# The impact of mechanical and thermal effects on high reliability electronic interconnects and performance enhancement methods

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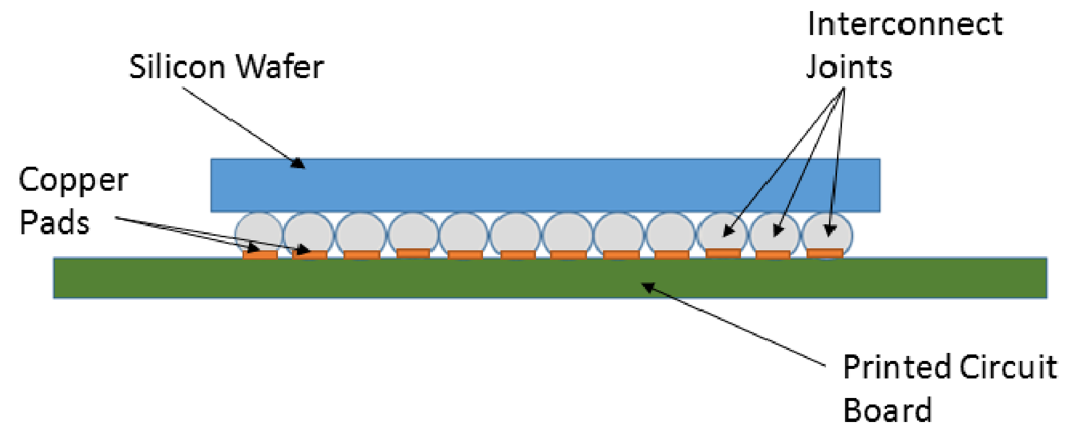
# Introduction

https://www.google.com/selfdrivingcar/

# Wafer-Level Packages

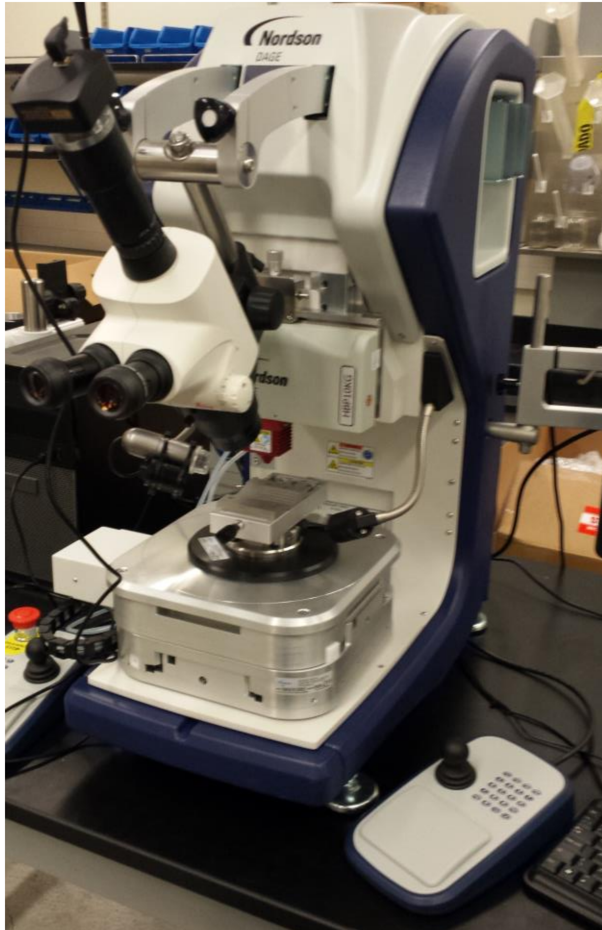
- What is an interconnect?
- Solder Balls
- Pb vs. Pb free
  - SAC alloys

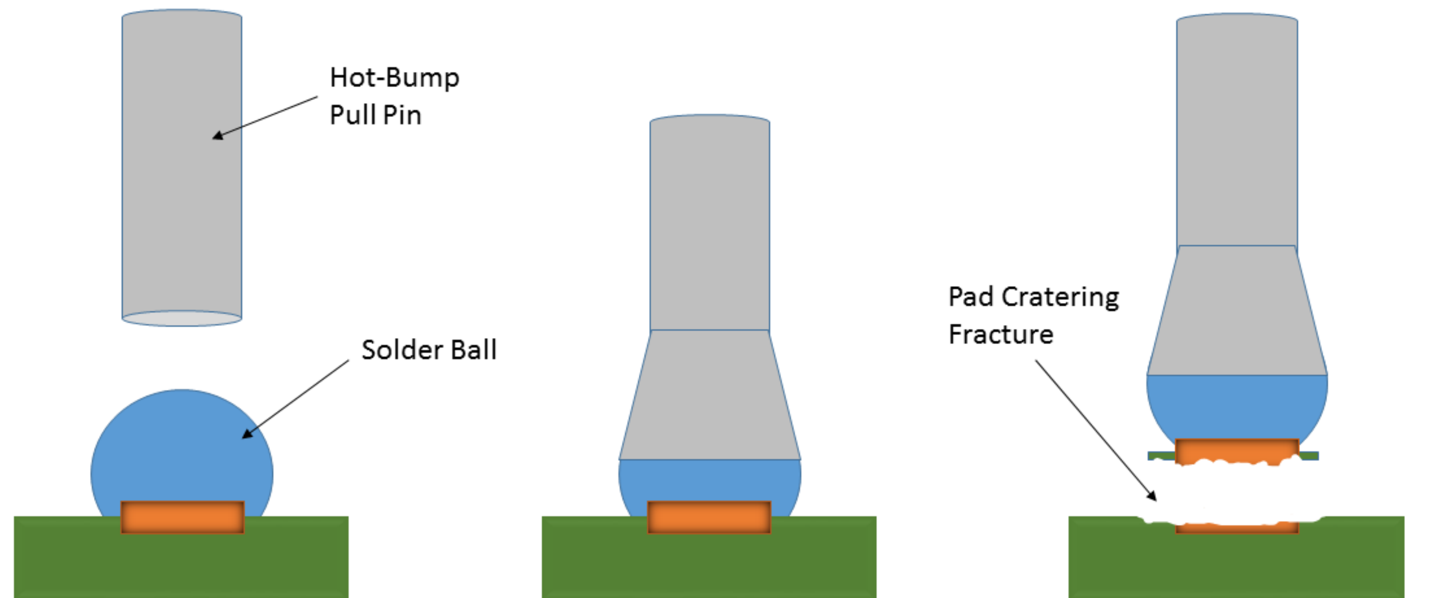


# Reliability Issues

- Mechanical Shock
- Corrosion
- Temperature
  - Long exposure to heat
  - Cyclic exposure

# Bond Tester



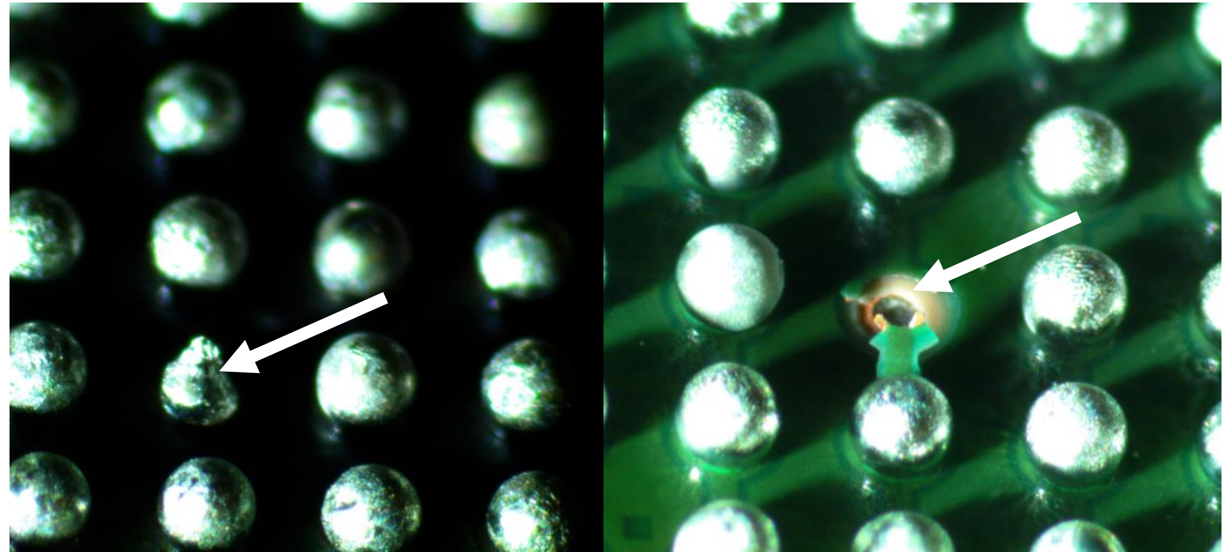

A hot-bump pull pin is moved into place on top of the solder ball at room temperature.

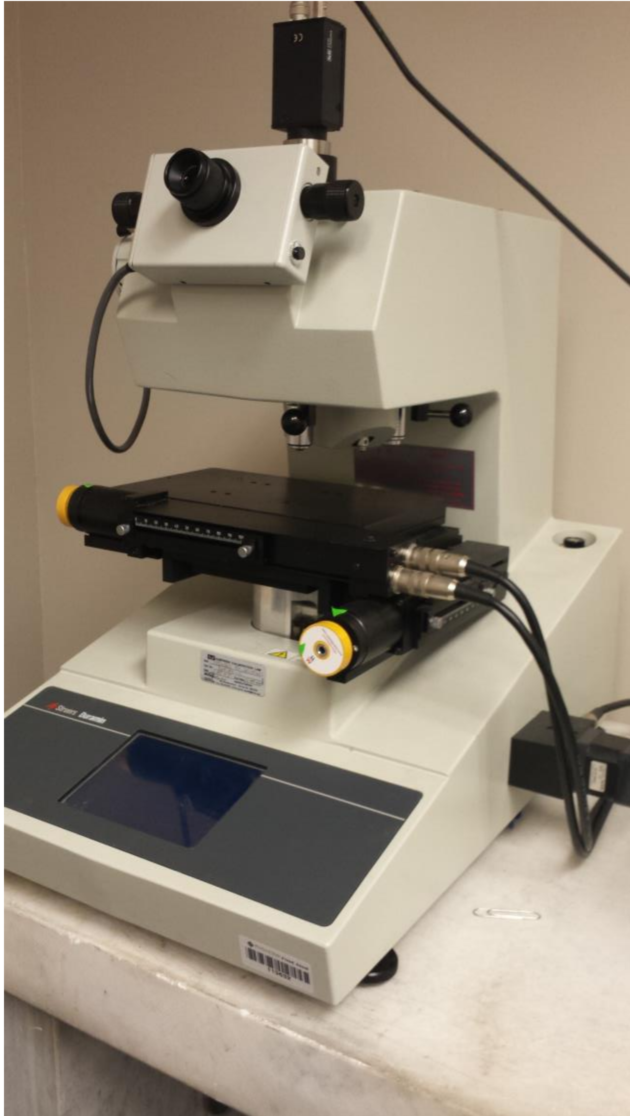
The pin reaches a temperature of 260°C and solders to the ball.

The mechanism pulls on the joint and breaks it.

# Bond Test Results

- Aged and Unaged Samples
- “Pad cratering”



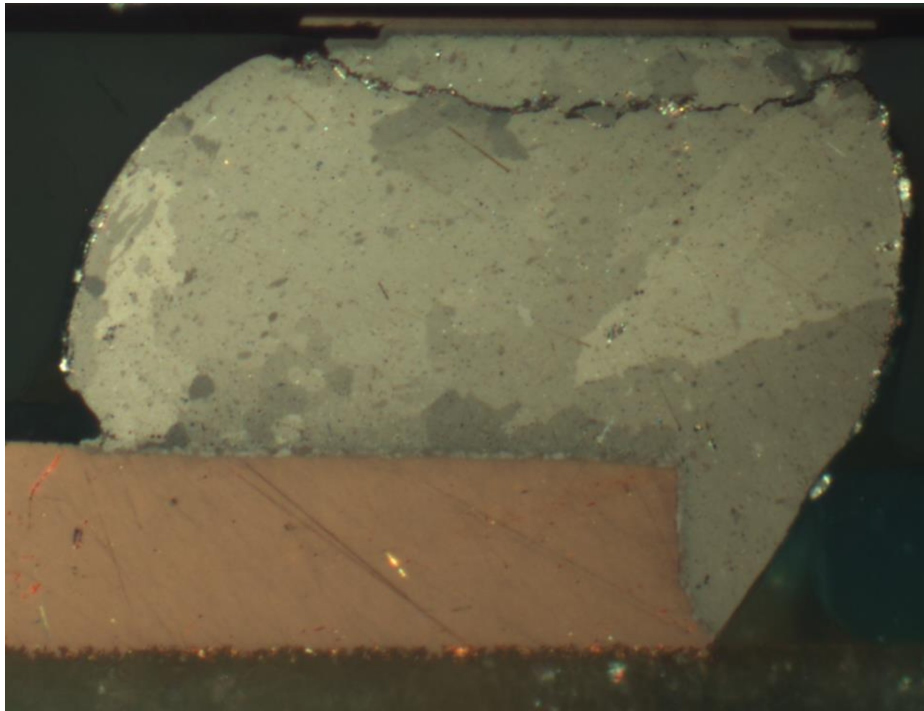


# Hardness Results

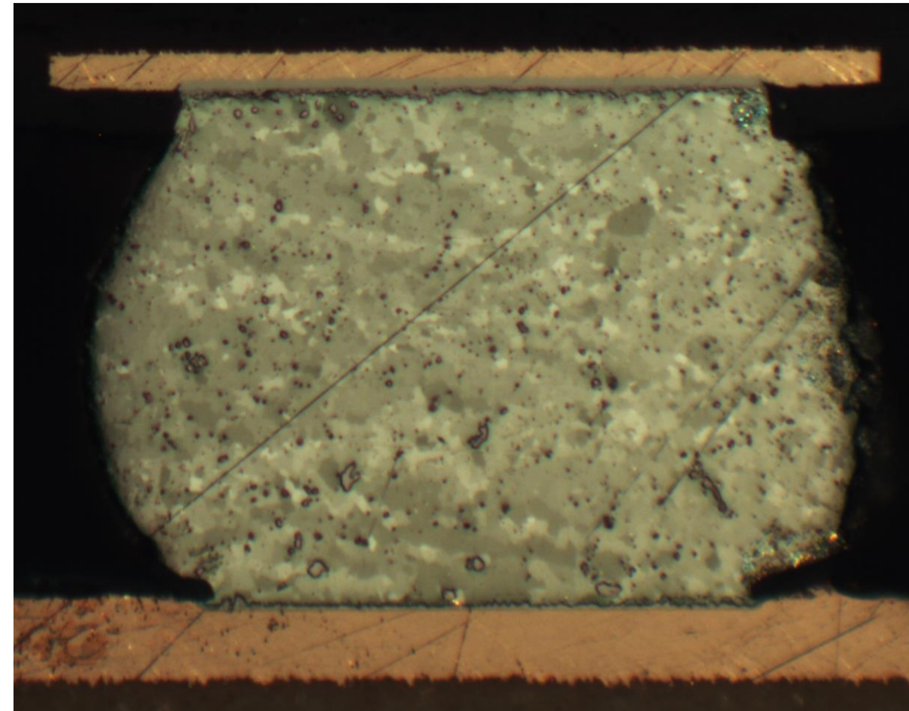
| Table 1: Bond Strength and Hardness Test Results | | | |
|---|---|---|---|
| | Laminate Failure % | Average Force (kg) | Average Hardness (HV) |
| Aged | 89.47% | 1.523 | 22.45 |
| Unaged | 26.09% | 1.789 | 24.59 |

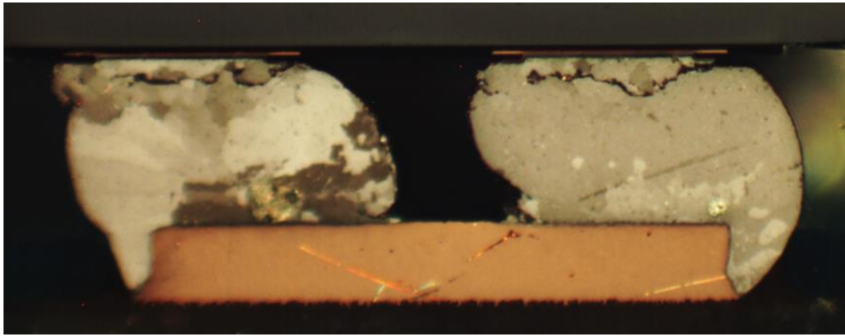
# Nano Particles

NORMAL SAC ALLOY, AGED



SE NANO PARTICLE ALLOY, AGED

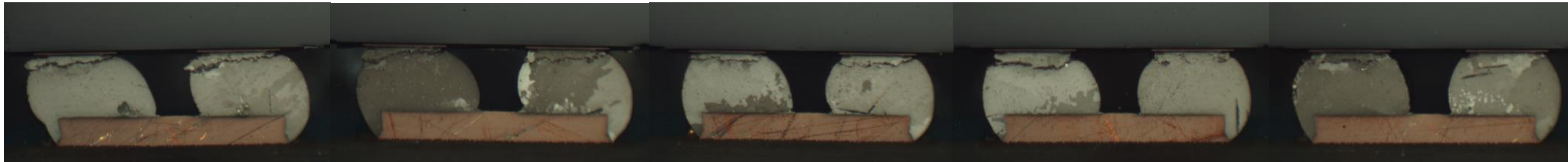




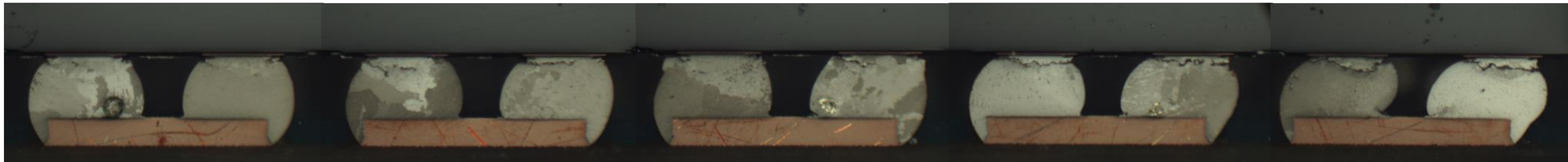
# Thermal Cycling

- CTE mismatch
- Change in crystal structure
- Edge bond solution

L1 L2 L3 L4 L5 L6 L7 L8 L9 L10



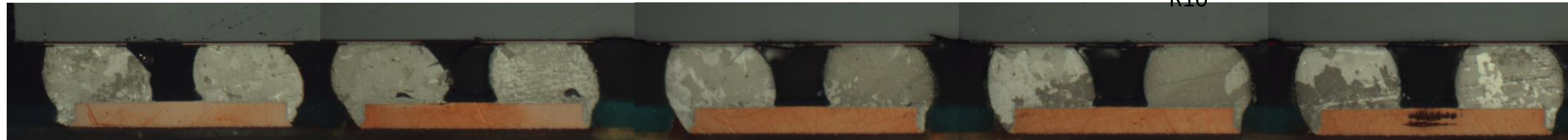
R9 R8 R7 R6 R5 R4 R3 R2 R1



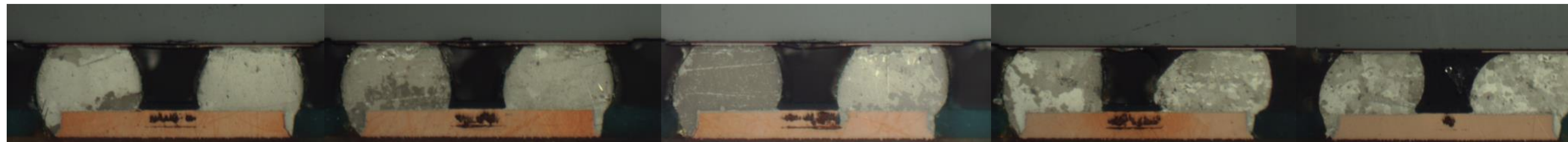
No Edge Bond, Edge Row

L1 L2 L3 L4 L5 L6 L7 L8 L9 L10

R10

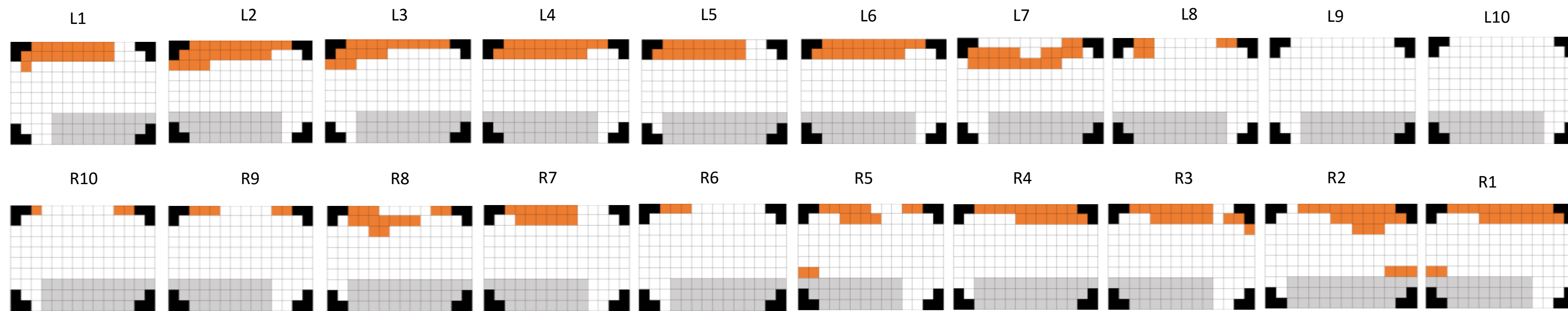


R10 R9 R8 R7 R6 R5 R4 R3 R2 R1

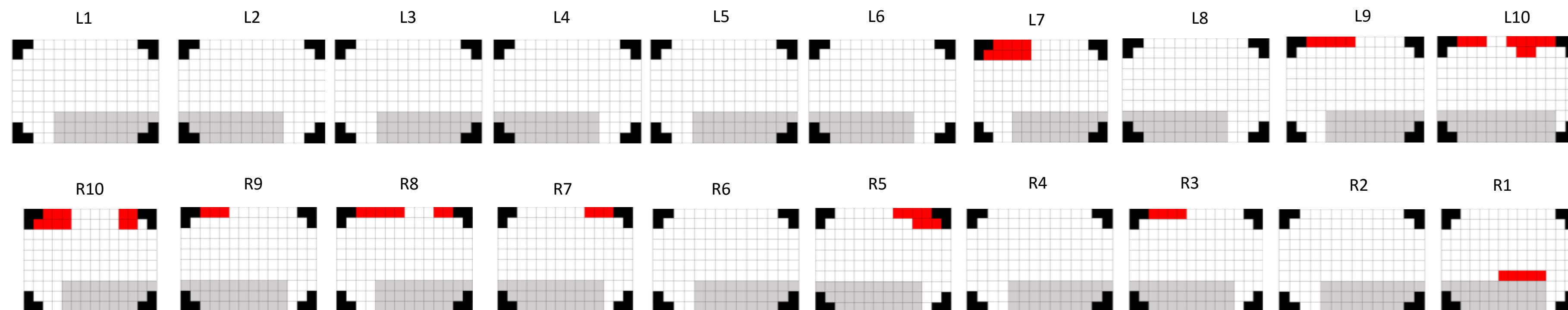


Full Edge Bond, 4th Row

# No Edge Bond




# Full Edge Bond



# Summary

- Importance of interconnects
- Impacting Environments
- Bond Test
- Thermal Cycling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  - The National Science Foundation

# Questions?

# References

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