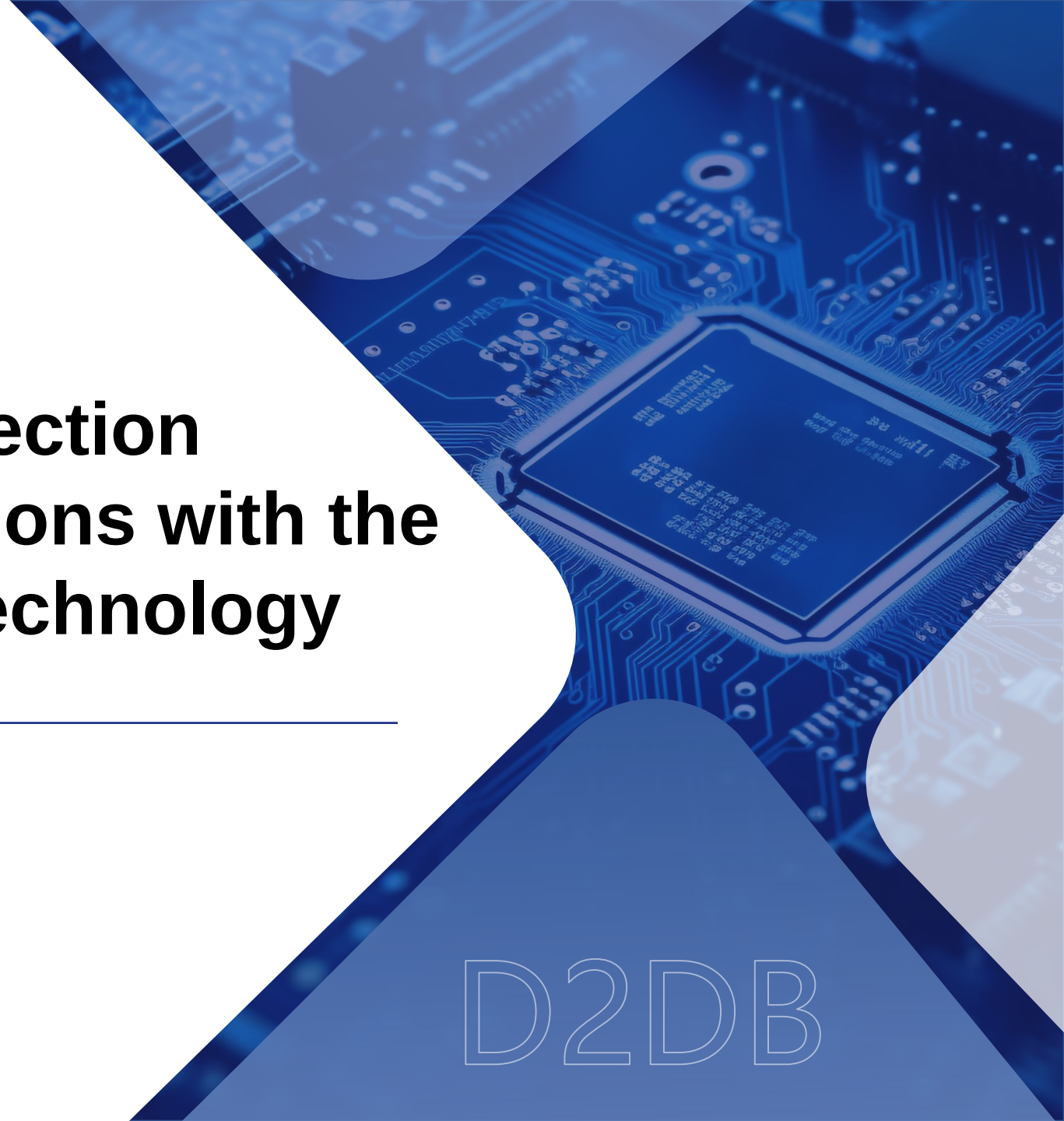


Extending DRSEM inspection capacities and Applications with the Introduction of D2DB Technology

HPO Center

Hao Yu

CONTENTS

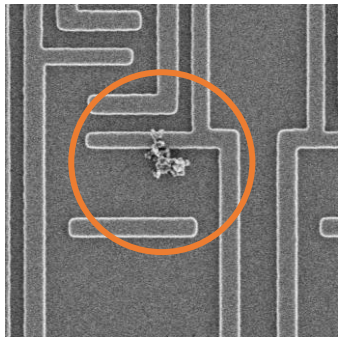
01

PART ONE

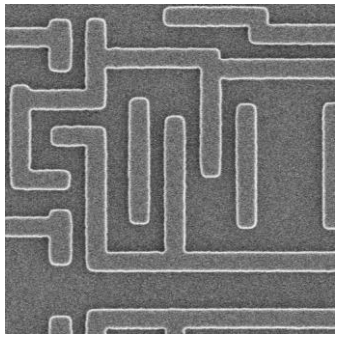
Overview

Challenge for Defect Review

DRSEM equipment advances should be accompanied by advanced defect detection algorithms.



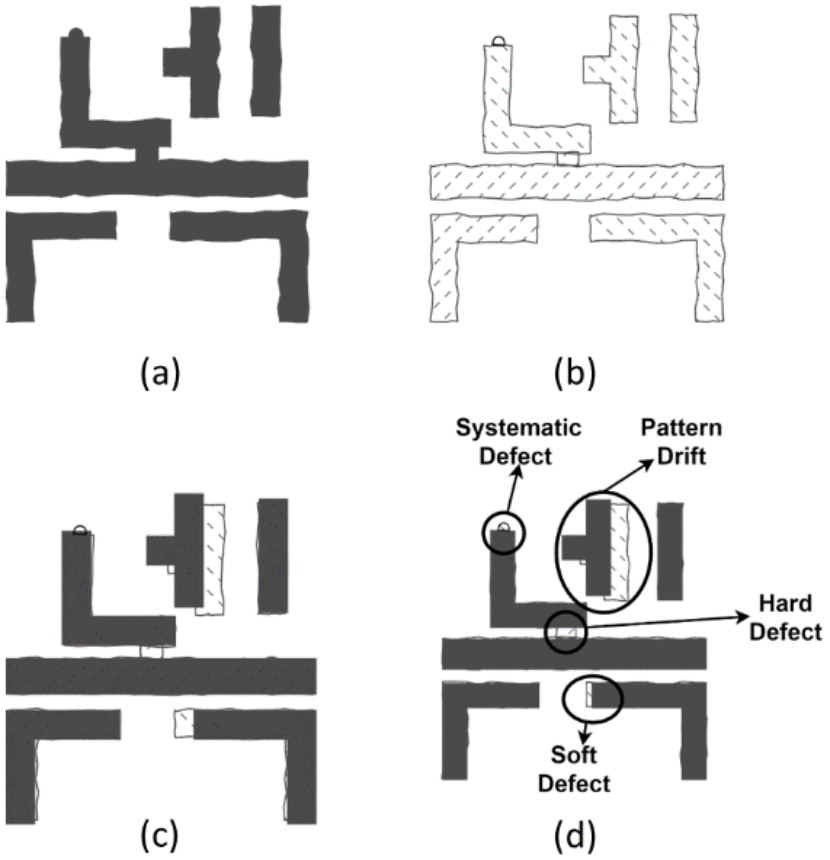
Defects that are easier to detect using traditional methods



Where is the defect?

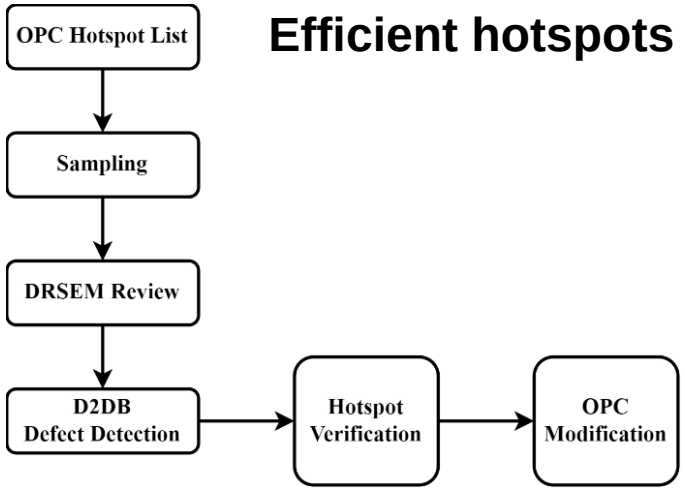
Advantages of D2DB Technology

Defect detectability enhancement

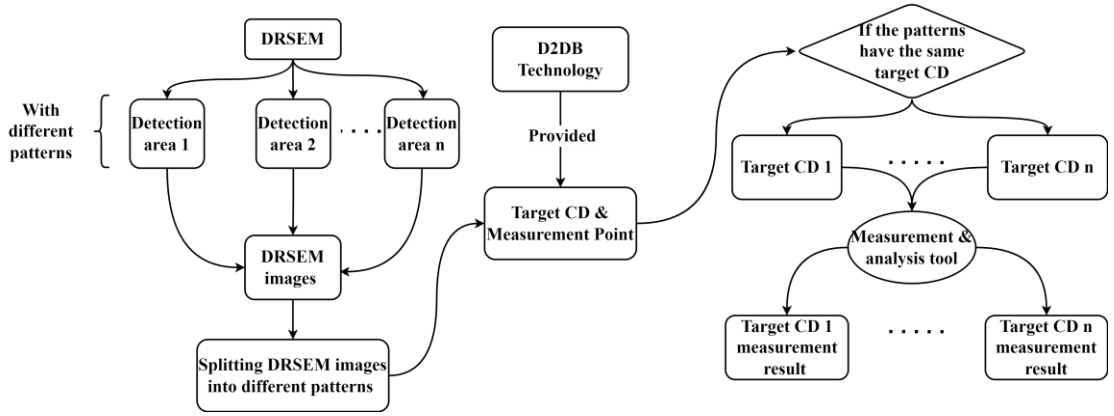


Application extension

Efficient hotspots verification



Long-term CD monitoring



02

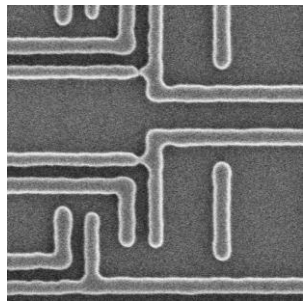
PART TWO

DJEL D2DB Workflow

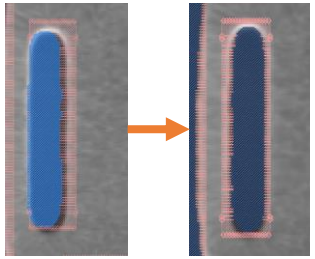
DJEL D2DB Workflow

This workflow has been validated on both test wafers and production wafers

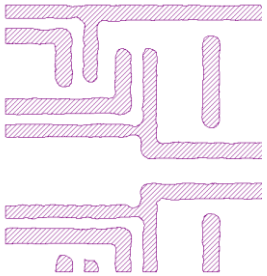
Image Acquisition



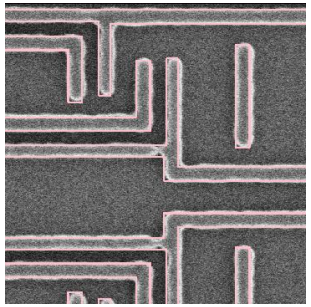
Data Pre-processing



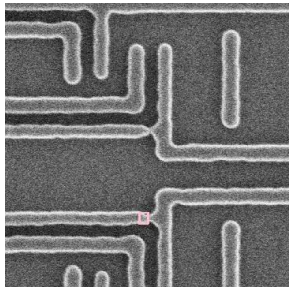
Contour Extraction



Alignment Image with Design

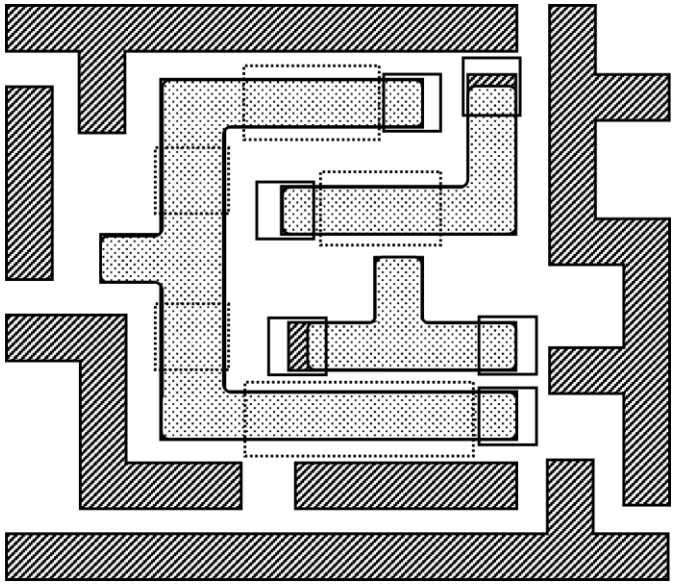


Defect Detection

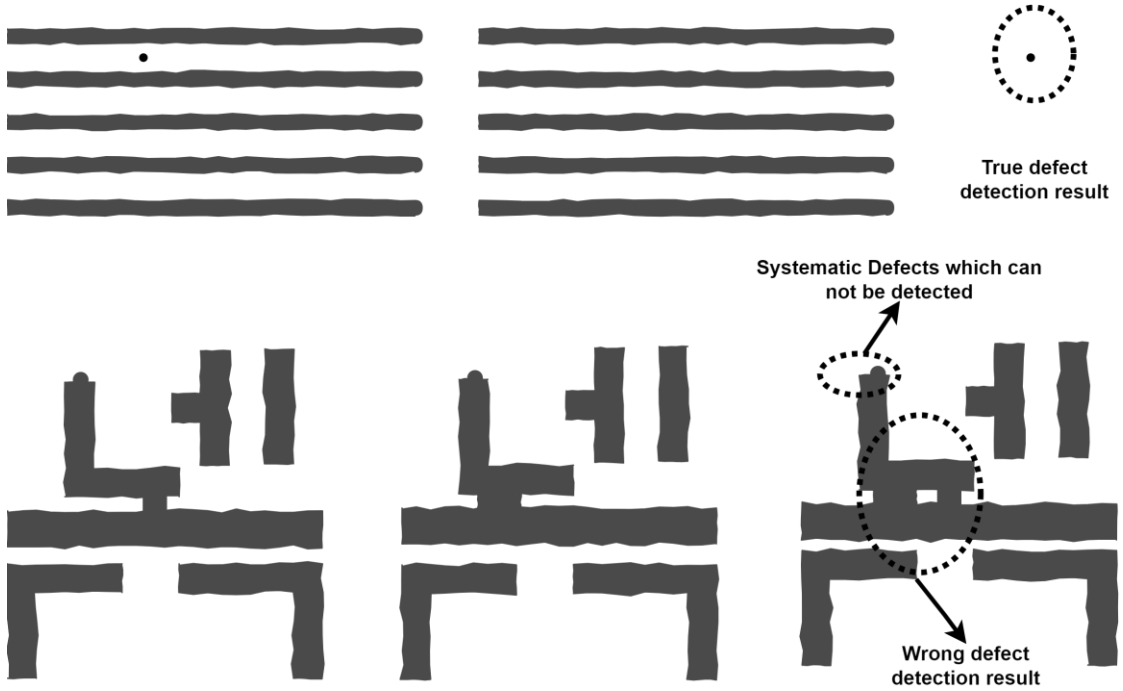


Detectability Enhancements

Using the design layout as a golden reference, even the tiniest EPE can be detected.

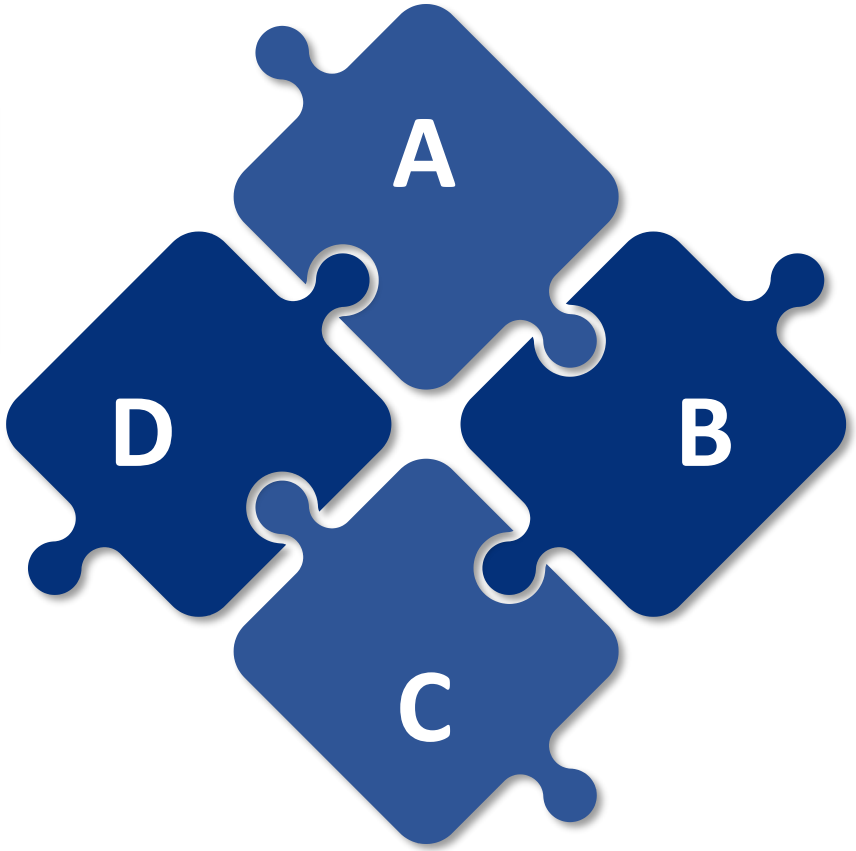


D2DB is able to detect defects repeated on dies and shoots, which are often missed by the D2D method.



DJEL D2DB Application Scenarios

A **Defect detection**



OPC hotspots verification B

D **Long-term CD monitoring**

DTCO optimization C

03

PART Three

Experiment Results

Experiment Design

A

Experimental Workflow

- Hotspot List Generation
- DRSEM Image Acquisition
- D2DB Defect Detection

B

Image Pre-Processing

- Image rotation and distortion correction for the DRSEM images

C

Defect Detectors

- Types:End/CD variation/pinch/bridge/complex pattern

Defect Detection Parameters

The table lists only a part of the criteria for defect detection.

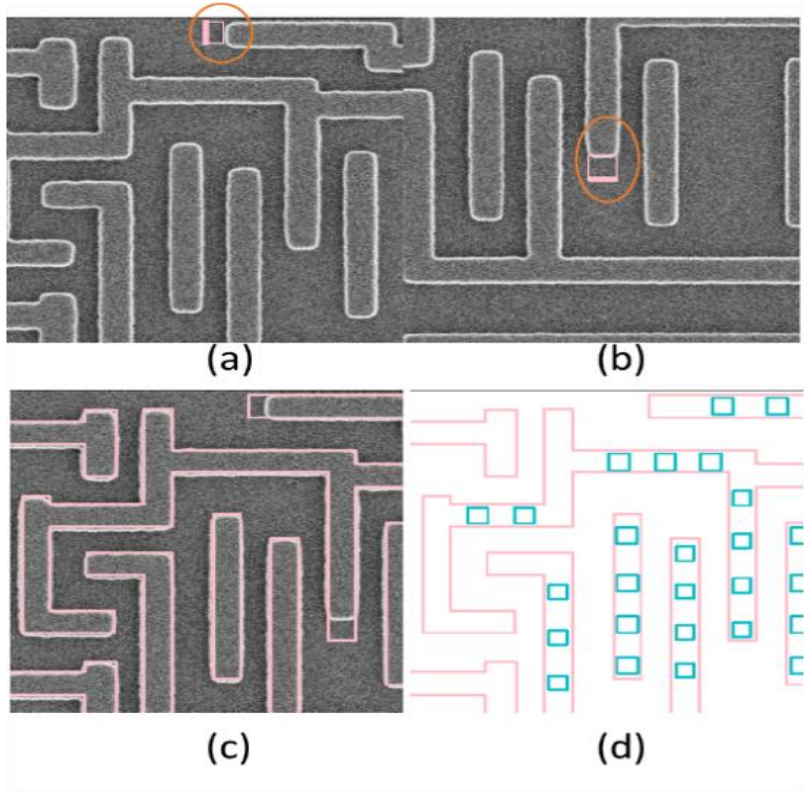
Setting recipe parameter is still a challenge for users who are not familiar with the design layout data.

Detectors	Detection threshold
End	<= -30 nm or >= 30nm
Line width	<= -1.5 ratio or >= 1.5 ratio
Pinch	<= 50nm
Bridge	<= 60nm
2D Complex pattern	<= 0.6 ratio or >= 1.2 ratio

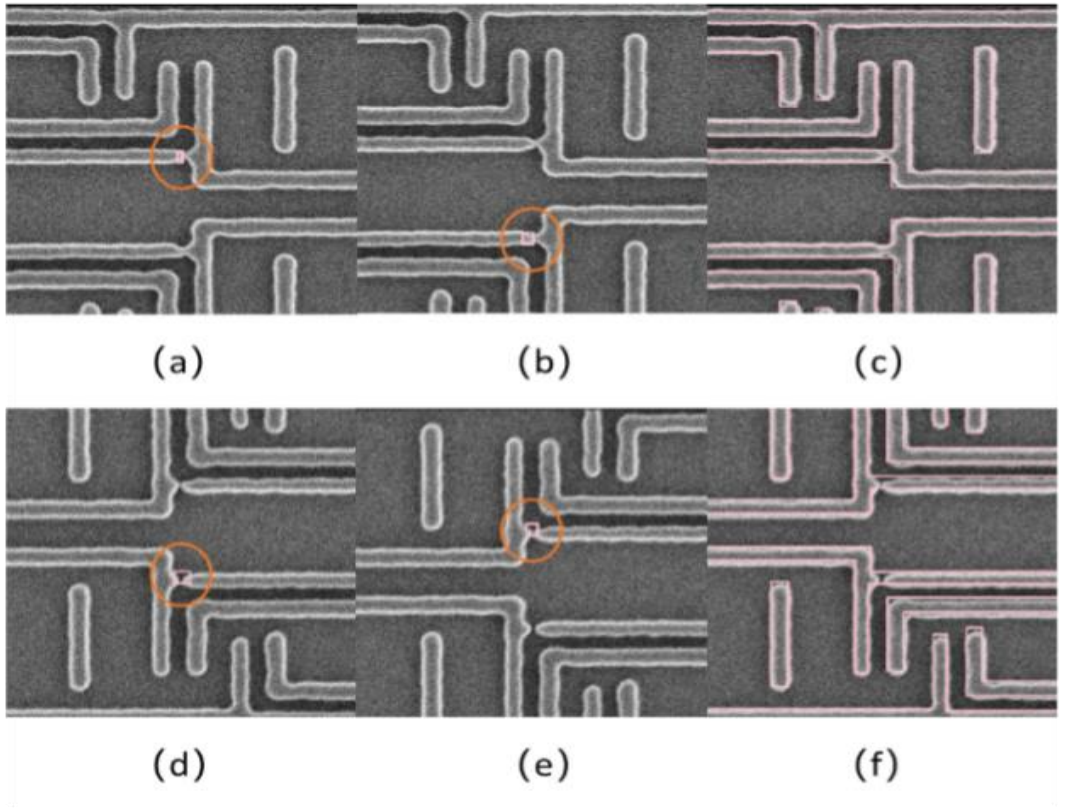
Detectability Enhancements

End pullback defects are detected on simple patterned areas.

Defect classification using multi-layer design data enables correct risk ranking.

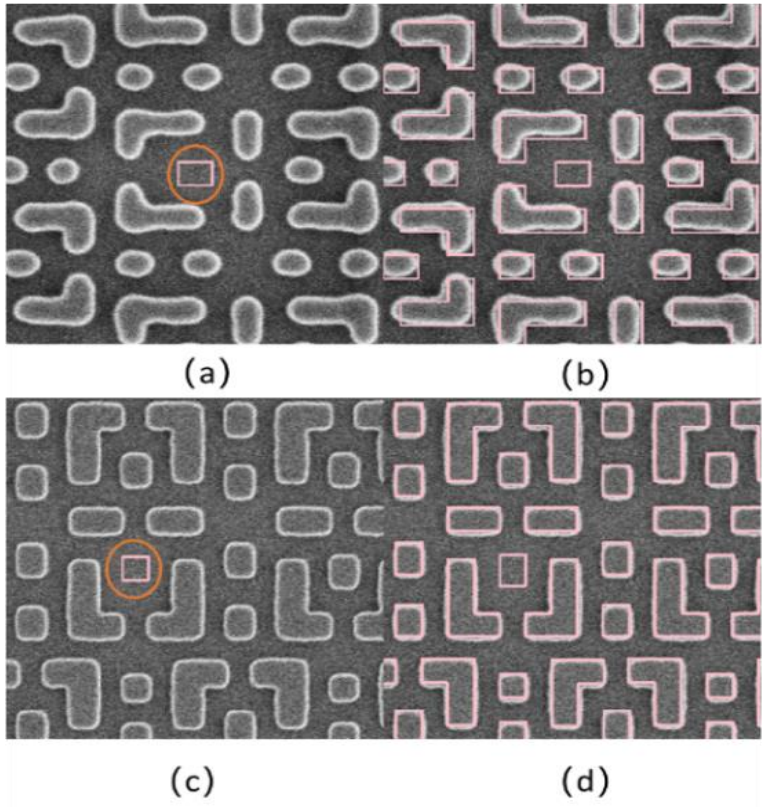


Pinch defects are detected on complex patterned areas, which are often misclassified as bridges without design layout data.

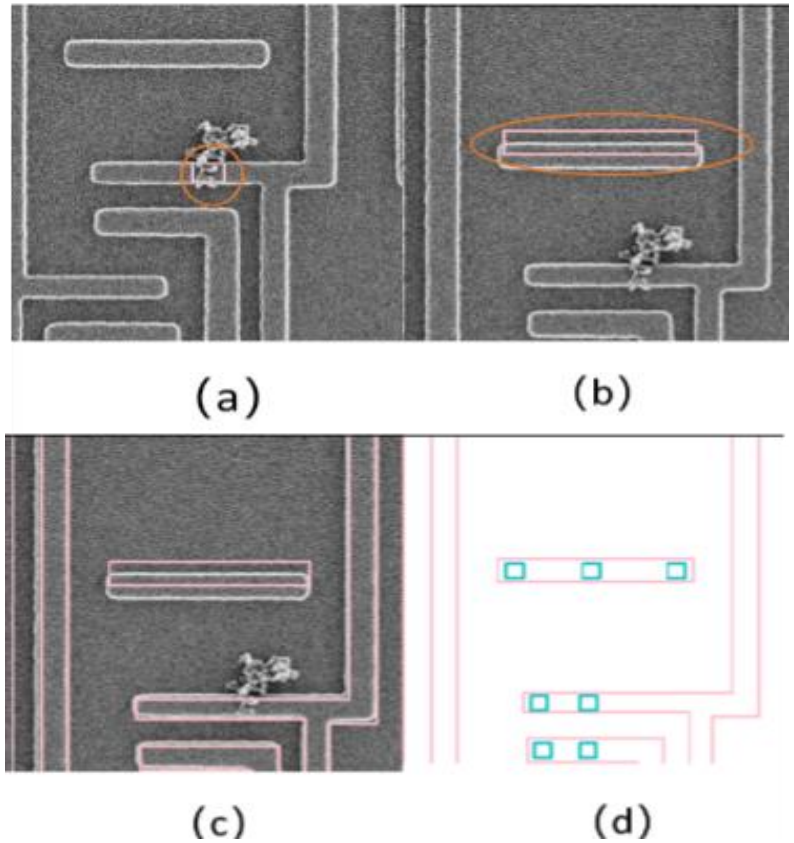


Detectability Enhancements

Missing patterns on SRAM areas are detected without false defect detection.



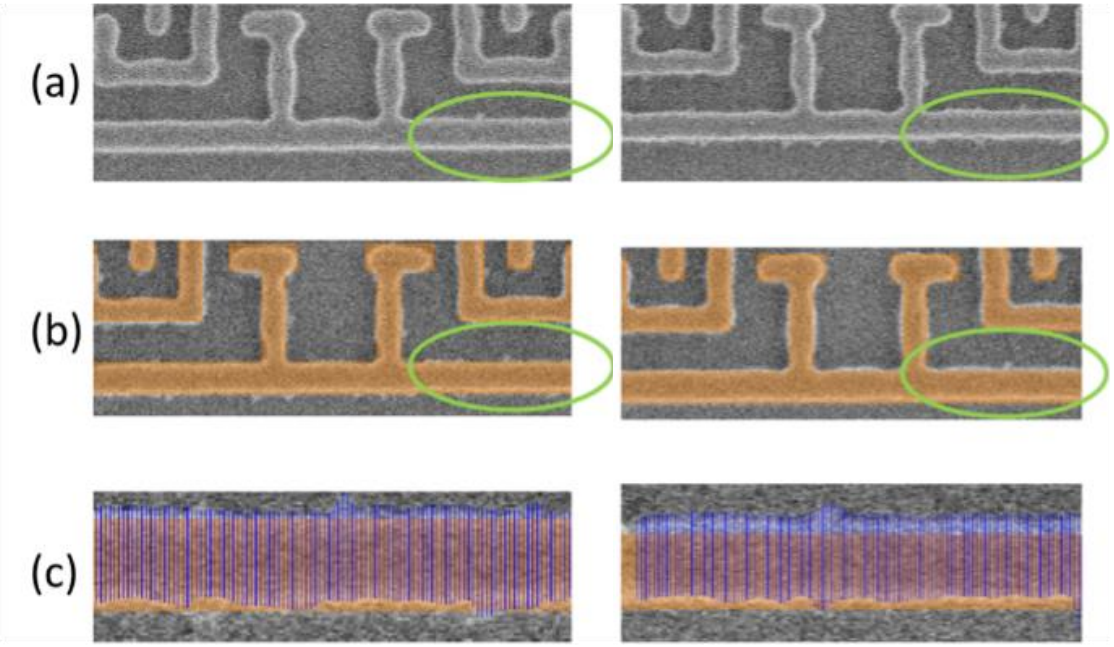
Both particle and pattern drift defects are detected and correctly classified.



CD Measurements on Real Patterns

- D2DB can also collect CD data on real 2D patterned areas.
- Different from the CD data on CD-SEM, the CD variation on real patterns is much greater than on test patterns.
- These data are more suitable for long-term CD monitoring.

CD Measurements



Validation on Production Wafers

- Image count :4600
- Image FOV: 3um
- Image size: 720 x 720

- CPU count: x64 cores
- Time Consumption: ~3 hours

✓ End pullback: 59 (nonkiller)

✓ Bridge: 176 (killer)

✓ Peeling: 2 (killer)

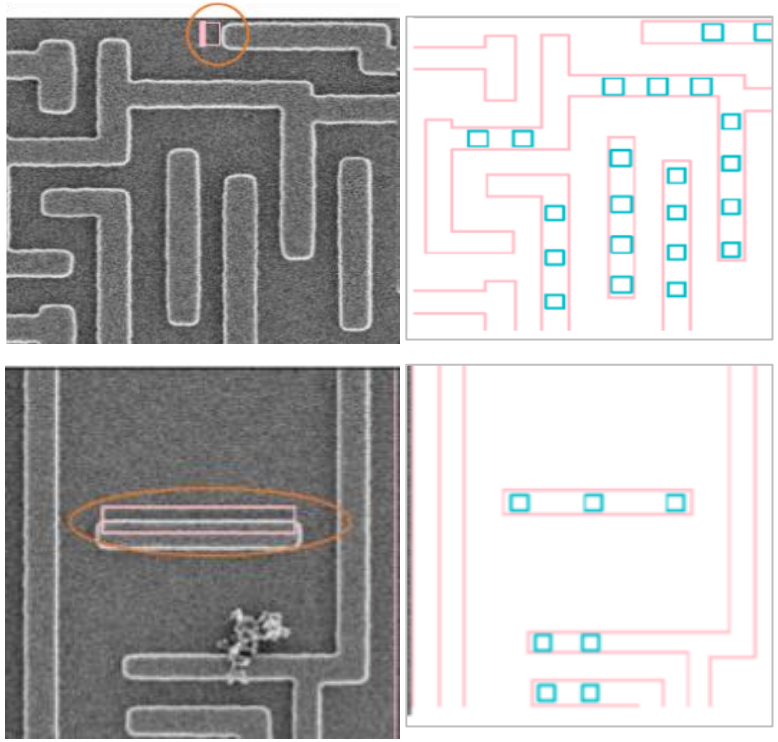
DJEL D2DB Method

✓ Capture killer defects and soft defects

✓ Utilize multi-layer design info

✓ Filter fake defects

✓ High throughput

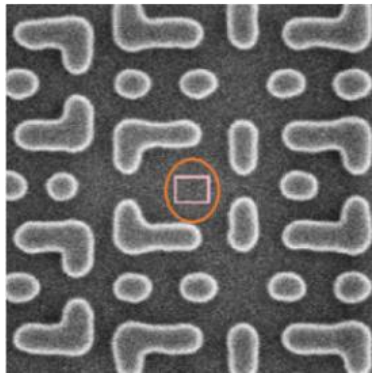


** Defect Type Samples (not the defects on production wafers)*

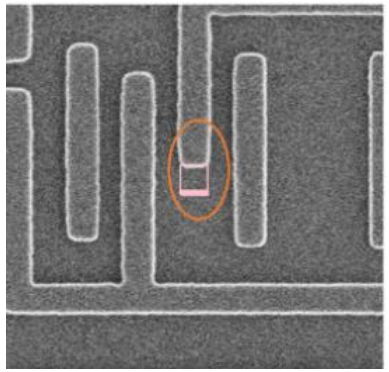
D2DB Assists Defect Classification

Use of different detectors and design layout information to identify defect types

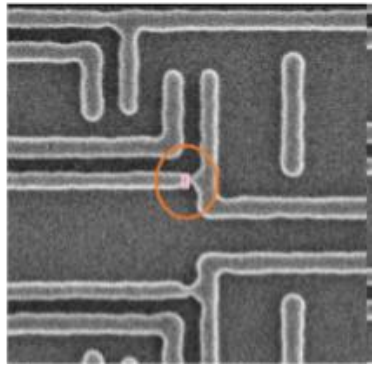
Missing



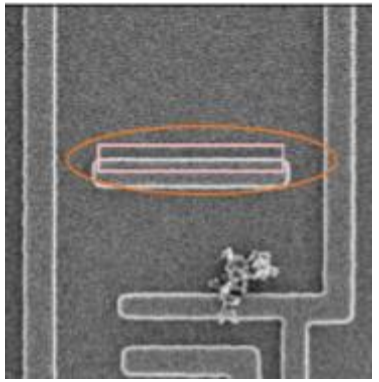
End Pullback



Pinch

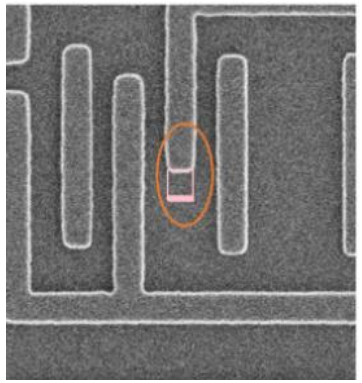


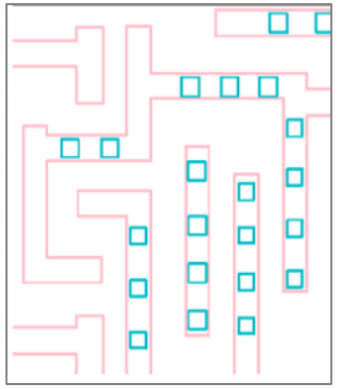
Pattern Drift



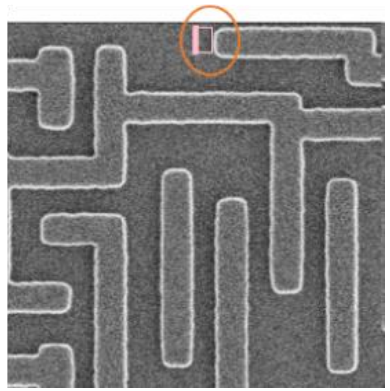
Using multi-layer information to capture critical defects

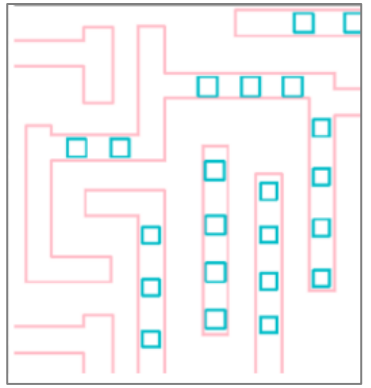
Critical





Uncritical





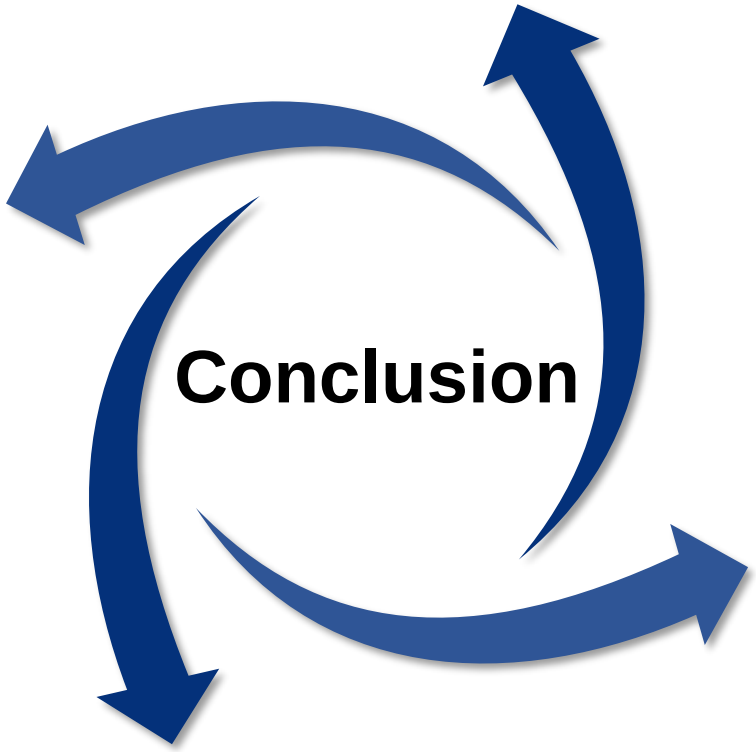
Conclusions

Verification

- DJEL D2DB flow is validated on both test wafers and production wafers.

Detection enhancement

- The D2DB approach improved the defect detectability of the DRSEM.



Application Scenarios Expansion

- DJEL D2DB method can be used for OPC hotspot validation and long-term CD monitoring on production chip patterns.

Multi-layout advantages

- D2DB offers advantages in defect filtering and classification by using design layout information.

THANKS ALL

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DONGFANG JINGYUAN ELECTRON LIMITED