Microfabrication Lab
2009 Summer Internship

UC Berkeley-EECS

Characterizing Aluminum uniformity using resistance

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Outline

- First week
  - Clean Room Procedure
- My Project
  - Objective
  - Define Terms
- Procedure
- Results (4 inch wafers)
- Results (6 inch wafers)
- Graphs and Analysis
  - Conclusion
- Acknowledgments

Clean Room Procedure

- First thing I learned was importance of minimizing contamination
- Always suit up: Hair cap, bunny suit, blue booties, white booties, goggles, gloves
- From human saliva to a small piece of junk, anything can mess up a wafer

My Project

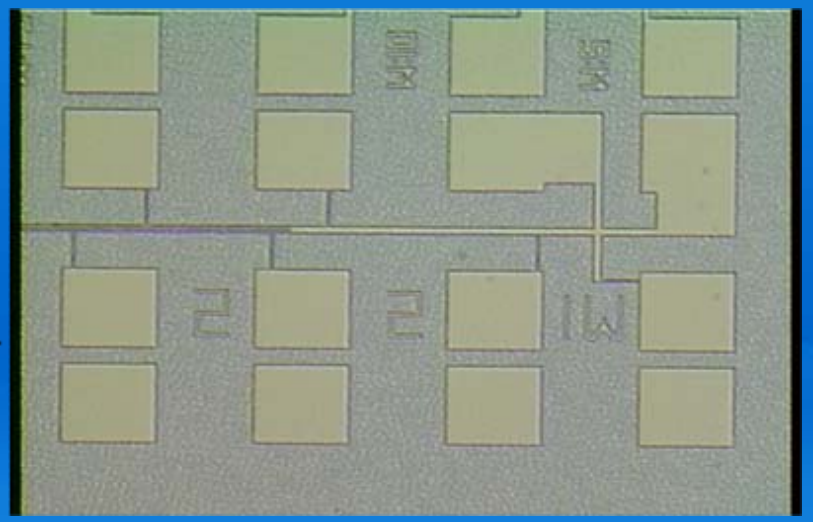
Objective: To measure Aluminum uniformity with NRC and V401 using resistance: 4" to 6" wafer upgrade

Terms:

- Resistance:
  - A measure of how strongly a material opposes the flow of electric current.
  - Measured in Ohms (Ω)
  - A low resistance = thicker film
  - A high resistance = thinner film

$$R = \rho \frac{L}{wt}$$

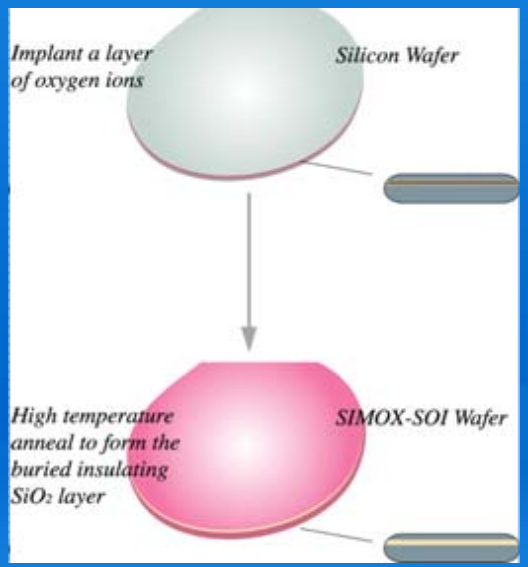
Split Cross Bridge →



Procedure

Step One: Grow Oxide Layer

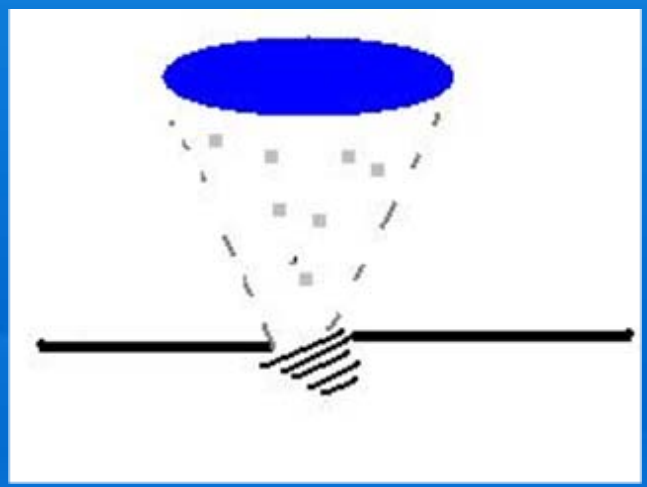
- Pirana bath (H2SO4 +H2O2)
- DI water rinse (4 cycles)
- Spin dryers
- Run Recipes--> Tystar furnace
- Silicon is very conductive; oxide layer serves as an insulator



Procedure

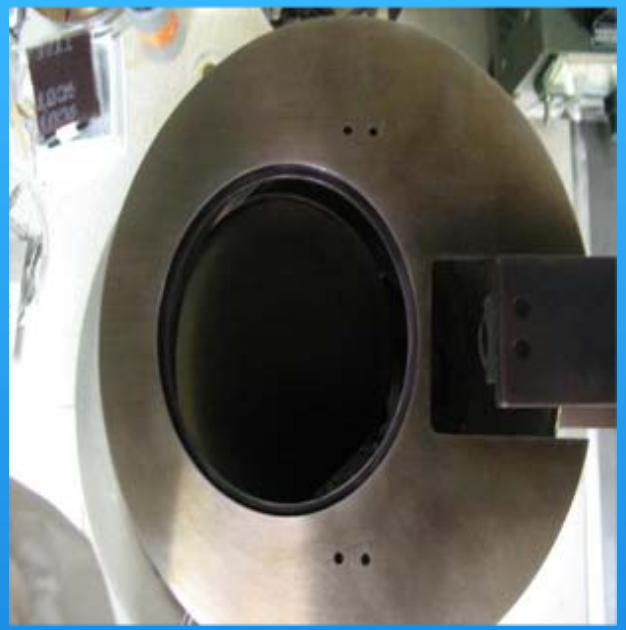
Step Two: Evaporate Aluminum onto Wafer

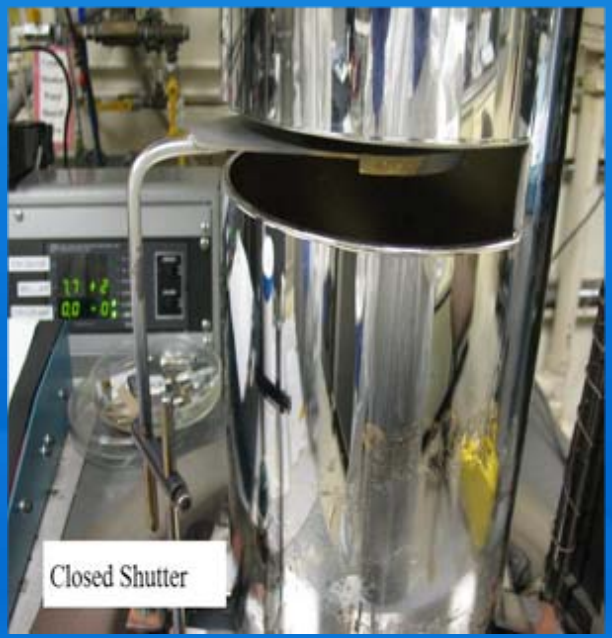
- Two thermal evaporation systems: NRC and V401
- Pumps out gas and pumps down the chamber
- Ran current through the filament
- Metal heats up and becomes a gas
- Condenses back to solid when metal reaches the wafer



NRC

V401




Closed Shutter


Open Shutter

Deposition Conditions

	V401	NRC
Pressure:	• $4 X10^{-6}$	• $4 X 10^{-6}$
Current:	• 38 amps	• 39 amps
wire basket	• 250 amps	• 247 amps
flat boat		
Deposition Rate:	• 5-7 Å/Sec	• 5-7 Å/Sec
Time:	• 3 minutes	• 3 minutes

Procedure

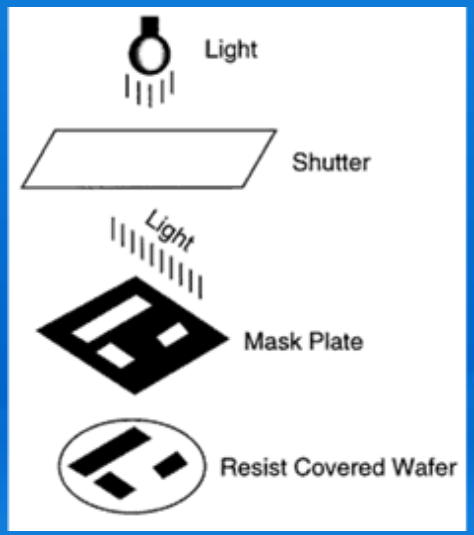
Step Three: Put a layer of BARC (6" only)

- BARC stands for **B**ottom **A**nti-**R**eflective **C**oating
- Aluminum is extremely reflective
- Minimizes reflections from Aluminum that could degrade the patterning
- Used svgcoat6
- Followed by a softbake

Procedure

Step Four and Five: Add Photoresist and Photo lithography

- I-Line Photoresist
- Shine light through to form a pattern (Quintel for 4" and gcaws6 for 6")
- Light transfers a geometric pattern to the photoresist
- Developed on svgdev6 (6") and manually (4")
- Finished with UV Bake to make photoresist hard and durable for etching



Procedure

Step Six and Seven: Metal Etch and Removing Photoresist

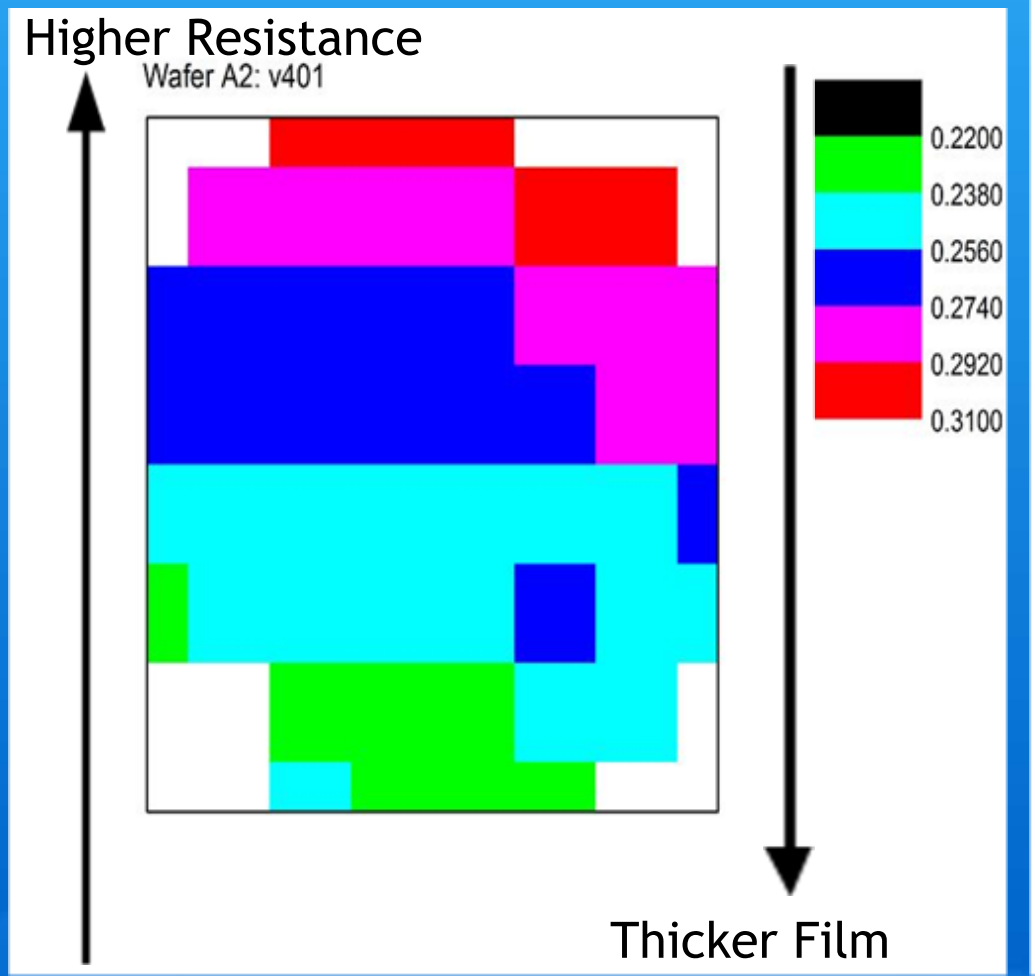
- Wet Etch for 4" (Patterns on 4" were larger)
- Centura for 6"
- Centura removed Photoresist in 6" wafers whereas 4" were put into matrix

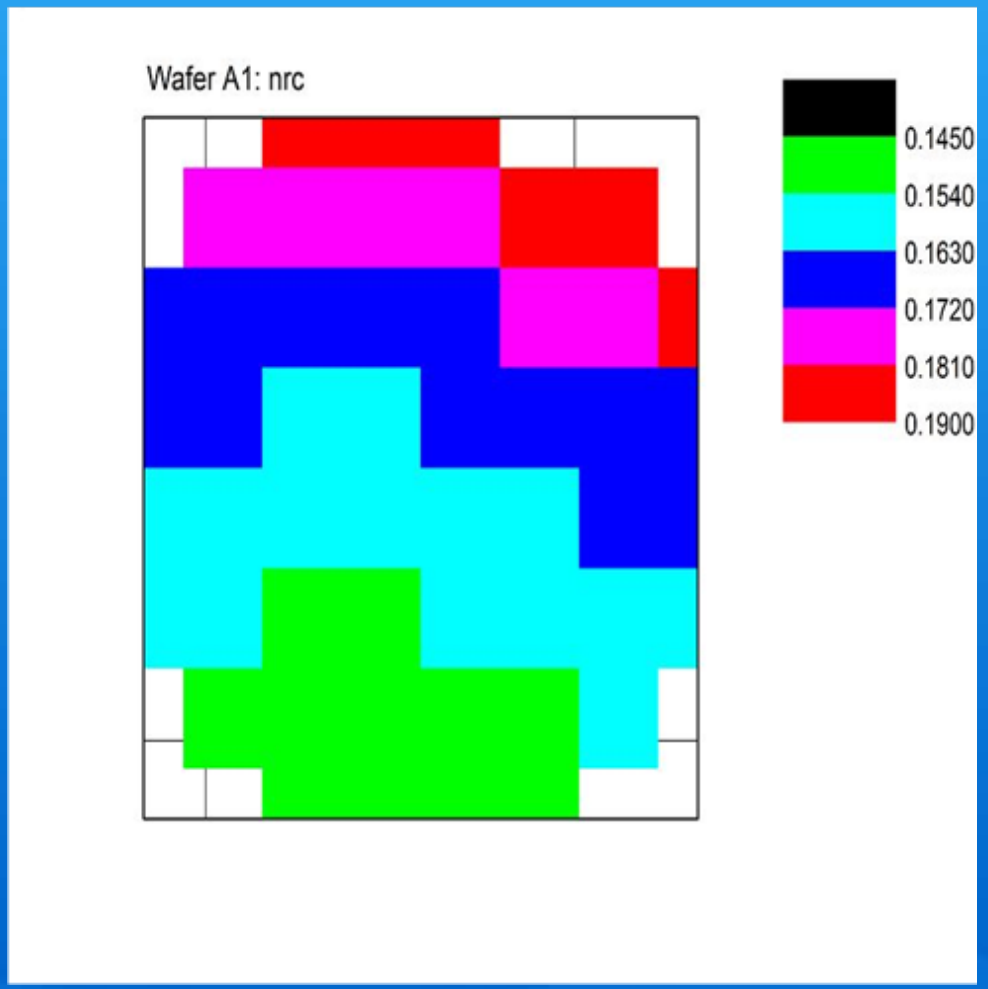
- Ready for testing
  - 2 point probe, Autoprobe, and ASIQ to measure 4" wafer resistance, 6" wafer sheet resistance, and 4" wafer Aluminum thickness.

Results 4"

V401

NRC

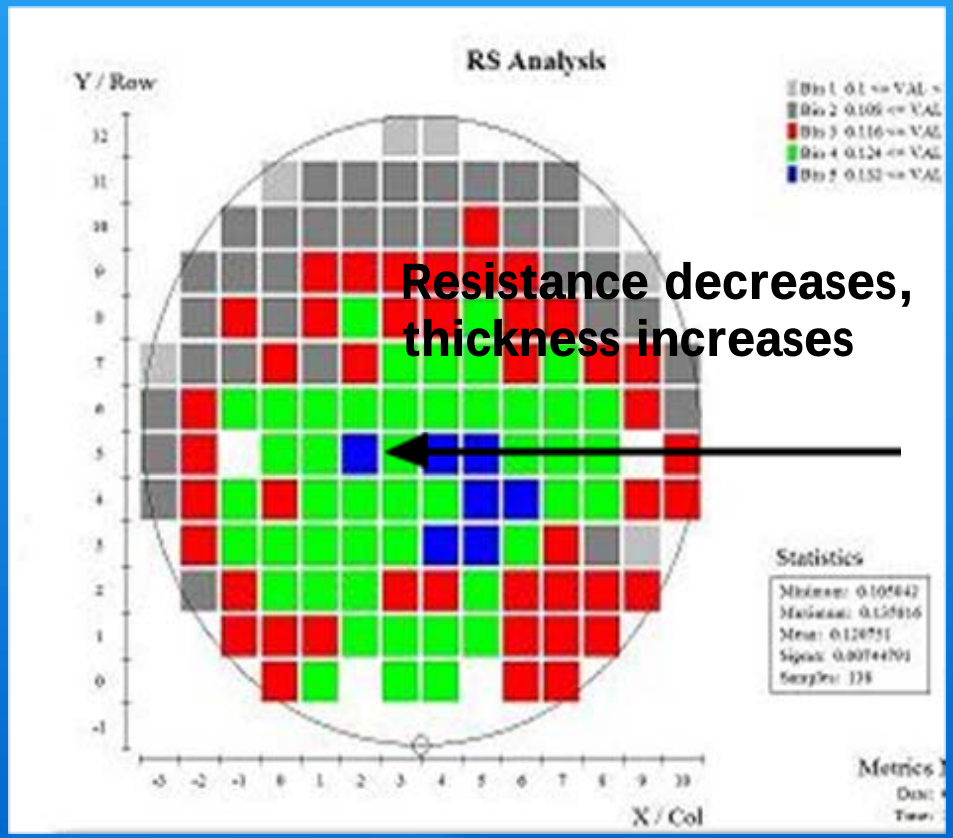


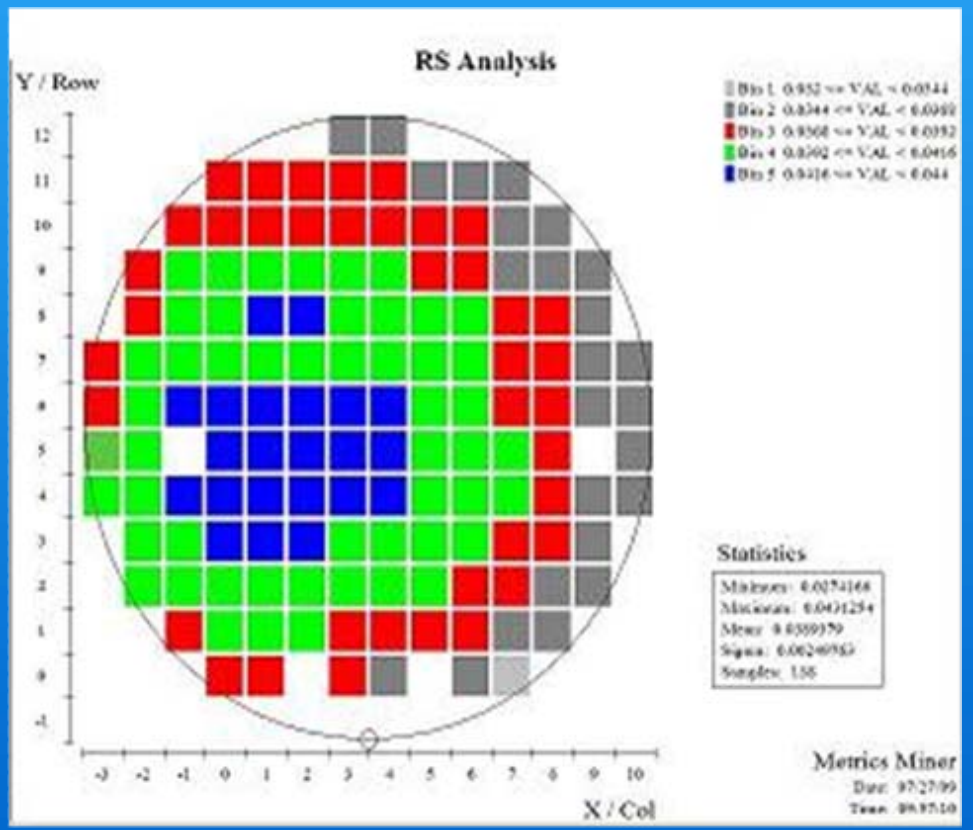


Results 6"

V401

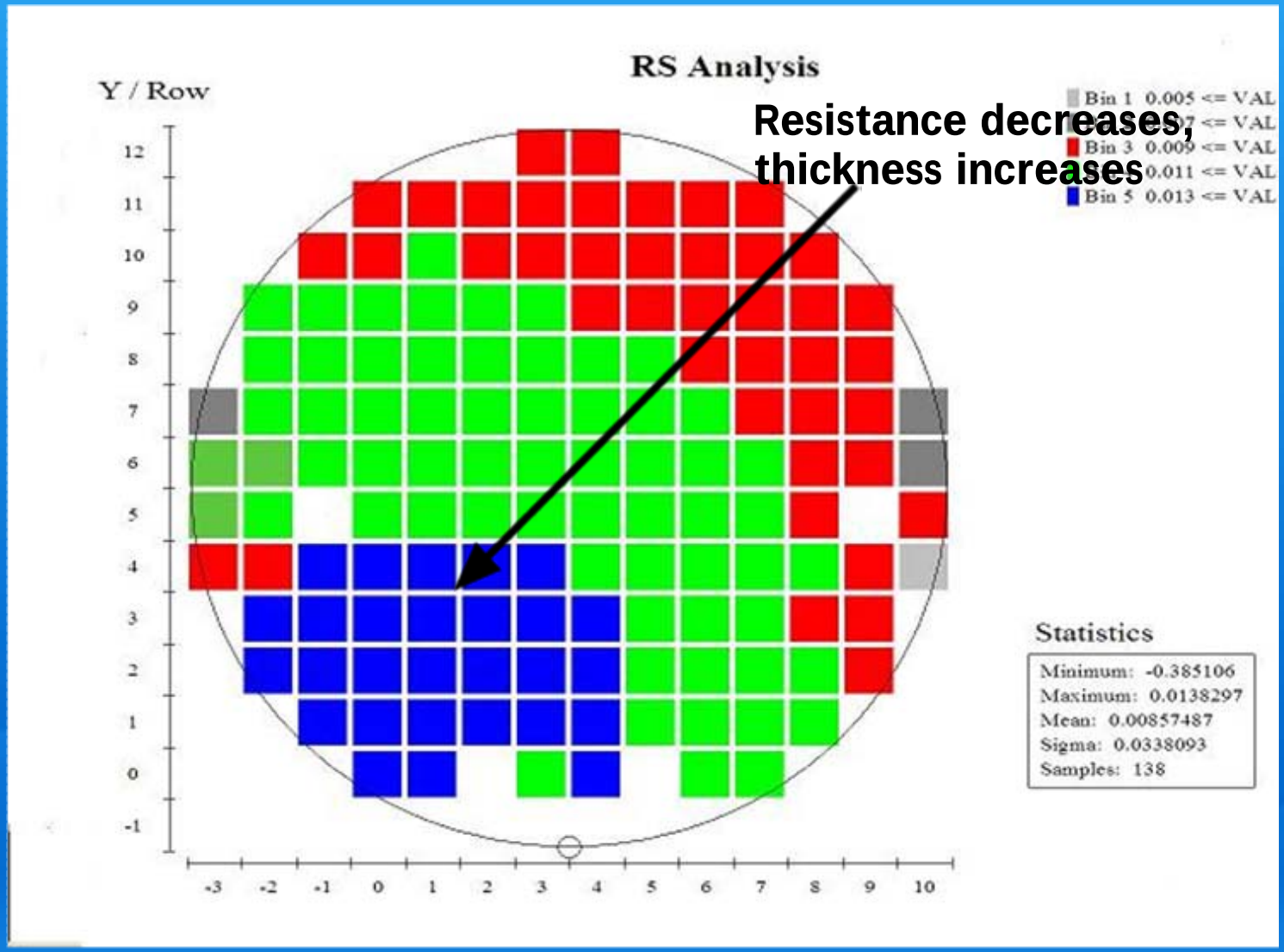
NRC





Results

6" with shutter closed and then opened



Data Analysis

Non uniformity: 100 X $\frac{\text{Max-Min}}{\text{Average}}$

	4"	6"
NRC	Wafer A1 25.5%	Wafer 16 40.3%
V401	Wafer A2 31.0%	Wafer 18 25.4%
		Wafer 24 100.16% (closed shutter)

Conclusion

- In both the 4" and 6" wafers, the percentage of non-uniformity equally poor
- Indicated that the uniformity is not considerably worse when upgraded to 6 "
- 4" Sloping Gradient vs 6" Bands
- When the shutter is closed, and then opened, thickness gradient is very uneven ; shutter should be replaced.
- If the chimney is taller, the uniformity will be better because it will have a larger diameter (although thinner)
- Or move the source lower
- Either way will increase the distance, which increases uniformity

Acknowledgments

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THE END