

Integrating Scatterometry for High Volume Manufacturing

Alan Nolet, Timbre Technologies, Inc.

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Why Scatterometry?

- CD SEM limitations
- Capable of crucial process insights
- High data integrity
- Fast and small enough for integration
- Enabler for next quantum step –AEC / APC
- Low COO



“In the land of the blind, is the one eyed man King?”

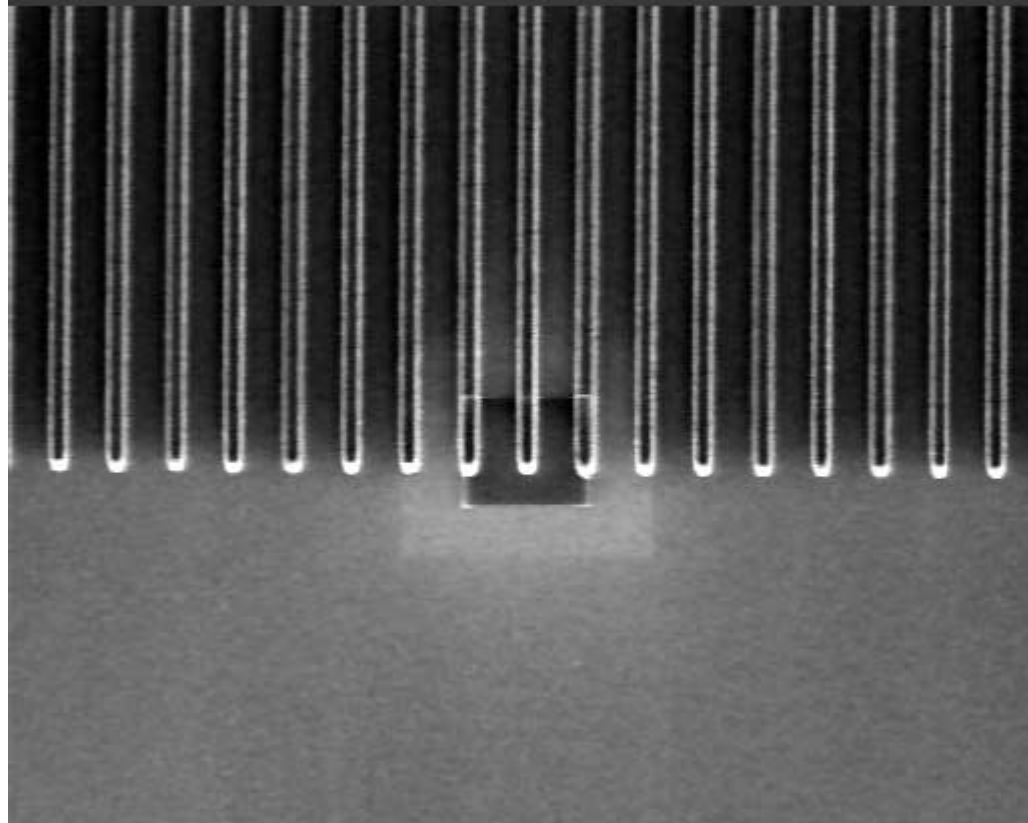
- Top view only
- Expensive
- Slow
- Unstable
- Resolution limited
- Damages sample
- Geometry limited
- Cannot be integrated



CD-SEM



CD-SEM Charging and Contamination



(A. E. Vladar, NIST)

**Typical site image after CD-SEM measurement
Charging from e-beam causes contamination and feature damage**



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- Low COO
- Demonstrated at advanced geometries and very high resolutions / repeatability



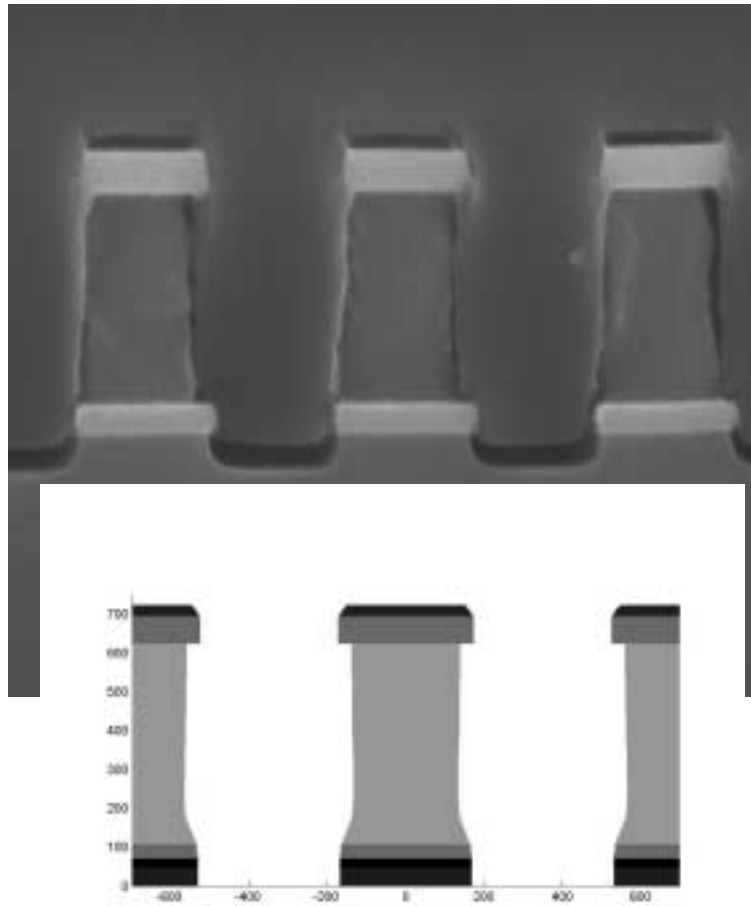
Production requirements

- FDC and process diagnostics across process variation and range.
- No throughput hit.
- COO constraints.
- Minimum footprint hit.
- No misdetection or false detection.
- Repeatable.
- Will extend to future nodes.

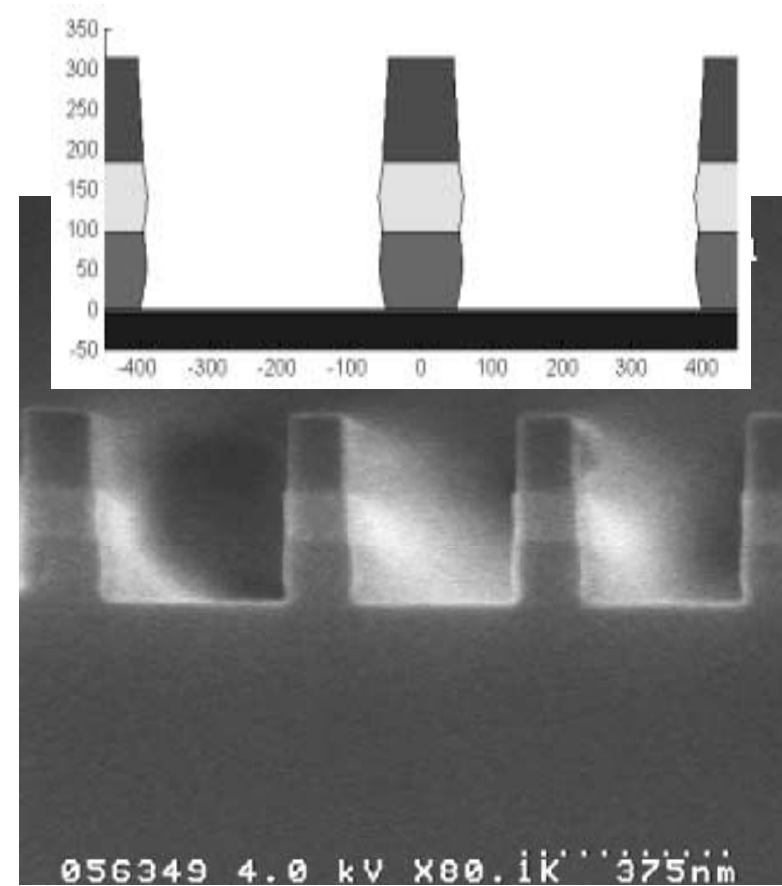


Processes do not follow simple profiles

Metal Etch



Gate Etch



Relevant Challenges

- PTOEM Integration.
 - HW, Tool controller, Data flow, etc.
- Correlation with and transition from existing Fab methods.
- Fab data management integration.
 - Format, tags, archive,
- Obeying the limitations of Scatterometry.



Fab data management integration.

- Data Use
 - APC/FDC/SPC - *At what level?*
 - Tightly Coupled: W2W (Tool Level)
 - R2R, Lot2Lot (Cell Level)
 - Long term Trending (Host Level)
 - What about tool level Feedforward and Feedback?
 - What is the Data collection strategy?
 - Every wafer?, Every Lot?, Every Carrier?,
Dynamic?



Loads of opportunities ahead !!

- Multi functions.
- Breakthrough processes.
- New EDA rules.
- Post processed rework.
- Process tool enhancement.
- ??



Summary

- Scatterometry shows great promise.
 - Huge ROI.
- Rapidly compressing 20 years of CD-SEM experiences.
- Integration requires complex coordination.
 - PTOEM, MOEM, IDM, MES, ??
- AEC / APC is within reach.

