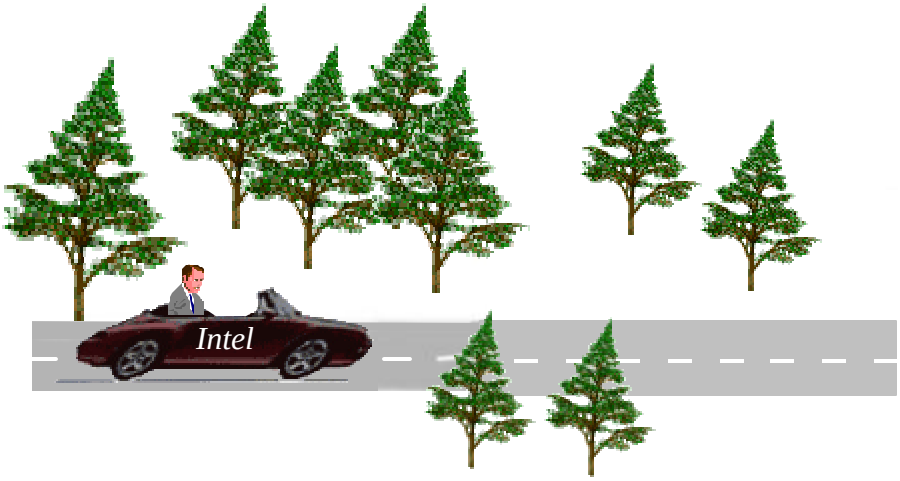
Critical Components for Process Control in Microelectronics Manufacturing: Epi Silicon Fabrication

ON-LINE TECHNOLOGIES INC.

http://www.online-ftir.com

Introduction

Major Changes Coming in Semiconductor Manufacturing



Major Changes Coming in Semiconductor Manufacturing

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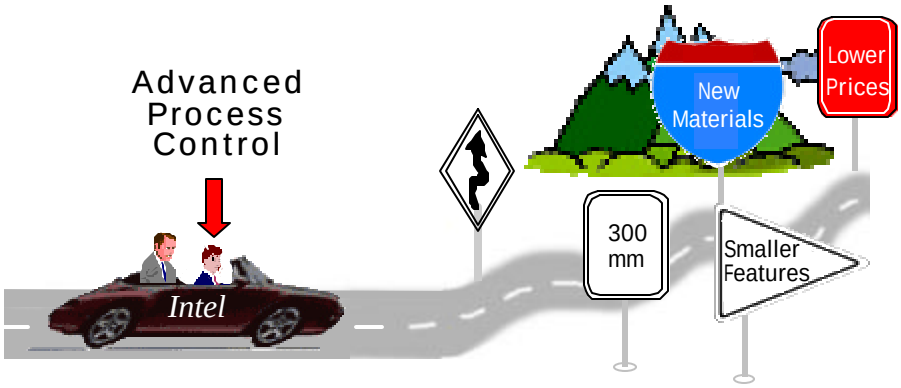

Advanced Process Control (APC) is Required

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Advanced Process Control

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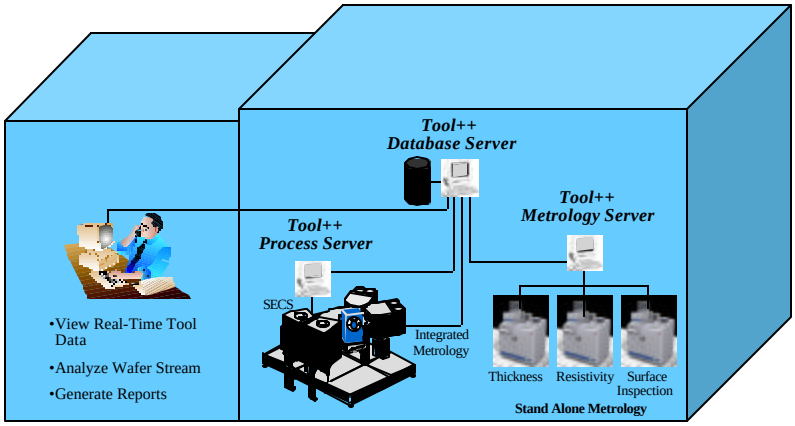
Advanced Process Control



Advanced Process Control (APC) Benefits

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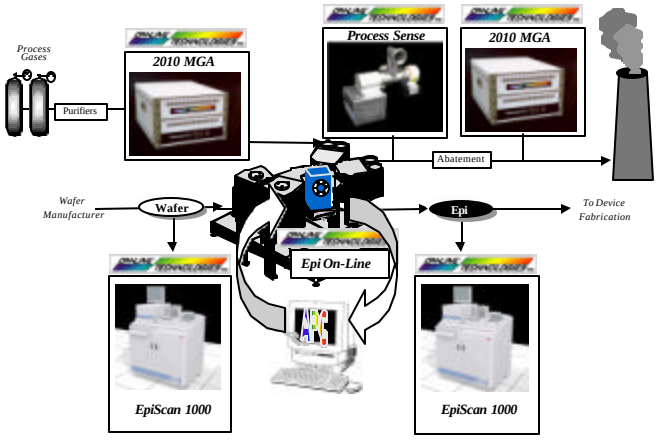
Products for Advanced Process Control



Program Goals

Overall Program Objectives

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Program Tasks

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Task 1 - Resistivity Sensor

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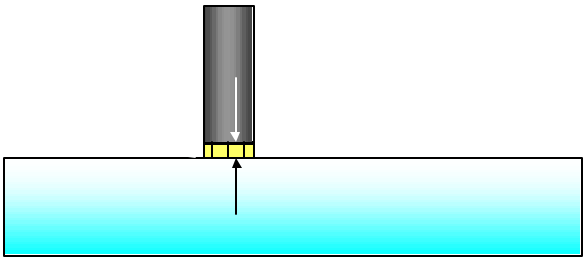
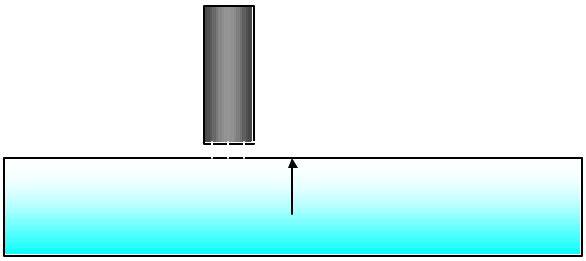
Phase I feasibility tests

Sample	Carrier Concentration, 10e-15 cm^3 Hg (liquid)–CV (AMAT data)	Carrier Concentration, 10e-15 cm^3 Diamond film (0.6μm) on heavily doped electrodes
1	1.1	0.87 +/-0.05
2	2.0	1.5 +/-0.2
3	5.1	4.3 +/-1
4	9.2	7.5 +/-2
5	23	20 +/-5
6	130	80 +/-30

Soft-Contact Resistivity Sensor



Phase II - Non-Contact Resistivity Sensor



Task 2.
Process Control Technology

Task 2

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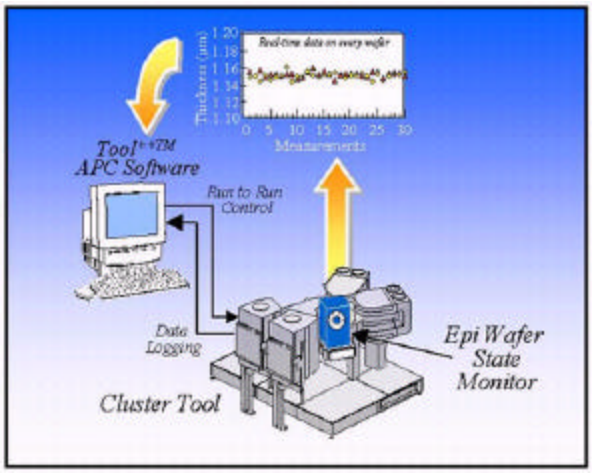
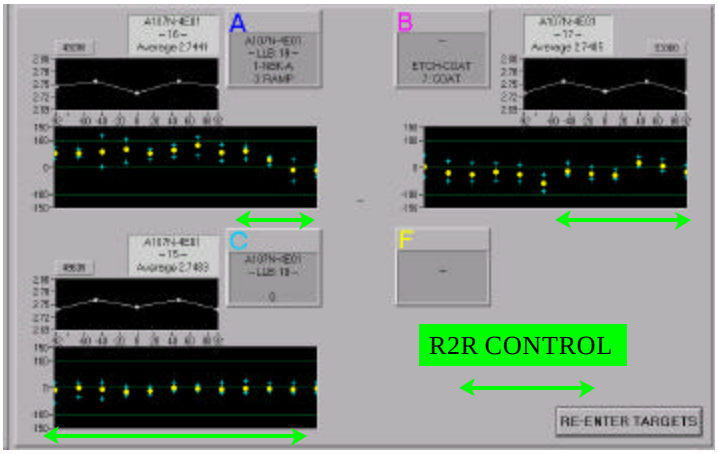
Integrated Metrology with Run-to-Run Control



Run-to-Run CONTROL PROCESS RESULTS



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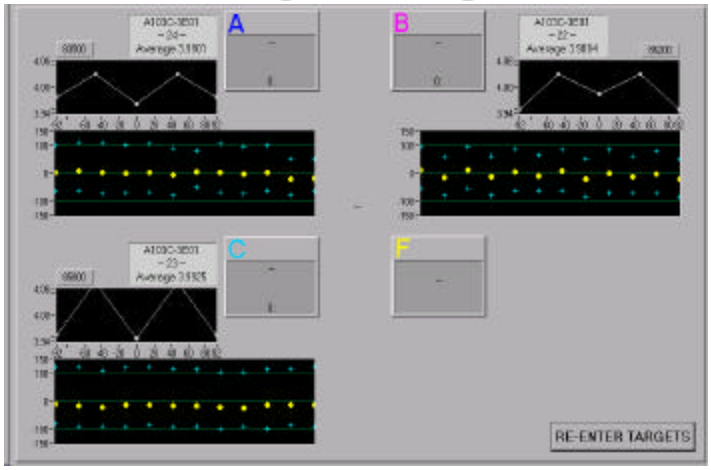
BEFORE UNIFORMITY TUNING



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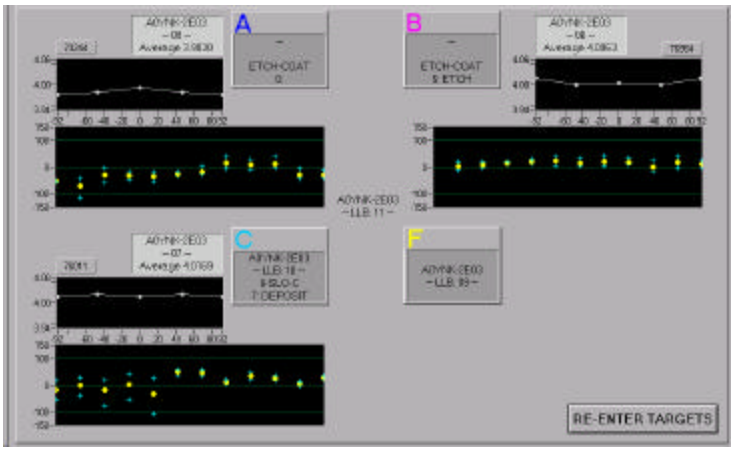
UNIFORMITY TUNING RESULT



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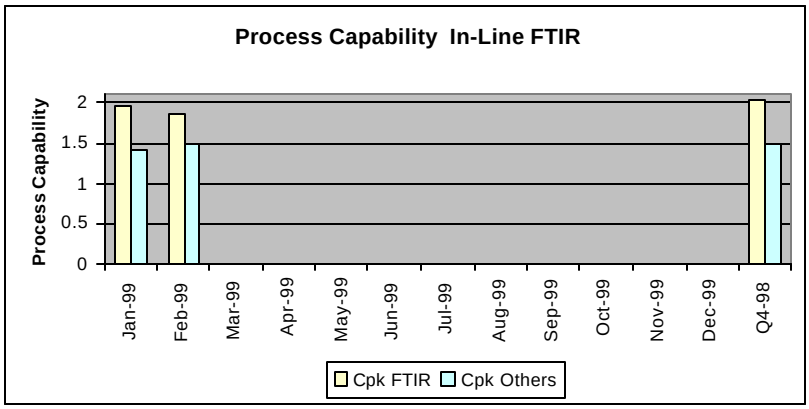
Product Quality Improvement



What Causes Thickness and Resistivity Uniformity Changes?

(Variables to sense and control)

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  - *Temperature*
  - *Temperature uniformity*
  - *Flows, Pressures*
  - *Contamination*
  - *Dopant Concentration*
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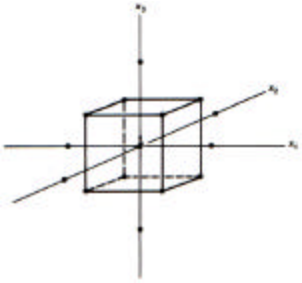
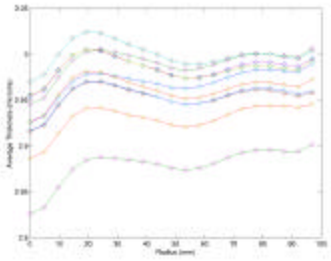
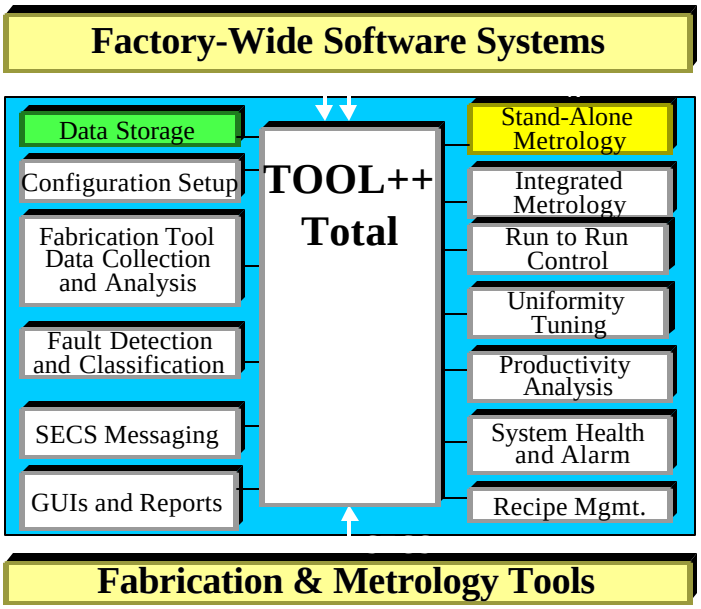
  - *Contamination*
  - *Autodoping*

Run-to-Run Control for Epi Silicon Deposition DOE -With MIT and Applied





Integration Software



Task 3
Application to Other Processes

What's New with FTIR?

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Quantitative Analysis for Device Films

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Low-k Dielectrics

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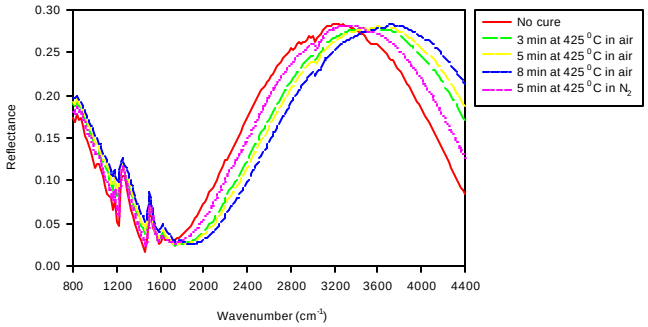
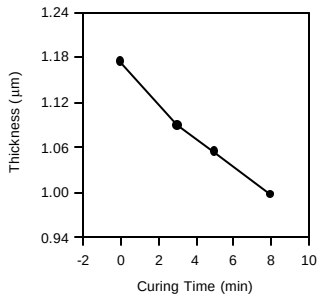
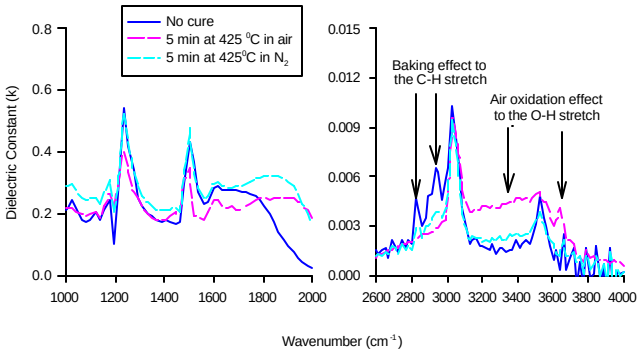
FTIR Spectra of Low-k Dielectric Films after Different Curing Conditions



Effect of Annealing Time on Low-k Dielectric Film Thickness



Effect of Curing and Ambient Environment on the Absorption Index k in a Low-k Dielectric



Deep UV Photoresist

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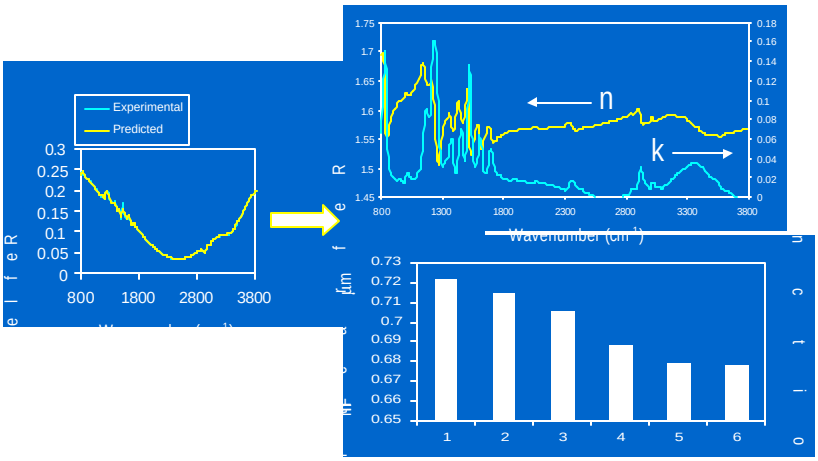
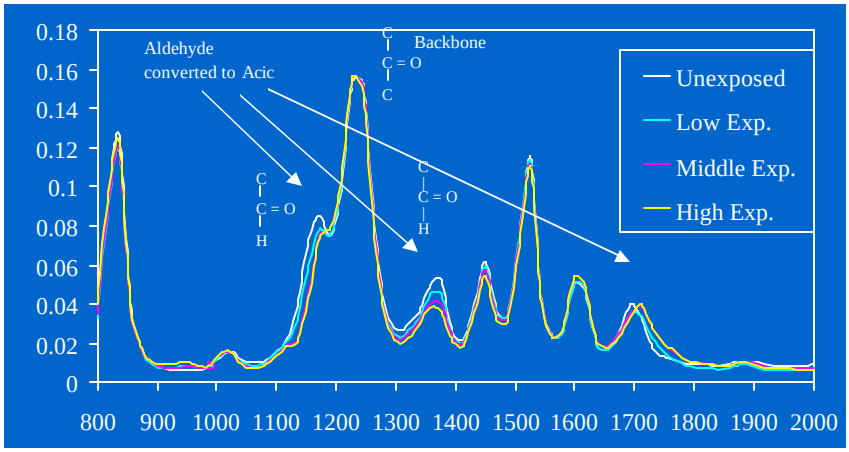
FTIR Spectra of DUV Resists
Reflectance vs exposure dose



Exposure Photochemistry

Tracking functional groups via extracted IR Optical constants



Conclusion

Cost of Ownership Benefits for Epi Fabrication

Return on Investment

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