POSTER #23-5

Reducing to thermal soak time of probe card with tunable power of heater in space transformer

*KWANG-JAE OH, JOO-YONG KIM, YONG-HO CHO, KYUNG-TAE MOON, Protec MEMS Technology

Introduction

- Since many applications, especially automobiles, require reliable memory for wide operating temperatures, such characteristics are measured from the wafer test stage.

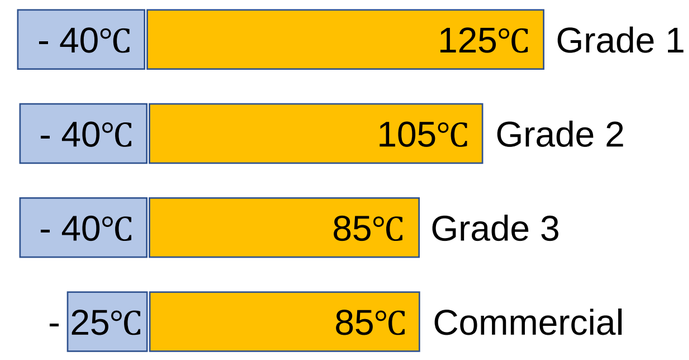


Fig.1. Wide operating Temperature Range of NAND Memory

- In the Wafer EDS (Electrical Die Sorting) test process, a probe card is used to determine whether it operates normally at hot/cold temperatures.

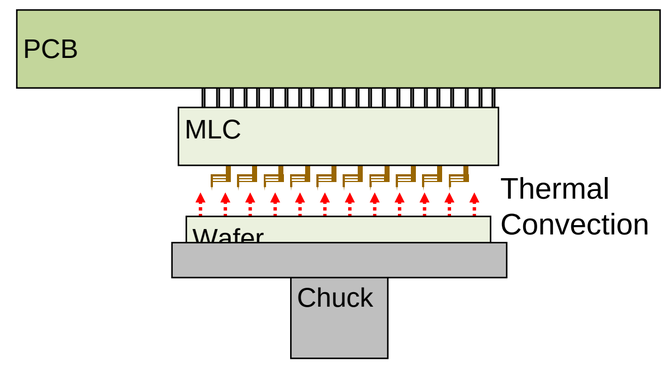


Fig.2. Probe card hot temp. soaking by thermal convection of wafer on chuck

- Testing at high temperatures, both the wafer and the probe card must be saturated with high temperature to ensure that the contact between the wafer pad and the probe tip is stably performed during the measurement.

- The Needs for increasing productivity: Reducing the setup and test time

  - Setup process : Multiple Pre-soak and One Quick-soak for balancing the temperature between the probecard and the wafer

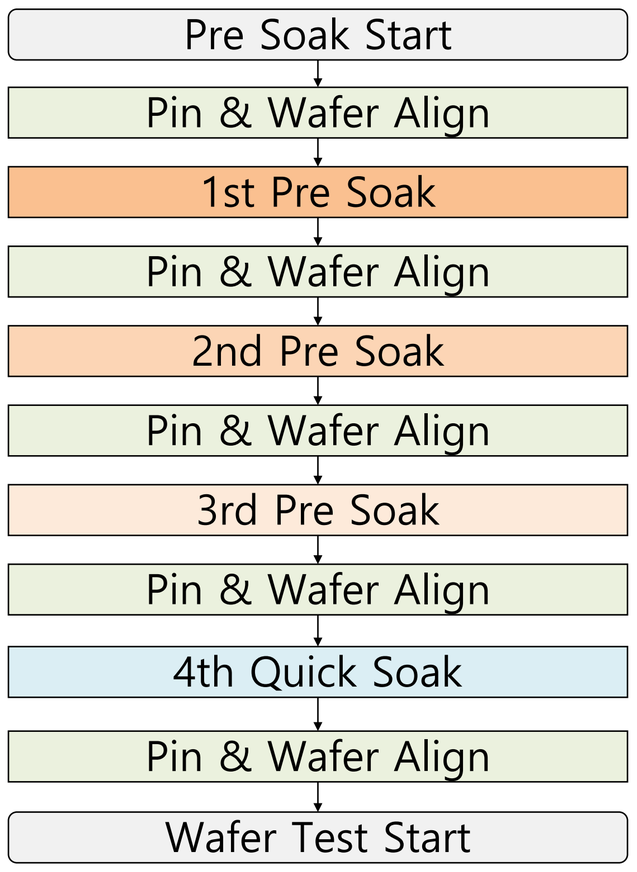


Fig.3. The Soaking process for saturation temperature before testing

Proposal of Reducing Test time using the Heater Circuit in STF

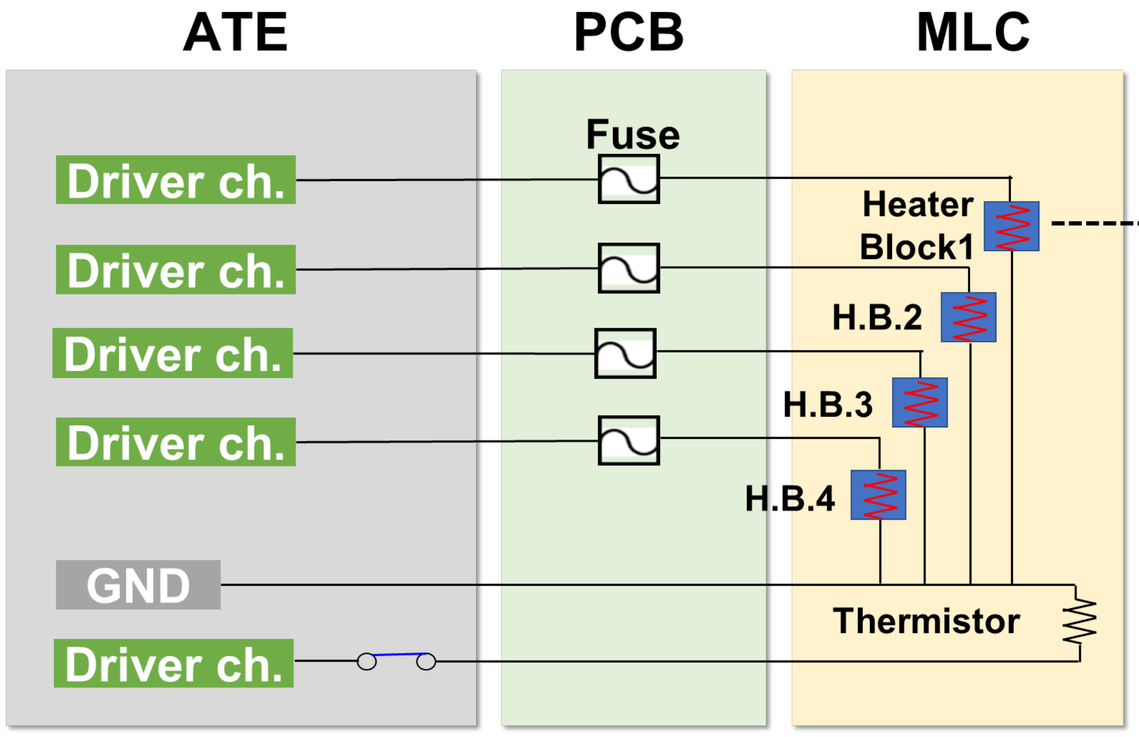
- When the temperature of the probe card is raised to a temperature suitable for hot test through thermal convection, it takes a long time and requires multiple soaking processes.

- When the heater pattern is designed in the MLC (Multi-Layer Ceramic), the temperature of the probe card can be quickly raised and saturated to the desired temperature by thermal transfer to the conduction rather than convection.

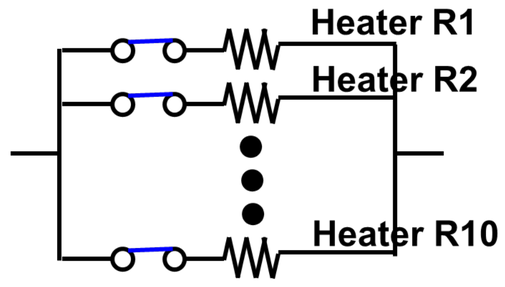
Concept and Design the Tunable Heater

- Heater Spec.
  1. Heater Object : Target temperature reached in less than 10 minutes
  2. Heater Target Power Range: 210 ~ 350W @ specific Voltage
  3. Design Parameter : 40 individual resistor patterns in MLC with 3 inner layers
  4. Heater Power Tuning Method
     - ✓ Parallel connection to each resistor
     - ✓ Adjusting the number of parallel resistor using laser cutting or switch

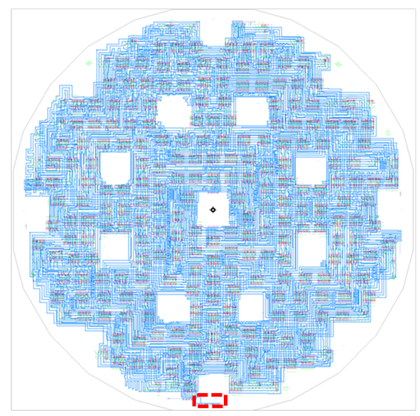
Heater Concept



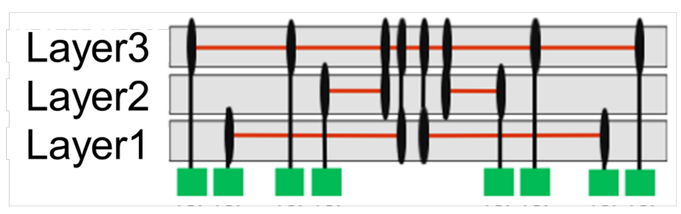
Heater Block

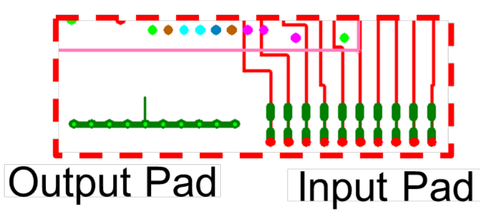


Heater Design



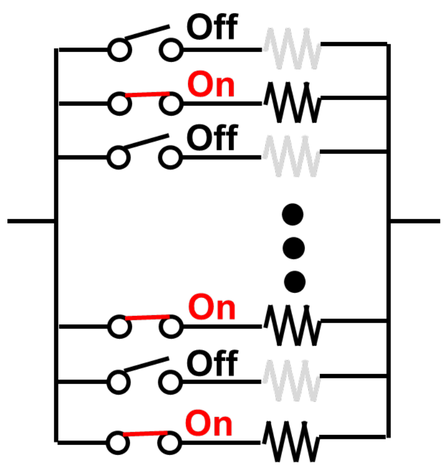
Heater Layout





Heater Power Tuning Method

1. Parallel connection to all of resistors
2. Adjusting the number of parallel resistor using laser cutting or switch

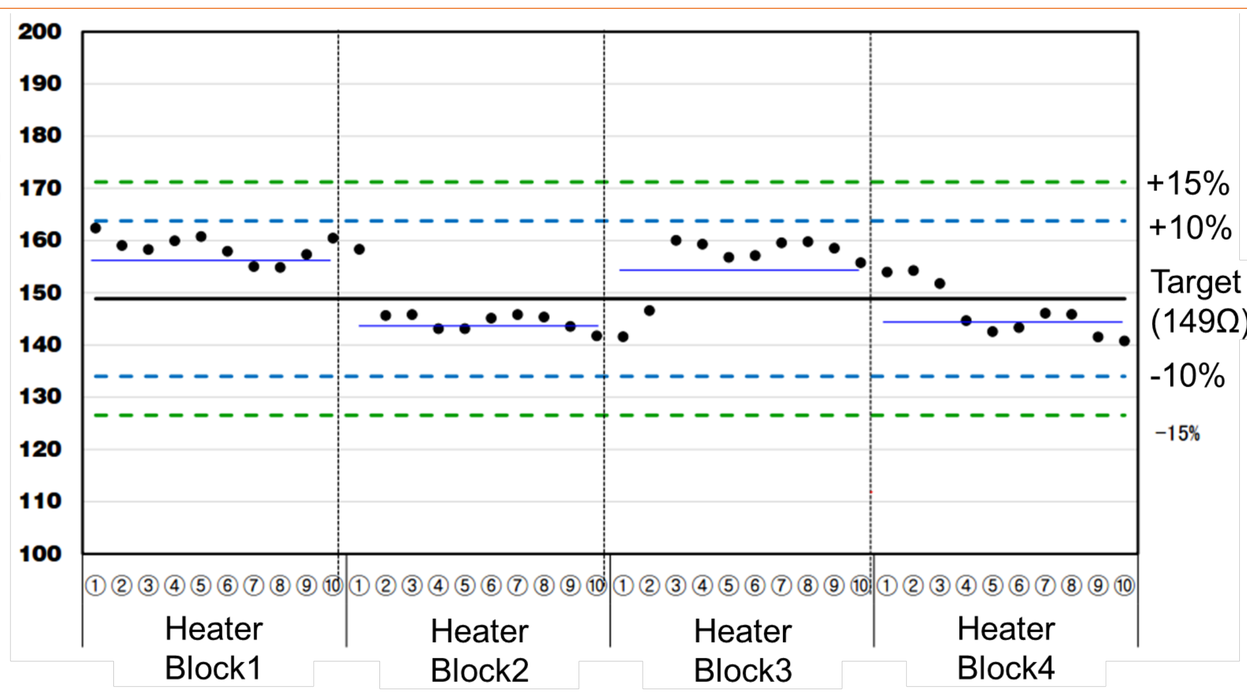


$$R_{total}\,[\Omega] = \frac{R}{\#\ of\ R_{on}}$$

$$P_{heater}\,[W] = \frac{{V_{Supply}}^2}{R_{total}}$$

# of R	1	24	28	32	36	40
R_{total} [Ω]	149	6.20	5.32	4.65	4.14	3.72
P_{heater} [W]	-	210	240	280	310	350

Heater Resistor Measurement



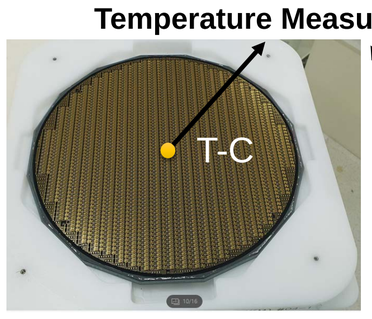
[unit : Ω]

	$R_{Average}$	# of R_{on} at Heater block		
		7	8	9
Heater Block 1	158.6	22.7	19.8	17.6
Heater Block 2	145.7	20.8	18.2	16.2
Heater Block 3	155.5	22.2	19.4	17.3
Heater Block 4	146.5	20.9	18.3	16.3

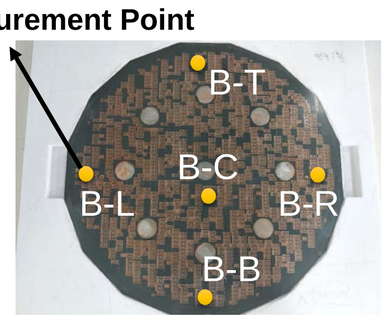
1. All Resistors Value : 145~158Ω (Target 149Ω, tolerance ± 10%)
2. Tunable Power Range : 200~350W (target 280W)

Heater Operation Test

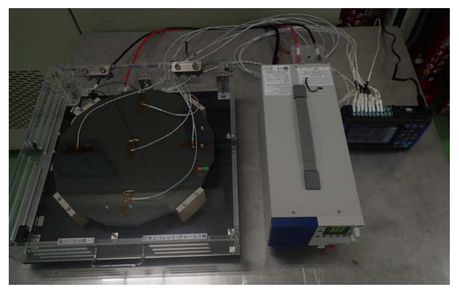
- Test Condition 1 - only MLC
  1. Test Sample : 12 inch MLC for Memory
  2. Tuning Heater Power : 280W, 350W
  3. Test Time : 1 hr
  4. Test Point : 6 points, Top center(wafer Side), Bottom T/C/B/L/R(tester side)

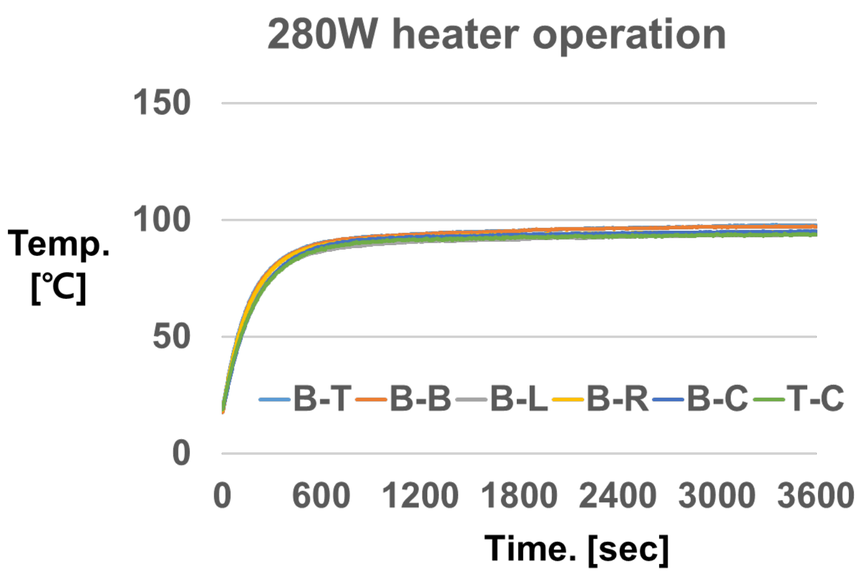


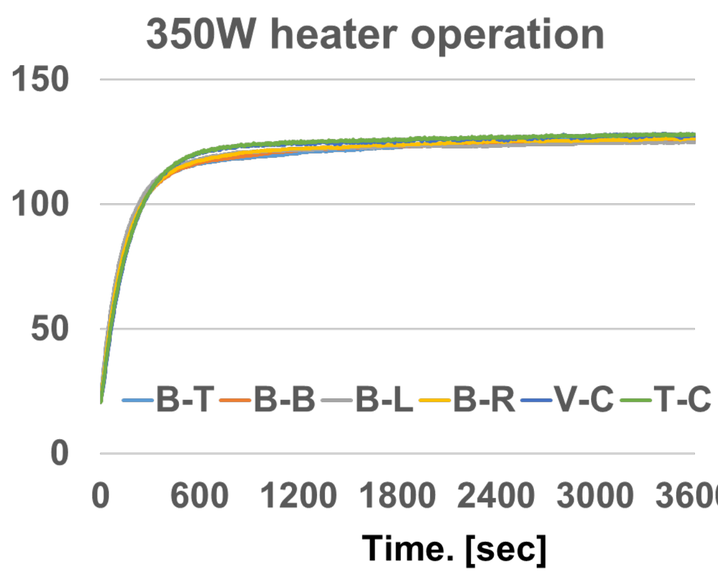
Wafer side MLC

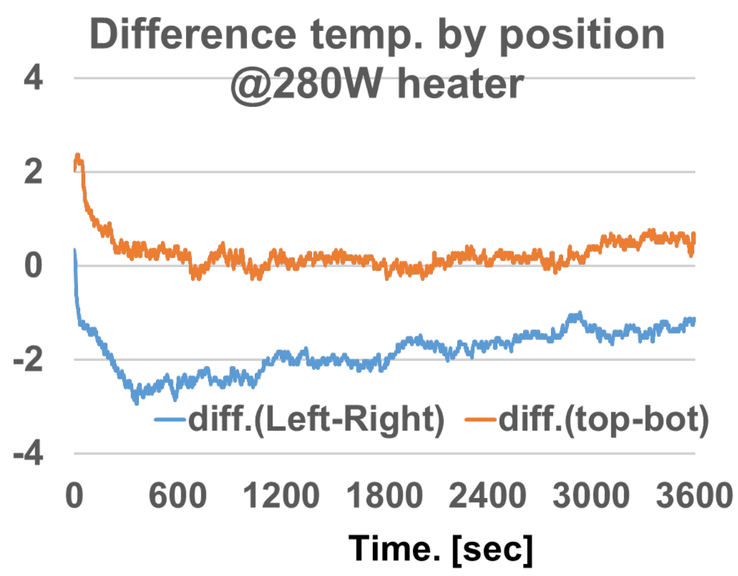


Tester side MLC


Measurement System



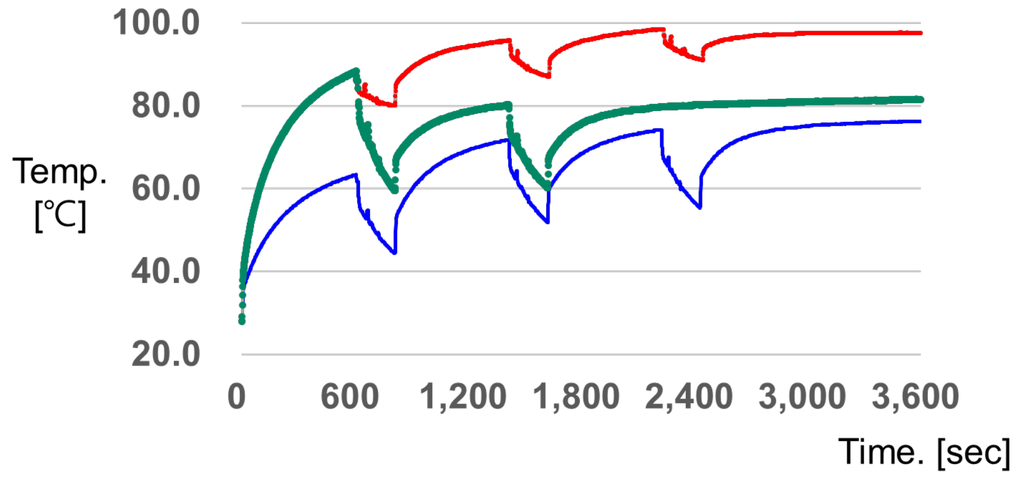




- Test Result 1 - only MLC
  1. 280W heater : 87℃ during 10minute, 92℃ saturation after 15minute
  2. 350W heater “ 120℃ during 10minute, 126℃ saturation after 15minute
  3. Difference temperature by MLC position(@280W heater) : max. ± 2℃

- Test Condition 2 – Probecard with 280W heater
  1. Heater on during all soaking process
  2. Heater on at 1’st pre-soaking then off
  3. Heater off during all soaking process

Difference in soak process depending on heater



- Test Result 2 – Probecard with 280W heater
  1. Saturation temperature after soaking, it is 20 degrees higher than heater off
  2. Heater on at 1st soaking process, the reach time of saturation temperature is half.
  3. If the saturation time is fast, the temperature stability of the probecard can be secured quickly (the saturation time of PCB and stiffener is also shortened).

Conclusion

- saturation temperature of the probecard can be reached quickly by using the heater.
- When using the heater, it reduces the soaking time, which has the effect of reducing the overall test time.
- Tunable Heater can be operated as a single heater design for various high temp. test .
- In addition, using heater, the temperature change of the probecard during idle time is small, so the length of the scrub mark can be reduced even in high-temperature tests.

Contact Information

- kj.oh@pmt23.com (South Korea)
- Jooyong@pmt23.com (USA)