VMEC Summer Scholars Program
Micron Technology Inc.
Metrology
ROCKY SHRESTHA

"Host Organization"

"Tools I worked on"
A. Spectra Fx

- Spectra Fx measures thickness of the film surface using optical devices.
- Two different optical devices are used:
  1. *Spectral Ellipsometer (SE):* Measures polarization states of light beam
  2. *Dual Beam Spectrophotometer (DBS):* Measures the intensities of light beam.

- Lamps used: a. Xe lamp: 240-800 nm   b. DUV lamp: 190-300 nm

B. Therma-Probe

- Monitor the dose and concentration of the dopants implanted in the wafers by measuring the intensity of damage on the surface of the silicon
- Damage on the film surface is because of the implantation of dopants
- Composed of two different lasers: Pump Laser and Probe Laser

"Projects completed"

1. Spectra Tool-to-tool Matching: Variability and Comparison

- Metrology: accuracy, reproducibility and repeatability
- Consistency in thin-film deposition process measurements across all fabs
- Uniformity in their product
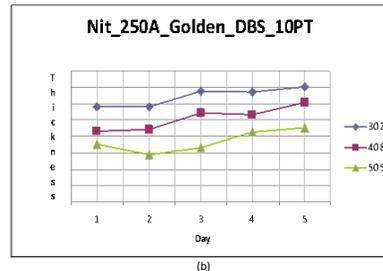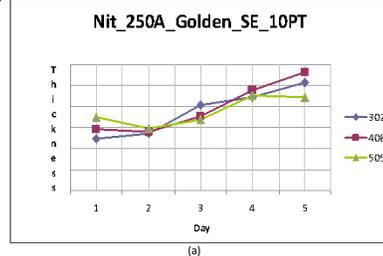- Figure out the different issues present, resulting in wrong data.

(a)

(b)

Fig: Thickness comparison of Nitride, measured using (a) SE & (b) DBS, for 5 different days and 3 different tools
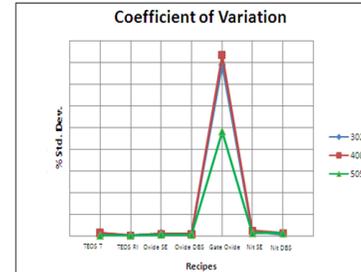
Coefficient of Variation

Fig: Comparison of Coefficient of variation between different recipes

2. Spectra: Issues in Measurement

a. Tool issue: Pattern Recognition failure
b. Recipe issue: Recipe training failure
c. Optical issue: Failure in optical parts
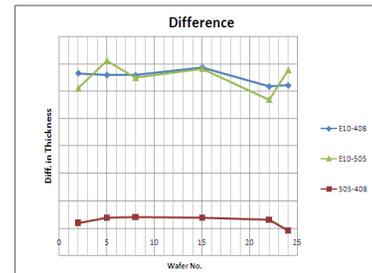d. Wafer issue: Failure in processing

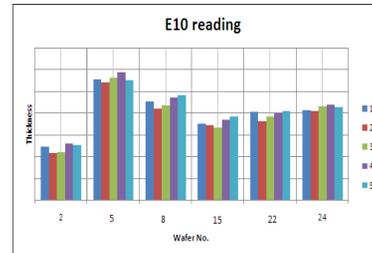Fig: Differences plotted for a sample lot measured in 3 different tools

Fig: Plot verifying the consistency in 5 different measurements in E10

Observation:
- Tool E10 had some issue.
- No tool issue: Pattern recognition didn't fail
- No wafer issue: Accurate data resulted from tools 408 and 505.
- No recipe issue: Consistency in measurement from E10 and high GOF
- Might be optical issue or some focus issue which was forwarded to vendor to check and fix the tool.

3. Spectra: DPN Correlation

- Gate oxide has presence of nitrogen, which prevents boron from escaping the surface
- Obtain a correlation equation, which will result the concentration of nitrogen from the mole fraction measurement
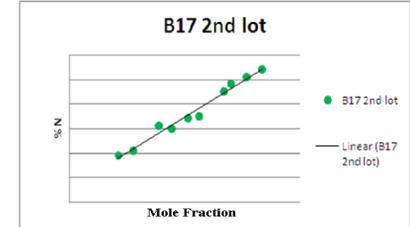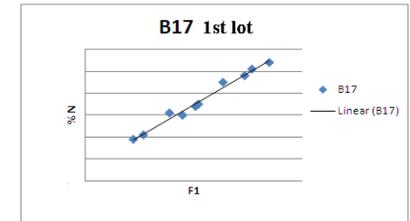

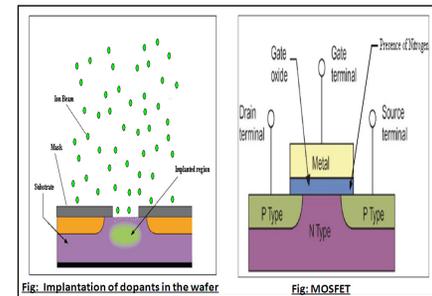Fig: Correlation plots for 2 different lots from same batch and same tool

Fig: Implantation of dopants in the wafer

Fig: MOSFET

4. Therma-Probe: Recipe creation and monitoring

- Based on sensitivity, consistency and repeatability
 Procedure:
a. Mask teaching
 b. Die setup: Reference die
 c . Die setup: Pitch
 d. Dice and Site selection
 e. Measurement
   - If the measured values is deviating away from the control target, necessary steps to figure out the issue is to be processed
   - If the issue is caused because of bad recipe training, recipe for that step has to be retrained

Bare Silicon Wafer → Fabrication processes → Fully Processed wafer → Si Chip → Packaged Chip → Products