Semiconductor Metrology Applications

ContourGT-X Platform Capabilities and Automation for Semiconductor Applications
Outline

- Introduction
- Brief BNS – SOM General Overview
- Semiconductor Applications
- Automation Cassette/Wafer Loading
- Summary and Questions
• History of QA/QC solutions for industry
  ▪ **Semiconductor**
    100+ Installed base multi-chip module inspection at board level
  ▪ **Data Storage**
    500+ Installed base disk drive slider metrology
  ▪ **Electronics and Industrial**
    1000+ Installed base
  ▪ **Worldwide**
    10,000+ Installed base

• **Manufacturing Excellence**
  ▪ Lean, six sigma-based process
  ▪ 100+ systems/quarter capacity
  ▪ Rapid production ramp capability
3D Microscope Surface Metrology
General Benefits of Core Technology

- Fast, accurate, GR&R capable metrology
- Non-contact, non-destructive
- 1000+ analysis parameters
- Stable and operator independent data
Bruker Stylus and Optical Metrology

Our Products Broad Overview

- DektakXT
- ContourGT-K
- ContourGT-X
- ContourGT-IM
- NPFLEX
- NPFLEX-LA
- SP9900+
- ContourGT Auto-Ready
Bruker DektakXT Stylus Profilers

*Industrial Standard for Films and Steps*

- **Dektak Reputation:** Field proven performance, ease of use and reliability
- **Dektak Experience:** 44+ year history in stylus profiler technology with over 10,000 installed systems world wide
- **Dektak Service & Support:** Regional call centers world wide for prompt, local support network

Dektak Stylus Profilers

*Over Four Decades of Innovation*

1966 Dektak 1
First Stylus Profiler for Thin Film Measurement

1981 Dektak IA
First Micro-Processor Based Profiler

1985 Dektak 3001
First Profiler for 100mm Wafers

1989 Dektak 8000
First Profiler with 3D-Capability

1991 Dektak 3
First Micrometer-Based Profiler

1997 Dektak 1000
First Automated 100mm Profiler

2002 Dektak 3000
First Profiler with Video 3D Analysis

2006 Dektak 6000
First Profiler with Video 3D Analysis

2011 Dektak XT
First Profiler with 64-Ch. Parallel Processing, True Hi-Color Camera, Single-Scan Design

Dektak 150
Industry’s Best Performance and Sample Flexibility
ContourGT-X Platform Detail
Stable, Accurate, Automation Ready

- Optical Metrology Module (OMM) with self-calibration on X8
- Programmable 8” or 12” Stage
- Automated Tip-Tilt in the head (+/- 6 degrees)
- Automated Z-Axis Focus
- Single Objective Adapter up to 5-Position Automated Turret

- Dell Multi-Core PC Running Windows 7, 64 Bit Platform
- Vision64 Operation Software – advanced
- Single 23” Monitor with 1920x1080 resolution
- Operator Assist Sample Lamp
- Small Footprint Option with Automation Ready Package
- Integrated Isolation Table
3D Optical Microscopes
WLI – Accurate, Fast, GR&R Ready!

WLI measures the intensity at each pixel as the objective is moving vertically and analyzes the intensity while moving through focus to determine the height of the surface at each pixel.
Apply Benefits to Industry Problems
Semiconductor Applications

- Broad range of applications including
  - Laser probe mark depth
  - Sensor dimensions and frequency performance (MEMS, DMEMS)
  - Cu wire bonding (bond force optimization, near line inspection)
  - Multichip Module HDI production inspection
  - Others (see next slides)
Probe Mark Solution

Auto Detect Deepest Point

Auto filter removes higher level from the reference area
Auto filter removes lower level from the reference
Wafer Roughness
3D Areal Measurement – Large Area, FAST!

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<th>Value</th>
<th>Units</th>
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<td>Sdq</td>
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Sa: 3.258 nm
Deposition, Etch, Probe Marks

Fast, accurate dimensions – non-contact!
Lead Frame Surfaces
Roughness and 3D Areal Parameters

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<tr>
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<th>Value</th>
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<td>\mu m</td>
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<tr>
<td>Sz</td>
<td>3.279</td>
<td>\mu m</td>
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Roughness and Sdr Uniformity:
Lead vs. Die Area – Roughness alone not enough to tell the story

Leadframe A vs. B: Average Roughness

Leadframe A vs. B: Surface Area Ratio

Die B – Sdr different even though Sa is the same
Die Attach
Height and Tilt Referenced to Lead Frame
Software auto detects features of interest – every time!
Vision64 Production Software Module
Operator interface enables simplified use

Wire bond metrology automation

Description
Bond depth of wire bond pads.

User Fields
Lot Number: B
Operator ID: Tom Stout
Panel ID: B

Measurement Status
Measurement: 1 of 1

Individual Measurements
Cu Wire Bonding Near Line Monitor
Cavity Depth and Ball Height Metrology
Wire Bond Near Line Monitor

3D Optical Microscope >5x Faster than industry standard methodology

![Bar Chart]

- **Bruker Optical Profiler**
  - Sample Preparation: 10 minutes
  - Measurement / Analysis: 0.25 minutes

- **SEM**
  - Sample Preparation: 40 minutes
  - Measurement / Analysis: 15 minutes

Legend:
- Blue: Sample Preparation (minutes)
- Pink: Measurement / Analysis (minutes)
Al Pad Metal Splash
Auto Detection and Analysis

Splash Analysis

Area of interest is identified by software

Highest peak and volume of Splash

<table>
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<tr>
<th>No</th>
<th>Region</th>
<th>Data Points</th>
<th>Rp% μm</th>
<th>Volume μm^3</th>
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<td>1.585</td>
<td>104.633</td>
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<tr>
<td>2</td>
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<td>2921.000</td>
<td>1.502</td>
<td>121.827</td>
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</table>

Avg: 2677.00  1.5434  113.230
Std: 244.00   0.0419   8.597
Skewness: 0.00  0.0000  0.000
Max: 2921.00  1.5853  121.827
Min: 2438.00  1.5016  104.633
Range: 486.00  0.0838  17.194
Al Pad Cavity Depth
Auto Detection and Analysis

Max Depth Analysis

Max depth below pad surface

<table>
<thead>
<tr>
<th>No</th>
<th>Region</th>
<th>Area mm²/mm</th>
<th>Full X Diameter μm</th>
<th>Full Y Diameter μm</th>
<th>Rv/μm</th>
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<td>1</td>
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<td>58.253</td>
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</table>

Avg: 0.002, Std: 0.000, Skewness: 0.000, Max: 0.002, Min: 0.002, Range: 0.000
Bruker 3D Optical Microscopes
Quality Characteristics

FAST

ACCURATE

REPEATABLE
Vision64 Stage Automation
Fast and simple operator setup

- XY Scatter and XY Grid functionality
- Wafer overlays clarify die positions and setup
- Grids are numbered and sub-grid (measure) locations are easily marked
- Variety of traversal patterns offered to customize motion
Programmable Staging
Wafer Grid and Within-Die Variable Points
**Cassette Loading Wafer Automation**  
*ContourGT-X Automation Ready Solution*

- TCP/IP interface
- Partner with CHAD Industries
- CHAD 200mm, 300mm systems provide front end interface
- SECS standard communication
- Bruker X8 data is transmitted to CHAD system
- Factory MES or SPC system seamlessly interacts with CHAD interface
Bruker BNS – SOM BU
Worldwide Presence - World Class Support
Overview of Two Year Roadmap
Semiconductor solutions

<table>
<thead>
<tr>
<th>System</th>
<th>2012</th>
<th>2013-2014</th>
<th>2015</th>
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<tbody>
<tr>
<td>Functionality</td>
<td>• Broad applications in Semi packaging/MCM</td>
<td>• MEMS/sensor metrology Color camera/defect inspect</td>
<td>• ISO Class 2 solution</td>
</tr>
<tr>
<td></td>
<td>• Partner for auto ready solution</td>
<td>• ISO Class 6 compatibility</td>
<td>• 450 mm auto loading</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Integrated defect inspection</td>
</tr>
<tr>
<td>Throughput</td>
<td>• Baseline</td>
<td>• 2x improvement via hardware/computational</td>
<td>• 5x over baseline</td>
</tr>
<tr>
<td>System S/W and Interface</td>
<td>• Vision64, 64 bit OS TCP/IP control via automation client or remote operation</td>
<td>• Streamlined software/GUI integration Enhanced Vision64 functionality</td>
<td>• Simplest, fastest Operator control SECS/GEM interfacing via full wafer handling or stand alone systems</td>
</tr>
</tbody>
</table>
SUMMARY

- Overview of product solutions

- Bruker serves a range of customers in the electronics and semiconductor spaces today

- ContourGT-X platform addresses with and without cassette loading several 3D metrology needs

- Automation solution is currently available and Bruker looks forward to serving your growing metrology needs
THANK YOU!!!
QUESTIONS?

Bruker Nano Surfaces

productinfo@bruker-nano.com
Matt.novak@bruker-nano.com

www.bruker.com