

# Calice WP4

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WP4 aims: look at Mechanical/Thermal/ Assembly issues

Utilise Atlas SCT experience

effort weighted to latter end of period

- conducting Glues
- Assembly concepts

## Conducting Glues

Silver filled 2 part epoxy ( no mass loss no voids)

Ag has high  $\sim 1/1000$  solid Ag -interconecting particles

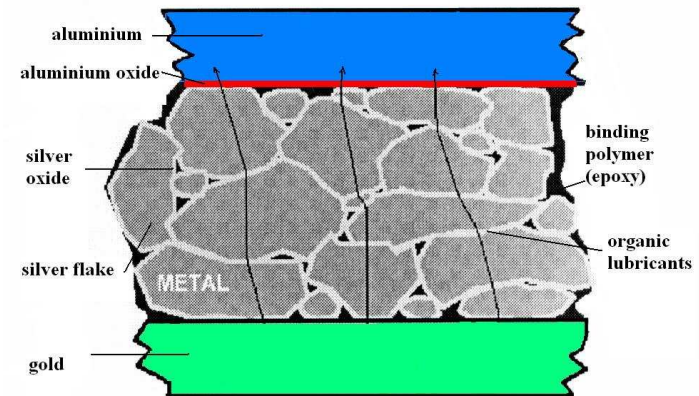
choose particle size , viscosity,cure temp EPO-tek 4110

Areas of interest - resistance aging

Interface problems

oxide layer at Al/Ag interface

Production wafers old



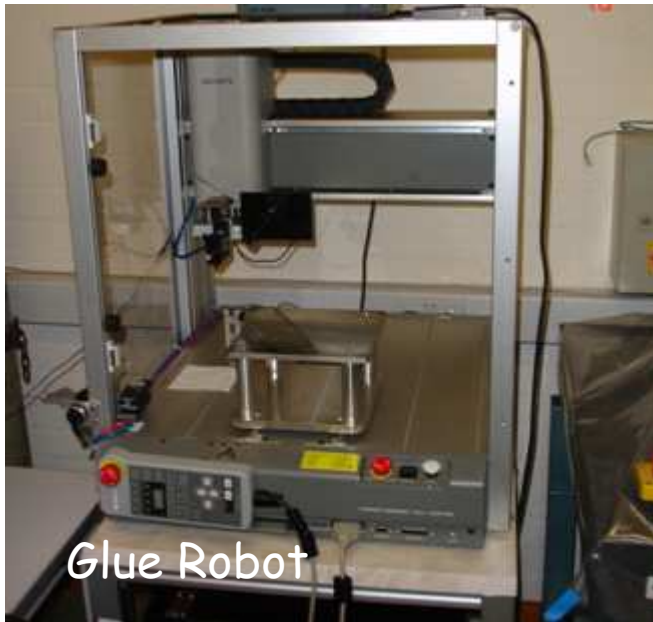
CTE mismatch Si /PCB - glue flexible

Glass transition temp CTE change  $50 \times 10^{-6}$  to  $150 \times 10^{-6}$

Corrosion/electro chemistry - Ok for N<sub>2</sub> atmosphere

Glue effects on wafer passivisation

## Glue test set up



Glue Robot



Programmable Environmental chamber



3x3 3mm square  
pixels



Standard 6X6  
10mm square pixels

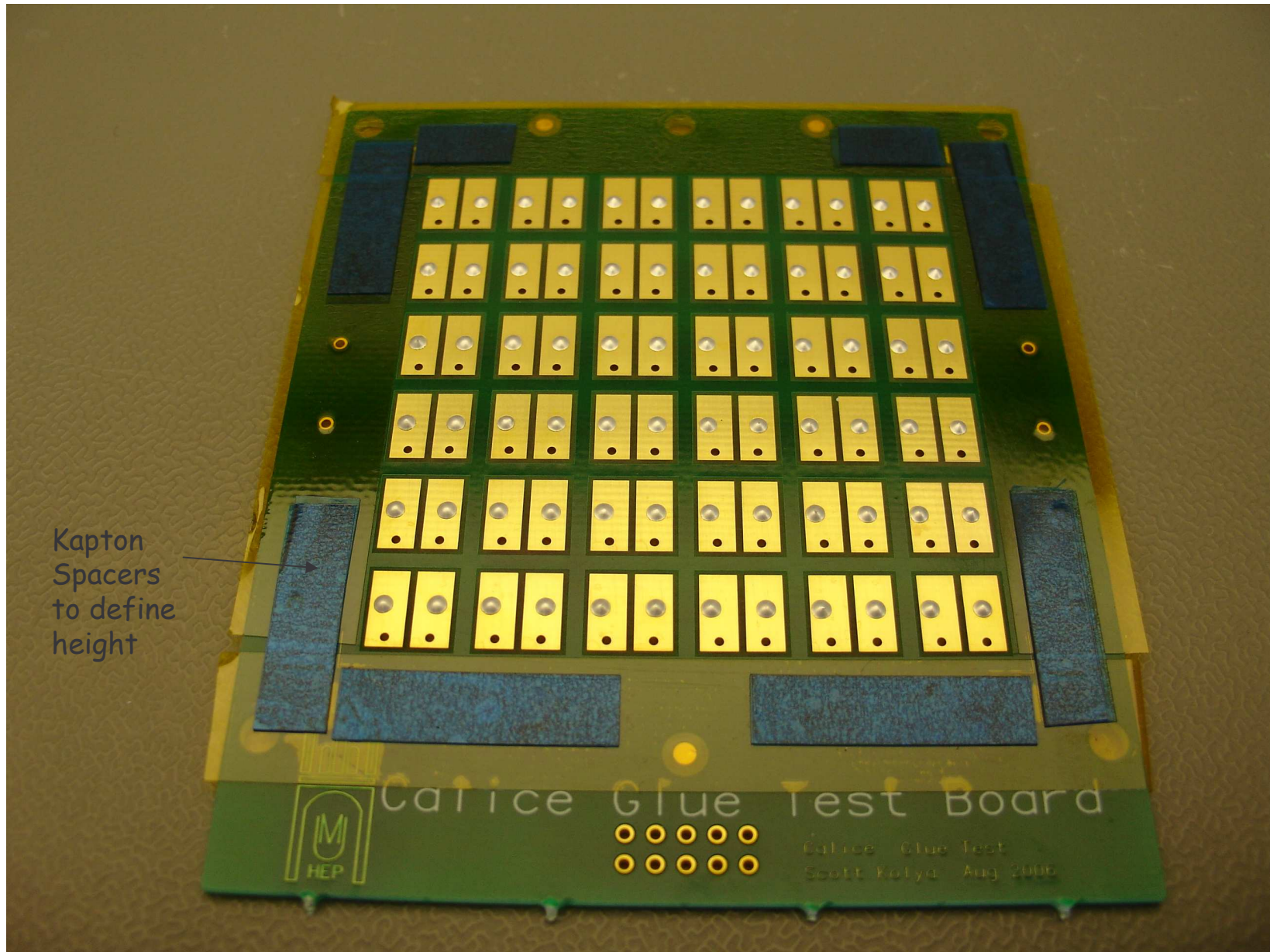
Resistance measurements  
Keithley 236 SMU or 2000 DVM

Labview

Prague wafers



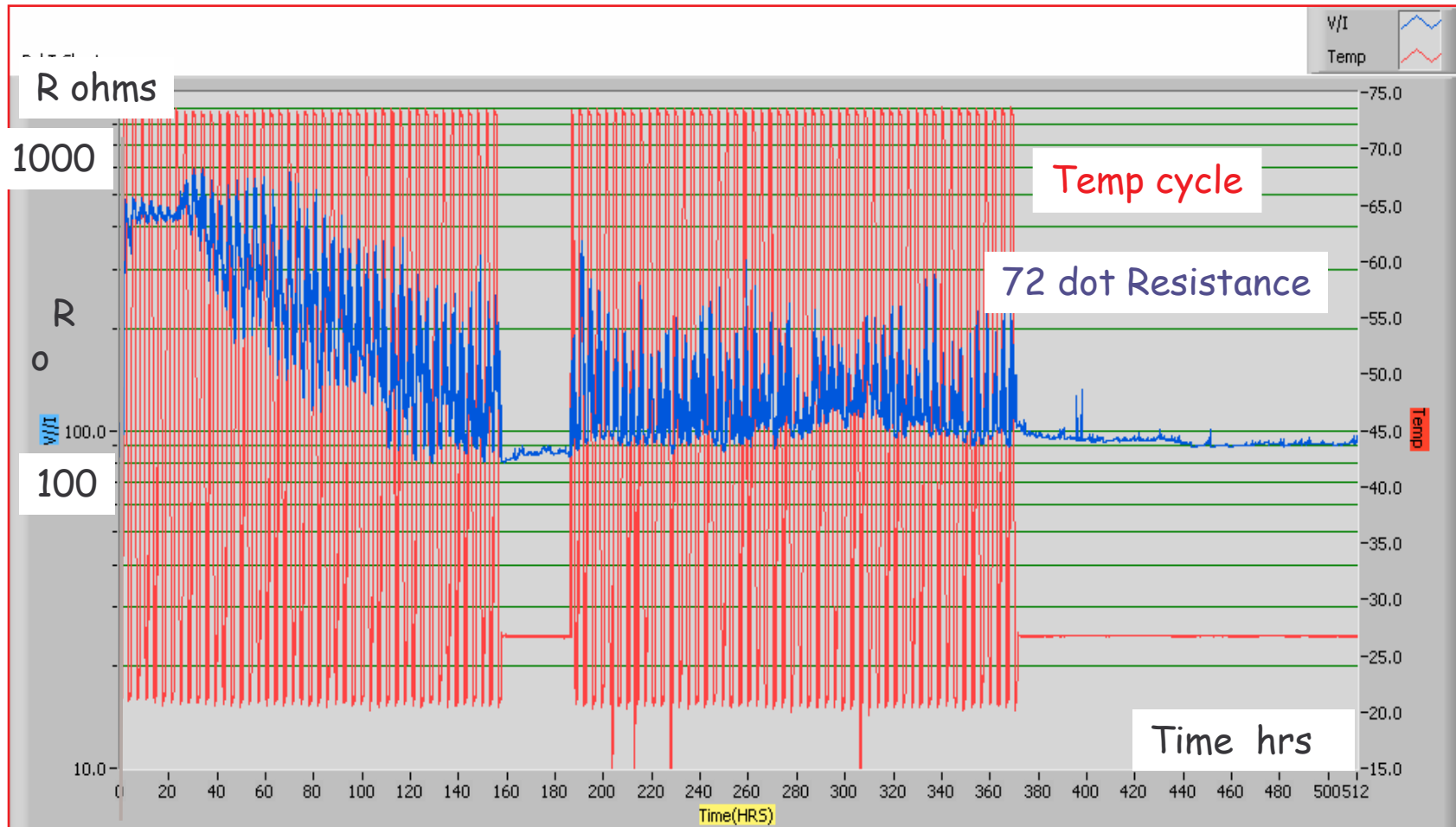




# Long term Thermal Cycling

72 dot Snake test - continually powered 500 hr 20 to 70 degrees 1deg/min

- Slow reduction in resistance over 100 hr then stable at ~ 1 ohm /dot
- Resistance change each cycle as result of expansion / contraction
- No evidence for beginnings of joint failure



## "Virgin" glue joints show initial training behaviour

Cured for some days no previous bias applied

On first application of voltage IV curve can show high resistance at low voltage typically <500 mv then chaotic transitions to lower resistance states as the is voltage increased.

Finally a step transition to "normal" state ~1 ohm typically at a few volts. Once this state has been established it seems permanent.

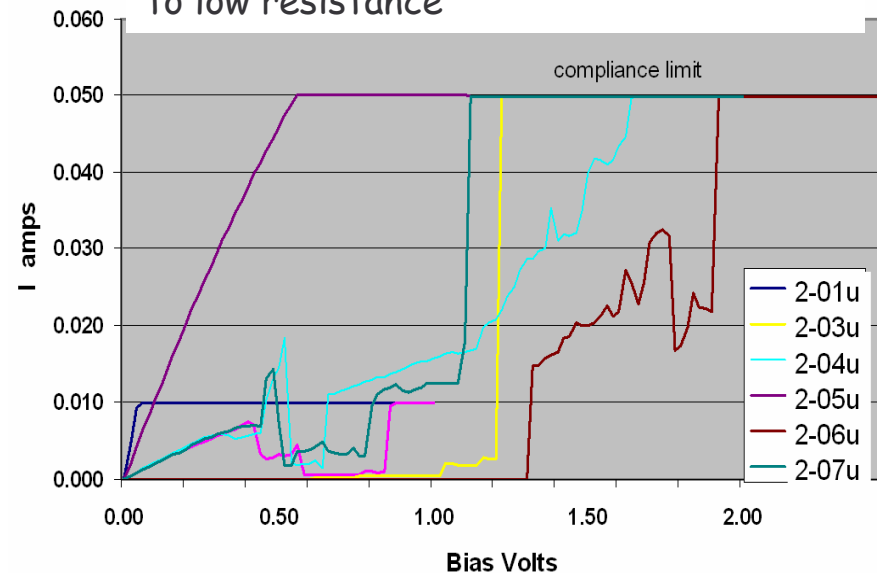
The mechanism is probably a complex mixture of punch through of nanometer scale oxide interface films and mechanical breakthrough due to expansion by localised heating

Initial resistance measurements with low voltage sources - many DVMs - can give very misleading results.

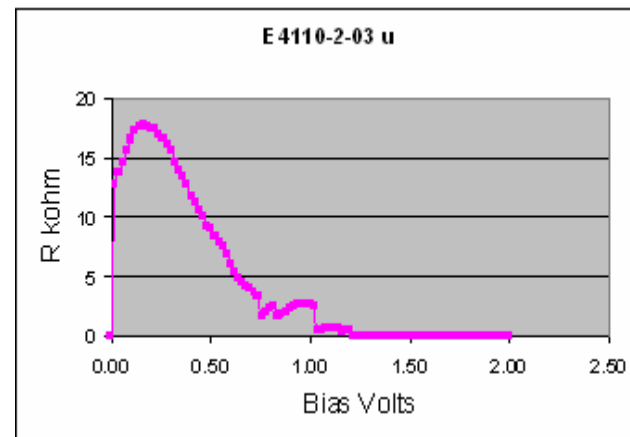
This is consistent with our Atlas experience - few volts needed for initial measurement.

Some evidence oxide films can reestablish themselves if detectors left unbiased for months in normal air- can be 'reset' by few volts.

Dot pair IV curves showing transition to low resistance



Corresponding Resistance plot



## Summary

'Virgin' glue joints can show initial high resistance behaviour at low bias

Bias > few volts enables conducting paths to be established

Care needed when making DVM measurements

Consistent with Atlas observations

Thermal Cycling Tests show no indications of beginnings of joint failure

## Where now?

Wrap up glue studies

Move on to assembly studies