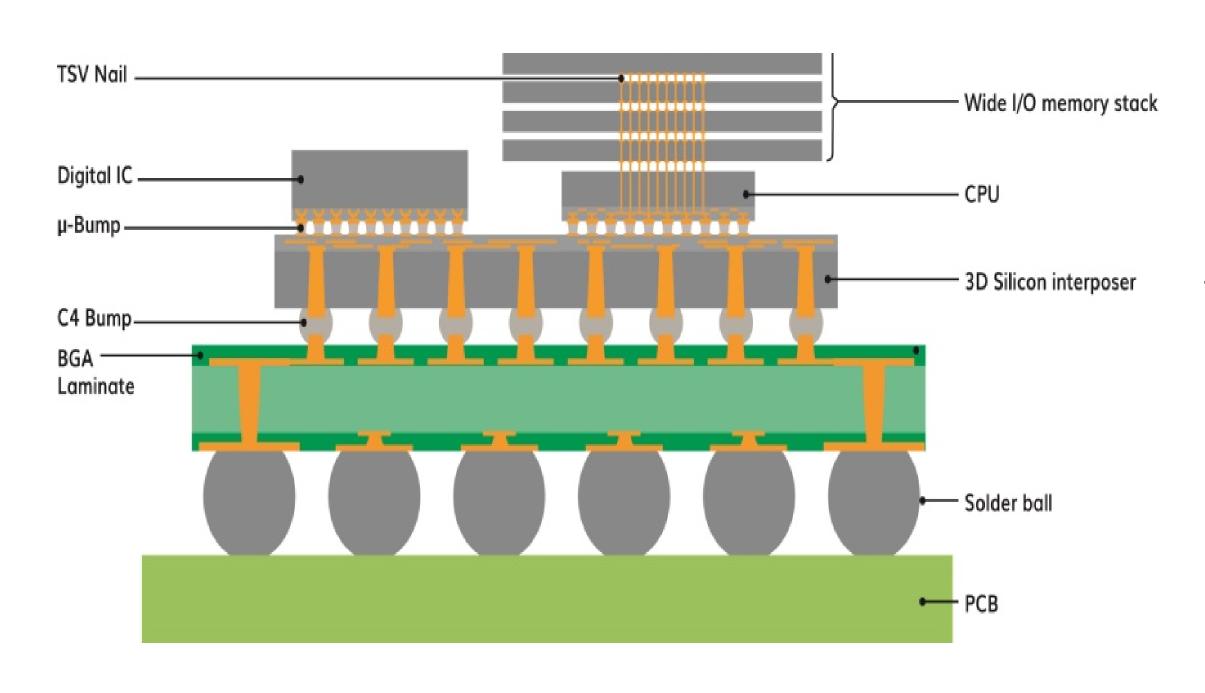
Interposer

RDL / UBM

Bumps / μ-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

FRT Measuring Applications

FRT

FRT

Measuring

Applications

Measuring

Applications

Wafer Topography, Step Height and Width, Thickness and TTV, Roll-Off Amount, Nanotopography, Roughness, Bow, Warpage, Defect Inspection (Particles and Holes)

Patterning

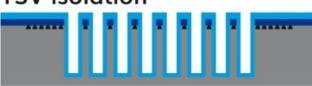


Photoresist Thickness and TTV, Litho CD, Overlay, Defect Inspection (Particles and Holes)



TSV Etching Depth, Width and Pitch, CD Metrology, Sidewall Angle, Defect Inspection (Photoresist Residuals)

TSV isolation



Dielectric Thickness, Layer Coverage and Uniformity, Defect Inspection (Layer Cracking and Delamination)

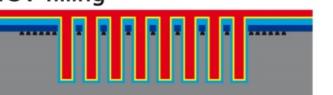
Seed/barrier

FEOL



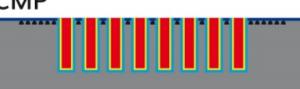
Barrier Thickness, Layer Coverage and Uniformity, CD Metrology, Defect Inspection (Layer Cracking, Delamination and Voids)

TSV filling



Cu Deposition Thickness, CD Metrology, Defect Inspection (Seams, Voids, Dimples, Recesses and Cu-protrusion) Strain around TSVs

CMP



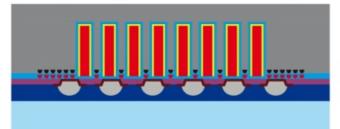
Cu Filled TSVs Topography, Flatness, Uniformity and CD Metrology, Uniformity and CD Metrology, Defect Inspection (Dishings and Erosions), Wafer Thickness and TTV

RDL/UBM/bumping



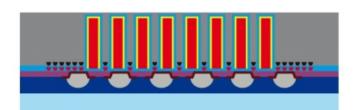
Line Metallization Thickness, Width and Roughness; Polymer Thickness, Slope Angle and Stress; RDL Final Package Warpage; UBM Height and Roughness; Solder Bump Height, Width, Pitch, Coplanarity and Defect Inspection

Temporary carrier bonding



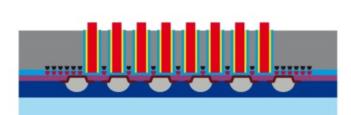
Carrier/Adhesive Thickness, TTV and Uniformity, Bonded Wafer Thickness, Bow, Warpage and Stress, Alignment Control, Wafer Edge Inspection (Edge Trim), Void Detection

Backside thinning



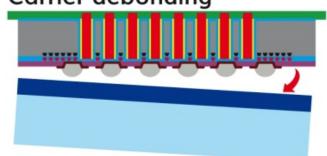
Remaining Si Thickness (RST) and Roughness after Grinding, Wafer Edge Inspection (Edge Trim), Defect Inspection (Cracks)

Nailing



Remaining Si Thickness (RST) after Etching, Cu Nail Height, Uniformity, Width, Pitch, Coplanarity and Defect Inspection)

Carrier debonding



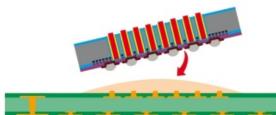
Solder Bump Height, Width, Pitch, Coplanarity and Defect Inspection (Adhesive Residuals, Cracks and Delamination), Isolation Layer Thickness and Uniformity

Dicing



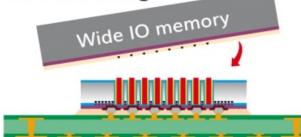
Groove Depth, Width and Uniformity, Protective Film Thickness, Defect Inspection (Edge Chipping and Cracks)

Logic to BGA



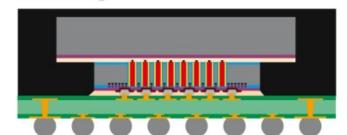
Stacking Overlay, Packaging Topography, Flatness and Planarity, Thermal Load, Warpage, Deformation, Global and Local Strain

C2C stacking



Stacking Overlay, Final Packaging Topography, Flatness and Planarity, Thermal Load, Warpage, Deformation, Global and Local Strain

Molding



Mold Topography, Flatness, Roughness and Thickness, Thermal Load, Warpage, Deformation, Global and Local Strain



MicroProf® DI

Inspection and metrology in one flexible tool

TYPICAL APPLICATIONS

- bare wafer inspection (e.g. particles, holes, pits, micro scratches, micro roughness, growth defects, inclusions)
- layer defects (e.g. par-ticles, holes, layer crack-ing, 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)





THANK YOU