Implementing FDC in the Wafer Dicing Process to Improve Product Quality

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Henry Hsu, Joe Hung, Sophia Lin, Vincent DiFilippo
Rudolph Technologies
Agenda

• Introduction
• Wafer dicing issues and impact
• Kerf solutions approach
• FDC as a tool for monitoring the dicing process
• Correlation of FDC and kerf metrology
• Typical Use Case
• Identifying critical parameters
• Closing the loop with FDC monitoring
• Conclusion
A tool-based FDC system can collect extensive tool sensor data from a dicer saw, generate meaningful statistical data, and store these in a database.

This FDC data can then be correlated by lot and wafer to measured wafer metrology data.

Advanced statistical techniques can then be used to identify which tool signals most influence die chipping.

These signals can then be monitored by FDC models, completing the circle to improve product quality.
Wafer Dicing Issues and Impact

**Typical Process Issues...**

- **Side Wall Cracking**
  - Impact: Yields, Increased escape rates

- **Bridged Dies**
  - Impact: Process issues, Yield Impacts

- **Backside Chipping**
  - Impact: Yield, Escape rates

- **Front Side Delamination**
  - Impact: Yield, Increased escape rates

- **Layer Delamination**
  - Impact: Yield, Performance
Rudolph Kerf Solutions Overview
Multiple levels of SAW Analysis and Process Control

- Defect present verification
- Die disposition
- Reticle-based setup
- Same pass as 2D inspection

- Adv. metrology measurements
- Cut quality feedback
- Adv. die disposition
- Process monitoring
- Increased process understanding

All of the Kerf Metrology & …
- Dicer process monitoring
- Adv. FDC / Metrology correlations
- Ideal for process development
- OEE improvements
- Excursion root cause understanding
Rudolph KERF Solutions

KERF Metrology & SAW Process Control

Enabling SAW process control, yield improvements, and escape reduction!!

**SAW PROCESS**
- Process Monitoring
- Faster Process improvement
- Predictive Yields

**FDC PROCESS CONTROL**
- High speed data collection
- 100+ signals recorded
- Fleet Process Control

**INSPECTION / METROLOGY**
- 100% Inspection Control
- KERF Metrology
- Die Classification / Binning
- Escape Reduction

**DISCOVER ANALYSIS**
- Complete SAW Visibility
- Metrology to FDC correlation
- Process Improvements
- Closed Loop Correlation
Wafer Saw Process for Advanced Packaging

- Automated manufacturing reports
- Dynamic metrology and defect sampling
- Fleet management: tool matching and performance rating

Rudolph provides process control at advanced nodes.
What is FDC (Fault Detection and Classification)?

• Detects an abnormal status of the equipment or the process running on it.

• Monitors key parameters as defined by fab engineering (such as low chamber pressure or low RF reflected power)

• Identifies the detected failure, such as a leak in the chamber or a faulty RF power supply
  • Knowledge-based
  • Statistical

• Acts to alarm or shut the tool down prior to misprocessing
Higher Data Sampling = More Sensitivity

Current: 1 sec Frequency (SECS/GEM)

Spindle Current

Same process

High Speed Data (custom data interface)

Spindle Current
FDC Parameters

Kerf Chipping Width

Raw data of FDC parameters and inspection tool measurements of kerf width. Collected across a wafer, these data were collected separately on a dicer and an inspection tool then automatically aligned in the Discover database.
Typical Use Case…

Categorize wafers based on the metrology data

Split the FDC trace signals by the good/bad wafer data based on the metrology

Identify individual or combination of signals that drive chipping, then model it.

Monitor for future excursions

Dicer Saw

Process

Multiple Wafer runs

Inspection

Metrology

Discover

Genesis

Good Wafers

Bad Wafers

FDC Data Recorded

HVM Data

Real time model now monitors for excursions. Alarms go notify the host, e-mail, stop the tool, etc.
Identifying Critical Parameters – Visualization

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Align FDC and metrology data to generate statistics

THEN

correlate summary data against kerf metrology data using multivariate methods, such as PLS in the Genesis analysis package.
By using summarized data and our visualization tool, we can identify signal peaks correlated with a bad cutline.
FDC Monitoring

Key parameters can be monitored by user-created models:

- Real time monitoring
- SPC monitors
- Golden trace
- Multivariate monitors

Key Parameters

- CT and ST vacuum
- Spindle speed
- Blade exposure
- Water pressure
- Feed speed
- Air pressure
TO IMPROVE DIE QUALITY...

Align FDC and kerf metrology data to allow correlation of tool signals to kerf parameters.

Create FDC heuristic models to monitor newly identified process parameters for future excursions.

Monitor key dicer signals with FDC to reduce kerf chipping.
Thank you!

info@rudolphtech.com
www.rudolphtech.com