Integrated Automation Solution Driving Zero Yield Loss under Reticle Management

Presentation
KLA/RAPID
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02 Integrated Intelligent Automation Solution
   (SARC/Smart Task assignment & FA /RA)

03 Value Summary of Integrated Automation Solution
Reticle Quality Control in IC FAB

One defect on reticle impact all chips on the wafer and may kill hundreds of wafers!

Income Quality Control (IQC) and Re-qual (RQ) are essential steps to control mask quality.
Common Production Issue in the Controlling Process

**Quality**
Can we avoid defect missing in IQC and RQ process

**Throughput**
Can we improve throughput and reduce cycle time

**Risk Control**
Can we avoid mis-operation in transport, setup, review and disposition steps

**Cost Reduction**
Can we achieve cost reduction for the whole controlling process

Income Quality Control (IQC) and Re-qual (RQ) are essential steps to control mask quality.
Integrated Intelligent Automation Solution

1. Systematic auto recipe creation
   - How to avoid defect missing in IQC and RQ process

2. Smart task assignment and factory automation
   - How to improve the throughput & reduce the cycle time
   - How to avoid mis-operation in transport, setup, review and disposition steps

3. Intelligent disposition by Reticle Analyzer
   - How to finally achieve cost reduction for the whole controlling process

Integrated Intelligent Automation Solution

Reticle Analyzer

Systematic Auto Recipe Creation
Smart Task Assignment Factory Automation
Auto Defect Classification Progression Monitor Printability Review
Litho.
Systematic Auto Recipe Creation
MO prevention on setup and cycle time reduction

Traditionally, recipe can only be set up when mask is on tool

Manual Setup Issue: low sensitivity or false defect

Chip and die info from tape-out system

Test keys are used for tool specified calibration

Sensitivity templates are predefined by PDM

SARC (Systematic Auto Recipe Creation)
Smart task assignment & factory automation
ADC (Auto Defect Classification)
DPM (Defect Progressing Monitor)
LPR (Litho. Printability Review)
Smart Task Assignment and Factory Automation
Throughput improvement and MO prevention in transportation

- Smart task assignment is like Autopilot
- Multiple production mode – throughput first mode, cycle time first mode, etc.
- Integrate all tools to optimize production flow and improve production/management efficiency

1. Wafer tool Utilization raising 2~3%
2. Manpower reduce 60%
3. Cycle Time save 0.008 DPL
4. Mask production MO 0
5. Excursion 0
6. Mask inspection efficiency raising 20%

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Reticle Analyzer

Scheduling

1. APC
2. DOMA
3. Qtime
4. Season
5. Monitor
6. Constraint
7. Lot Size
8. Reticle
Intelligent Disposition by Reticle Analyzer
Ensure mask quality, control risk and reduce cycle time

Complex Design for Better Process Window vs Challenge on Defect Classification and Mask Disposition

Model Based OPC
ILT

“Yield Management in Sub-10nm Chip Manufacturing” SEMICON Japan 2015, Manufacturing Innovation Forum

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Smart task assignment & factory automation

ADC (Auto Defect Classification)

DPM (Defect Progressing Monitor)

LPR (Litho. Printability Review)

Integrated dispositioning:
- Automatic
- Fast
- Accurate
- Consistent → Prevents operator error

ADC x DPM x LPR = Final Code

"Hundreds of real defects! Show me only the ones that I should be worried about!"
Intelligent Disposition by Reticle Analyzer - ADC

MO prevention on review

Inspection Images → RDC → Analysis → Classification Code

- 1A: Contamination on clear
- 1B: Contamination on dark
- 1C: Pinhole

Classification Code

ADC Performance Through the Year

User Daily Loading

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Smart task assignment & factory automation

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Reticle Analyzer
Intelligent disposition by Reticle Analyzer – DPM

Risk control and efficiency improvement

Early warning for haze growth

Yield hit

Take action before yield hit

Early Warning

Risk control and efficiency improvement

Defect will be highlighted once it changes bigger

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Reticle Analyzer
Intelligent disposition by Reticle Analyzer – LPR

Risk control and cycle time reduction

Which Defect is severe?

Get the answer in minutes

SARC (Systematic Auto Recipe Creation)

Smart task assignment & factory automation

ADC (Auto Defect Classification)

DPM (Defect Progressing Monitor)

LPR (Litho. Printability Review)

Reticle Analyzer
Driving Zero Yield Loss with the Integrated Solution

- Improve throughput and reduce cycle time
- Work Loading Reduced

- Early-warning for Cost Reduction
- Accurate and Stable
- Shorten Cycle Time

*In which need additional Wafer Printing Check

Warning for haze growth on DPM

LPR Simulation Efficiency ≥ 90% on PDMs

LPR clearly failed this defect

Achieve cost reduction for the whole controlling process
Thanks for Your Attention