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# ROUTE60™: a new vertical probing technology



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# Authors

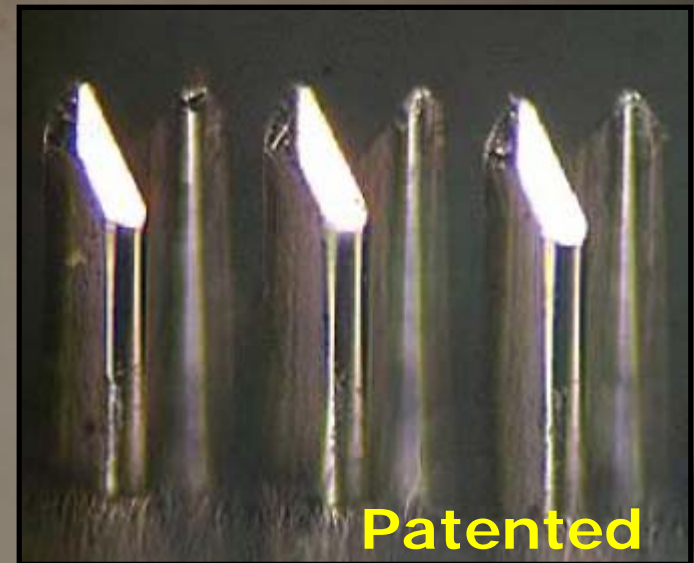
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- ◆ **S. Lazzari** – Technoprobe

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# Technology Introduction - Needles

- ◆ **Buckling Beam style:** higher possibility to control the gram force
- ◆ **Needle section equivalent to 3 mils  $\emptyset$  wire:**
  - ◆ Robust mechanics
  - ◆ High current capability
- ◆ **Flattened section** of needles allows **fine Pitch applications down to  $60\mu\text{m}$**



# Technology Introduction - Design

- ◆ **Gram Force adjustable** between 5 to 8 g
- ◆ **Small scrub action** proportional to OD
- ◆ **Tight Alignment:**  $\pm 10 \mu\text{m}$
- ◆ **Planarity** range :  $40 \mu\text{m}$
- ◆ **Temperature** range:  $-45 \div +150^\circ\text{C}$
- ◆ **Hard Ceramic:**
  - ◆ CTE  $3.3 \text{ ppm}/^\circ\text{C}$  close to Silicon
  - ◆ Low needles friction
- ◆ **Needles Assembly:** no template required, easy tip replacement

## Qualification on a 80 $\mu$ m pitch product

- ◆ **Embedded Flash Microcontroller** for automotive market
- ◆ **Small pad opening** (65 $\mu$ m  $\times$  70 $\mu$ m)
- ◆ Up to **4 EWS Tests, 3 testing temps** – **KGD** flow
- ◆ **Small probing process margins with present Epoxy** probe cards mainly @ HOT temp:
  - ◆ Passivation breakage
  - ◆ Large scrub marks impacted area
- ◆ **Benchmark** with Epoxy probe cards



# Product test flow description

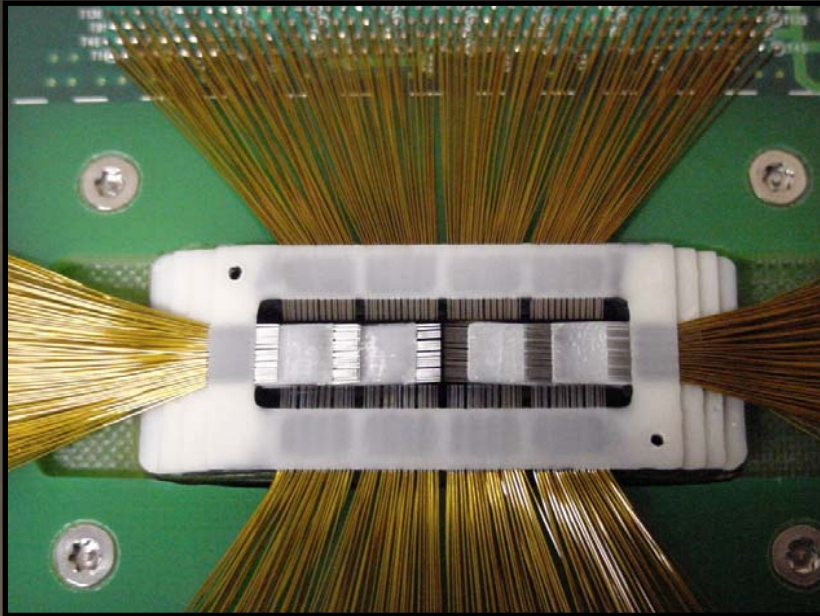
## Package Flow:

- ◆ EWST1 @ Room T - Vertical //32
- ◆ Bake (24 h)
- ◆ EWST2 @ Room T - Vertical //32
- ◆ **EWST3 @ Room T - Epoxy //4**

## KGD Flow:

- ◆ EWST1 @ Room T - Vertical //32
- ◆ Bake (24 h)
- ◆ EWST2 @ + 125°C - Vertical //16
- ◆ **EWST3 @ + 125°C - Epoxy //4**
- ◆ **EWST4 @ - 40°C - Epoxy //4**

# Probe Cards Pictures



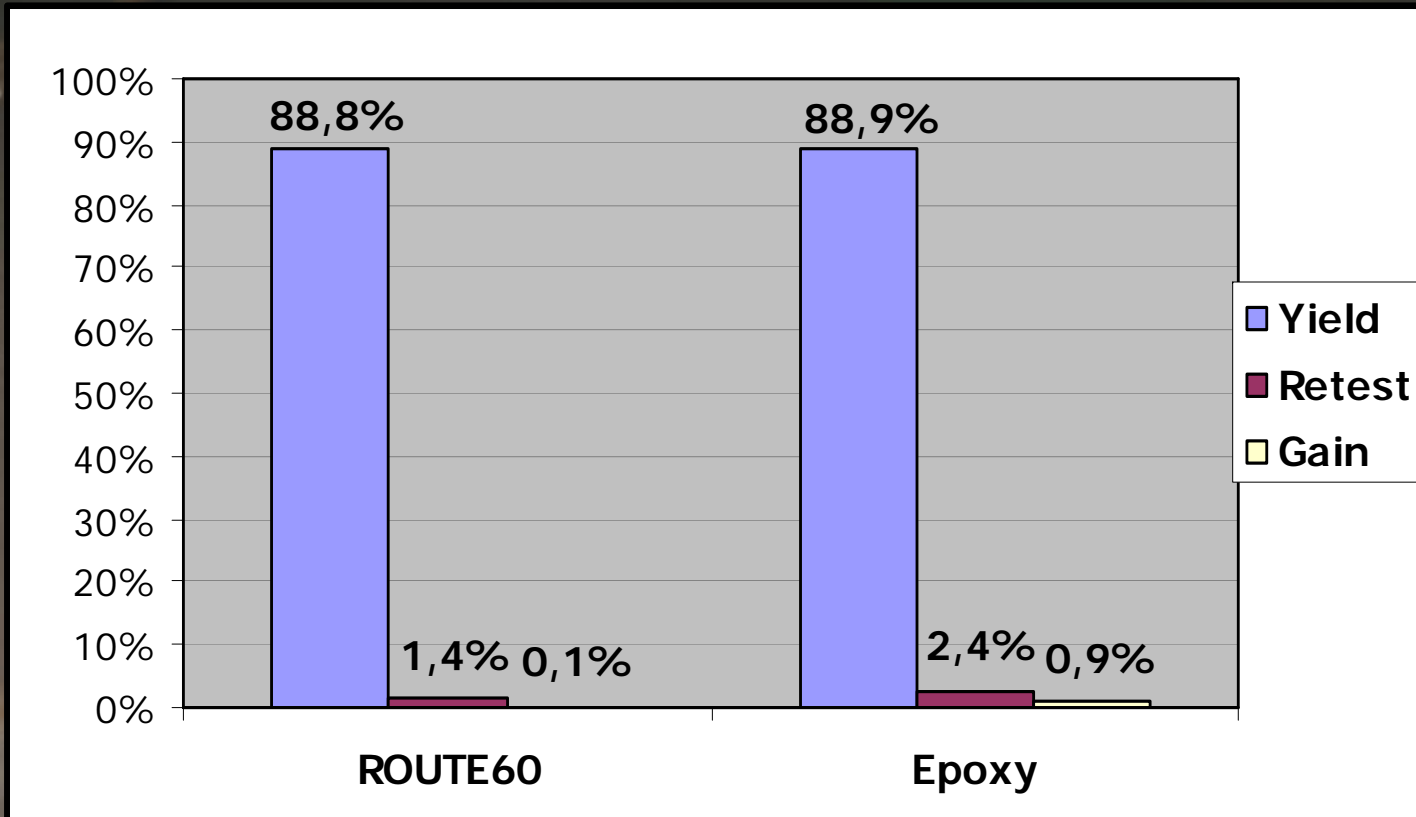
**Epoxy**



**Vertical  
ROUTE60™**



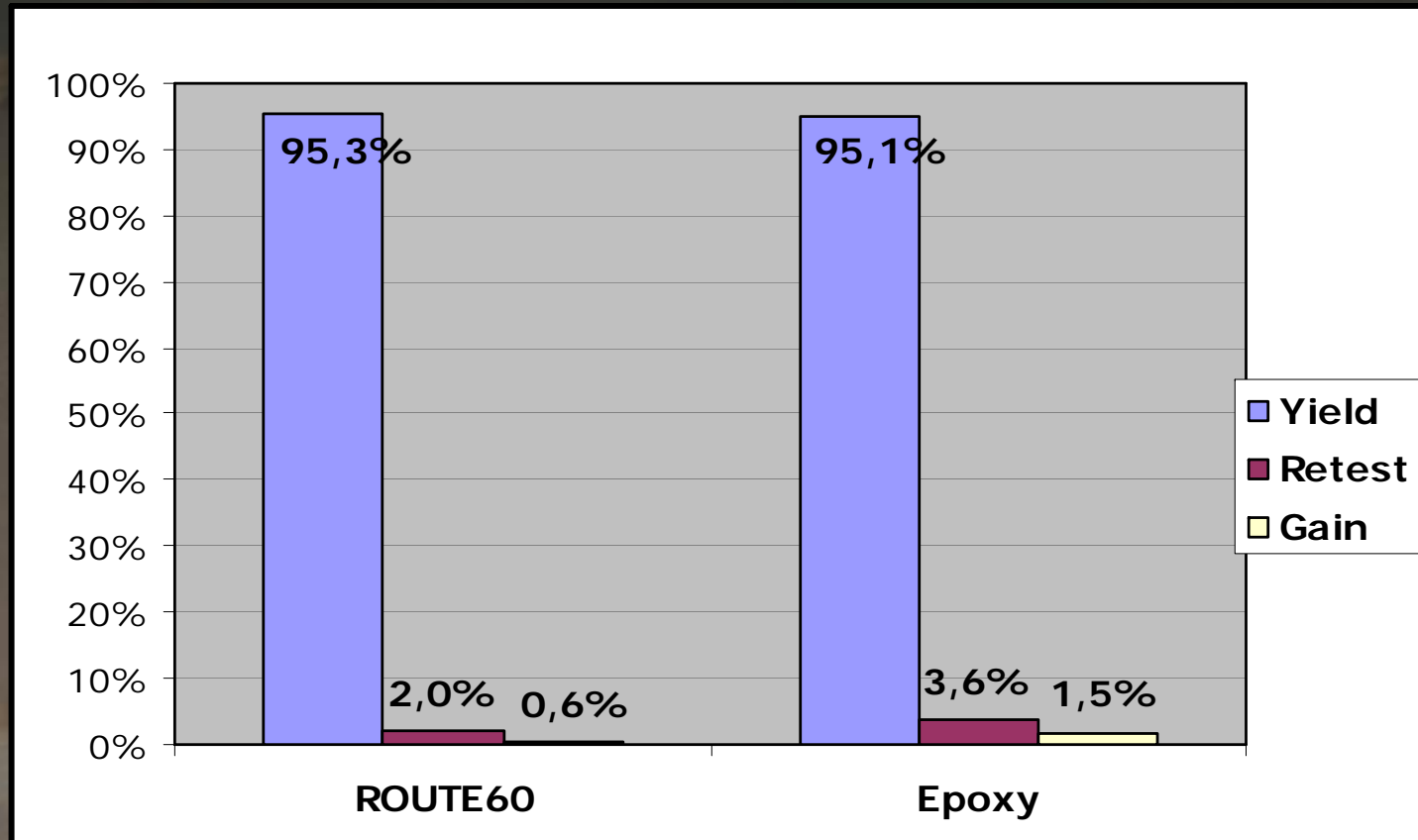
# Electrical results @ ROOM T (EWS3)



◆ **Retest rate:** - 1.0%

◆ **Gain rate:** - 0.8%

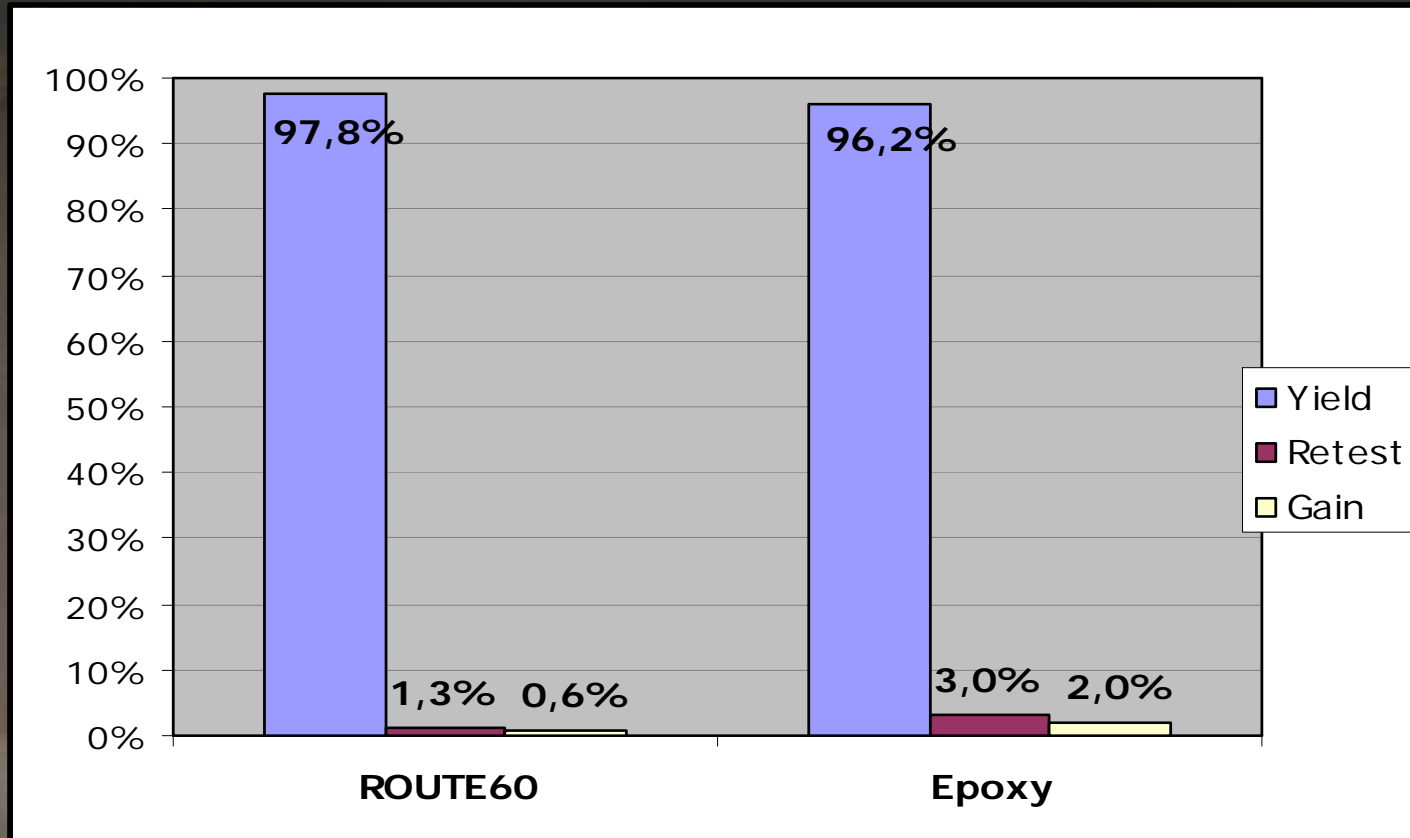
# Electrical results @ +125°C (EWS3)



◆ Retest rate: - 1.6%

◆ Gain rate: - 0.9%

# Electrical results @ -40°C (EWS4)



◆ **Retest rate:** - 1.7%

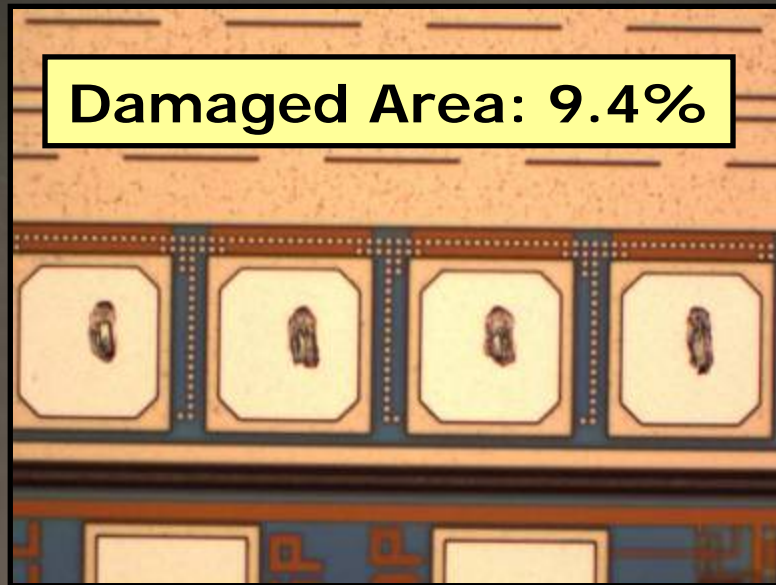
◆ **Gain rate:** - 1.4%

# Mechanical Results @ +125°C: ROUTE60™

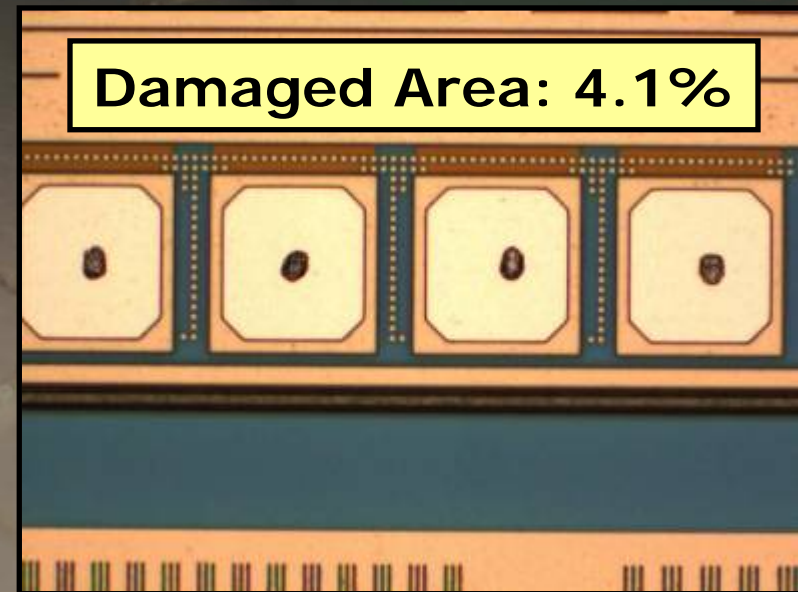
		CENTER		SCRUB		VITRIF	
		X	Y	L	W	L	W
UL		N/A	N/A	32,5	32,5	N/A	N/A
LL		N/A	N/A	10	10	2	2
TIME 0	AVE	33,0	36,0	13,7	14,5	29,4	26
	STDEV	4,6	2,5	1,5	1,1	2,8	3,5
	C <sub>P</sub>	N/A	N/A	2,5	3,4	N/A	N/A
	C <sub>PK</sub>	N/A	N/A	N/A	N/A	3,3	2,3
AGEING	AVE	32	34,3	13,8	14,1	27,6	24,9
	STDEV	3,2	2,4	1,6	1,5	2,8	3,4
	C <sub>P</sub>	N/A	N/A	2,3	2,5	N/A	N/A
	C <sub>PK</sub>	N/A	N/A	N/A	N/A	3,0	2,2

## Scrub mark pictures @ +125°C

**Epoxy**



**ROUTE60™**



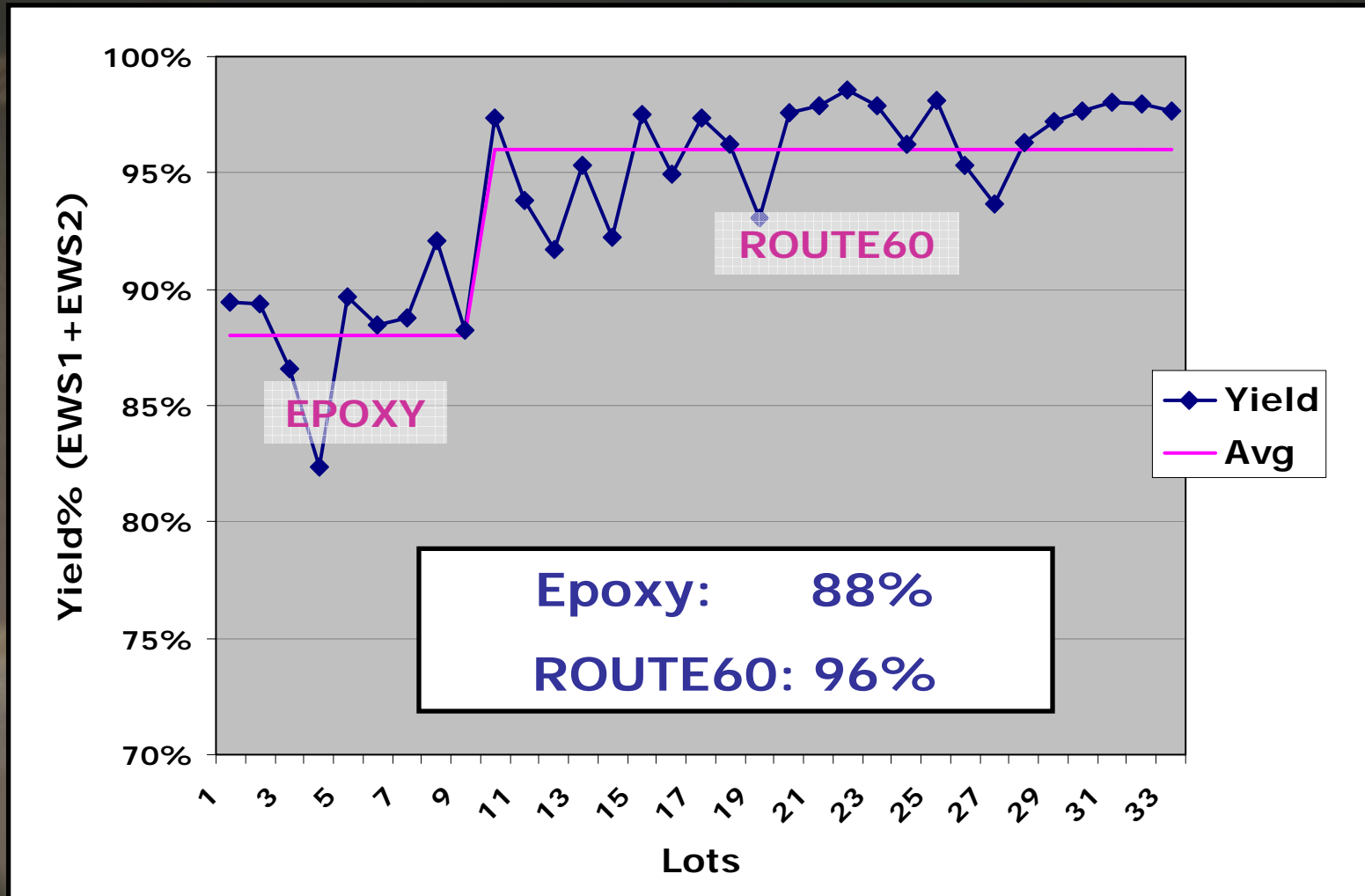
**PAD DAMAGE is largely reduced** using vertical probe cards: **more than 50% of reduction**  
probe cards: **more than 50% of reduction**



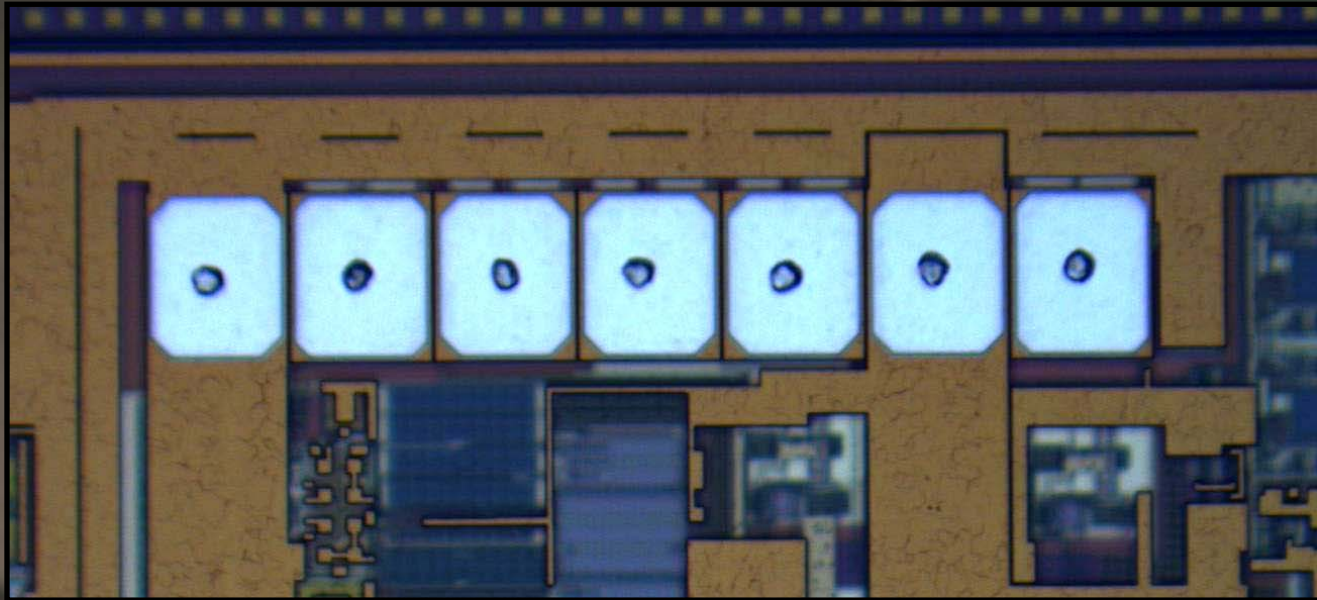
## 65 $\mu$ m Pitch Product Vehicle Results

- ◆ **Small pad opening** (58 $\mu$ m  $\times$  71 $\mu$ m)
- ◆ **Up to 2 EWS Tests**, ROOM T, //8
- ◆ **Small probing process margins** with Epoxy probe cards :
  - ◆ Passivation breakage
  - ◆ Large scrub marks impacted area
  - ◆ Contact issues
- ◆ **Benchmark** with Epoxy probe cards

# Electrical results after EWS1 and EWS2



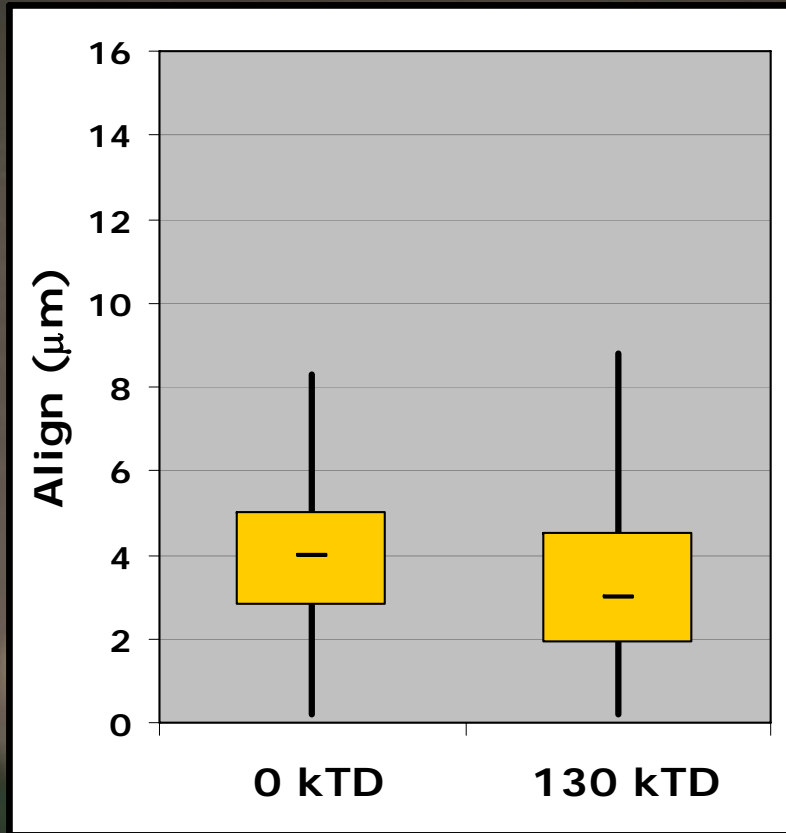
## Scrub mark pictures



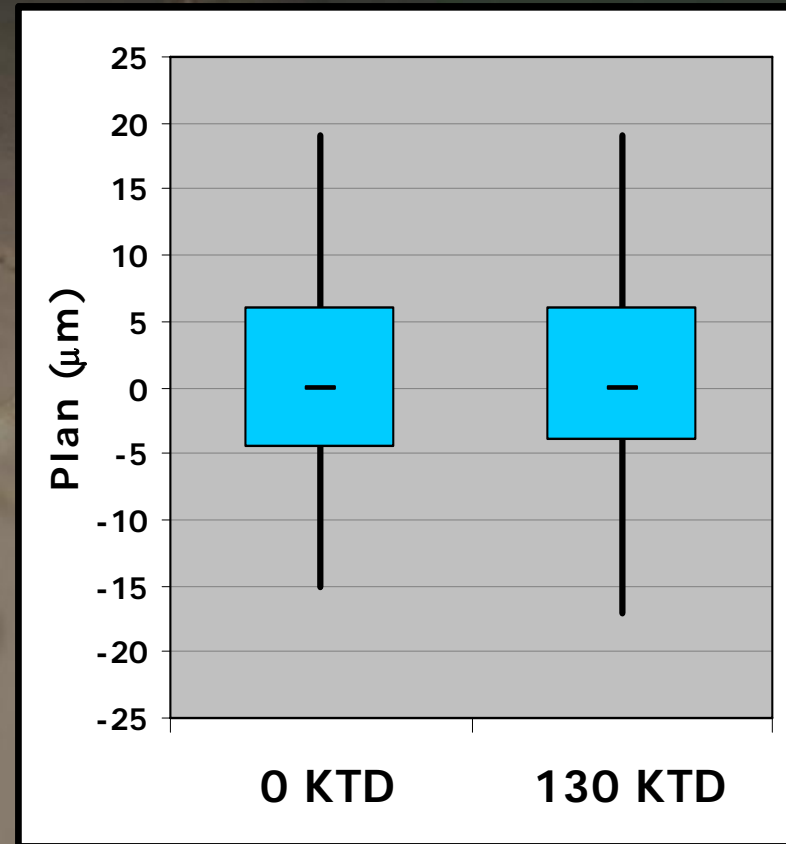
**ROUTE60™ on 58×65 μm pads  
at 65 μm pitch**

# Mechanical Results

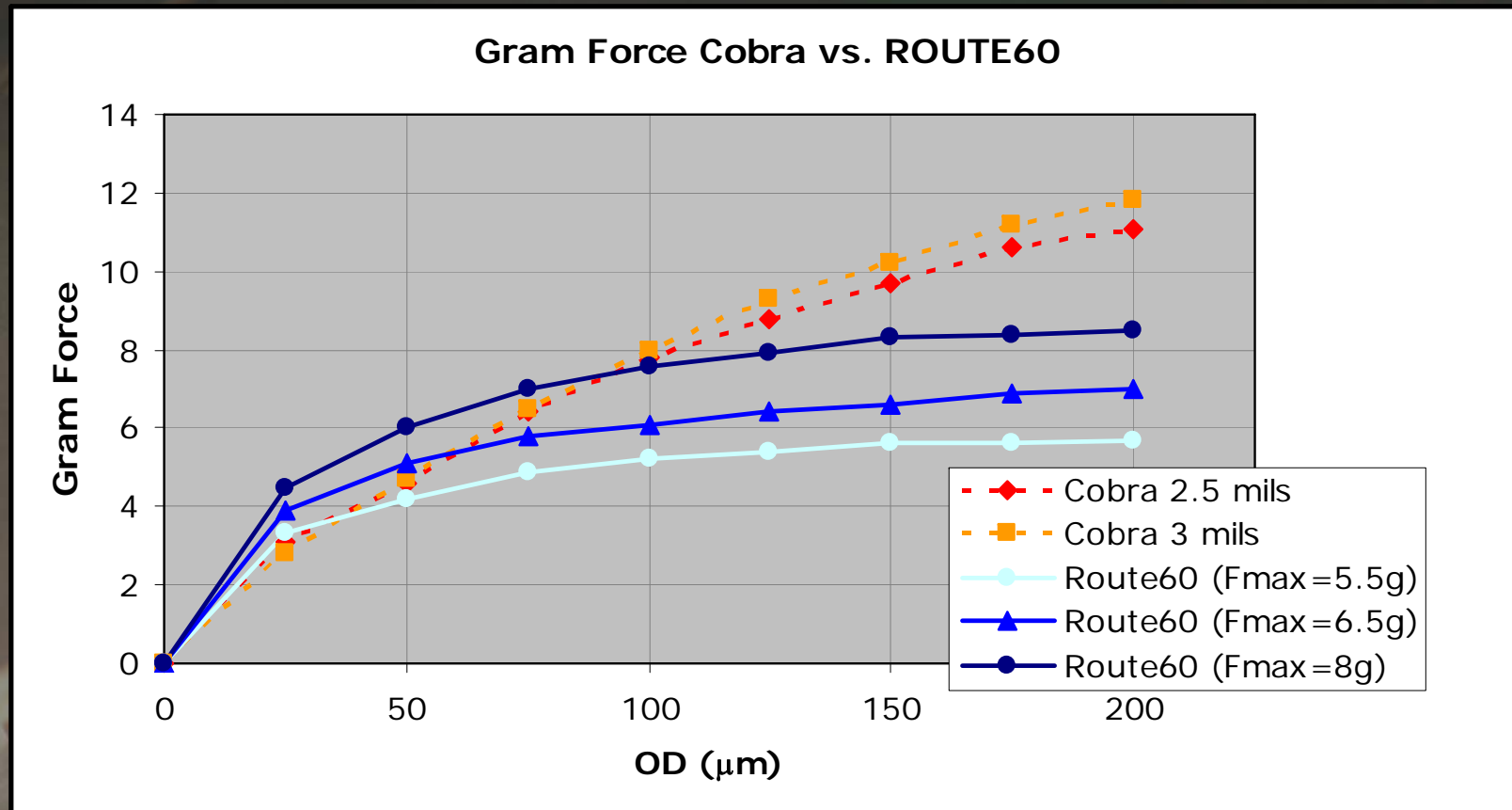
## Alignment:



## Planarity:



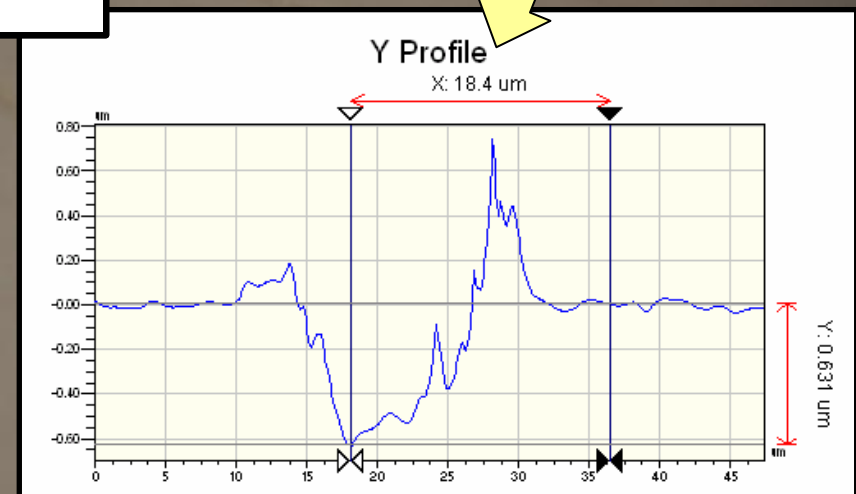
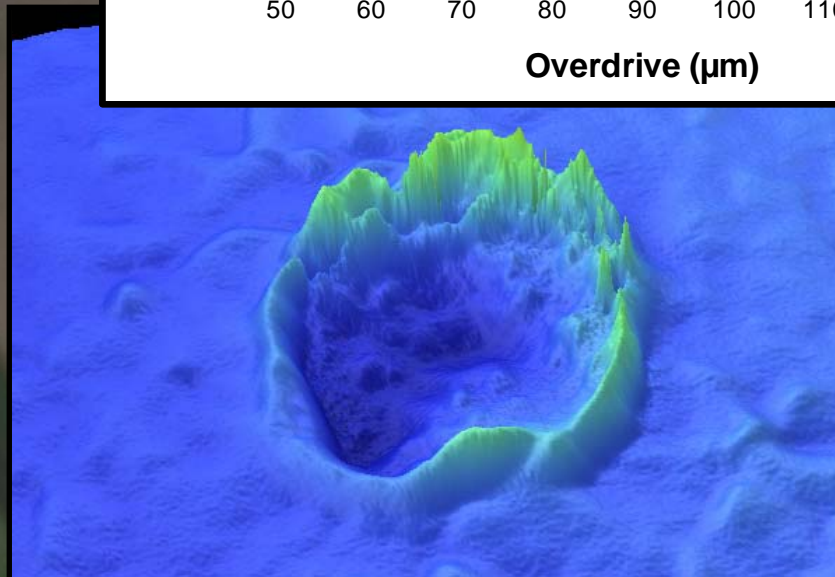
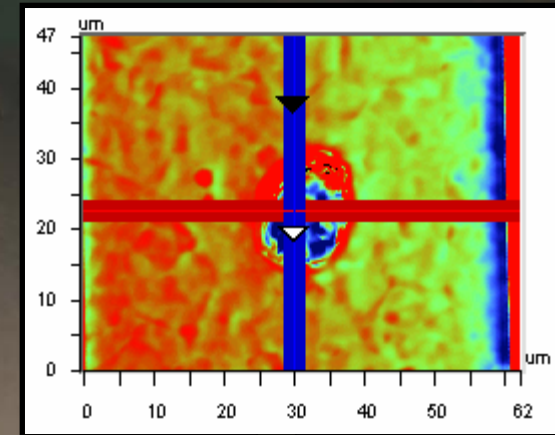
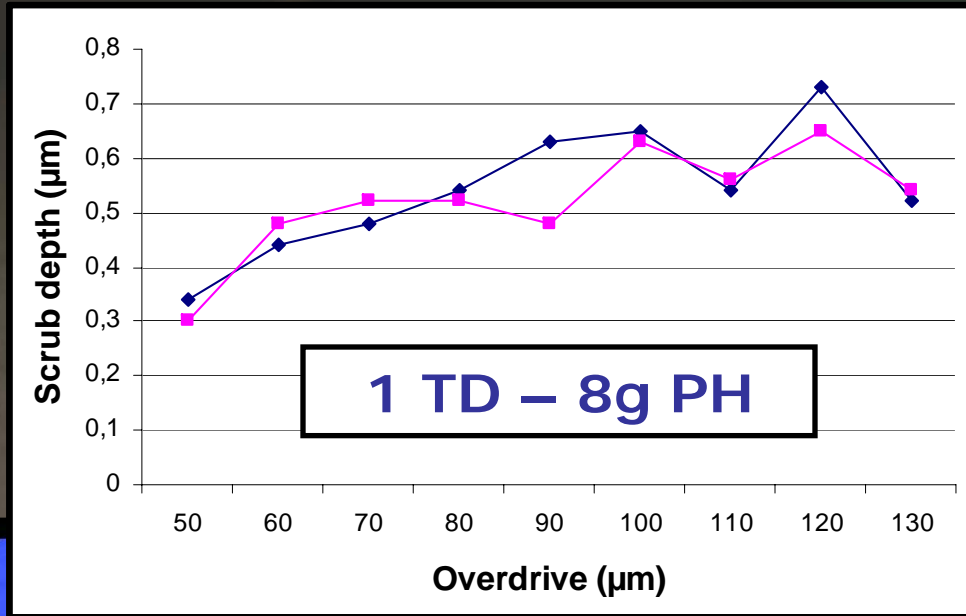
# Evaluations on pads over active areas



**Gram Force adjustable** between 5 to 8 g

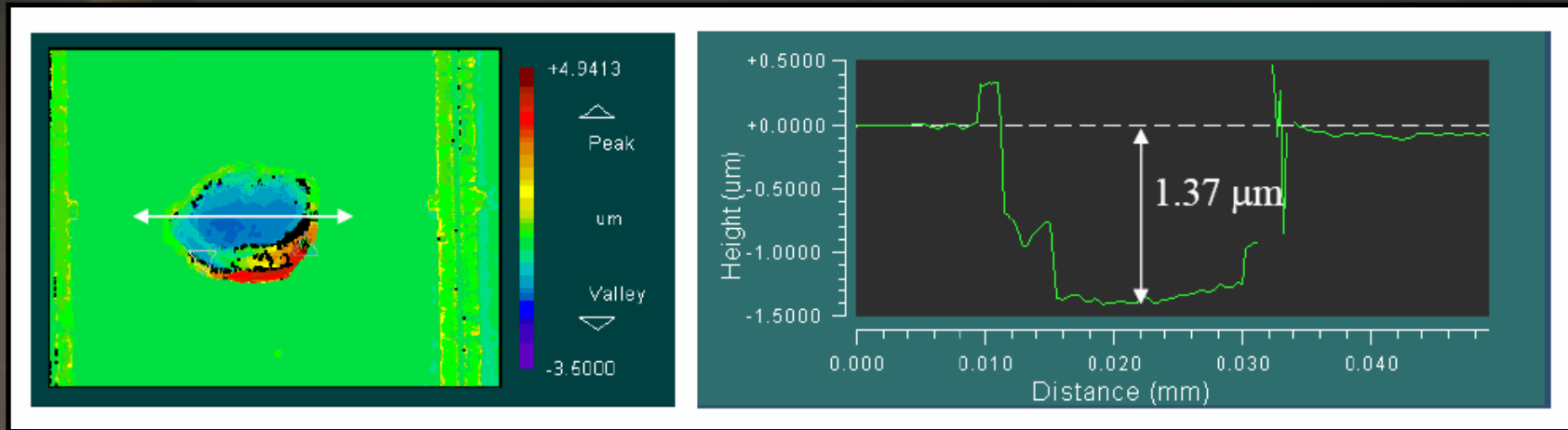


# Scrub depth analysis @ ROOM T – 1TD

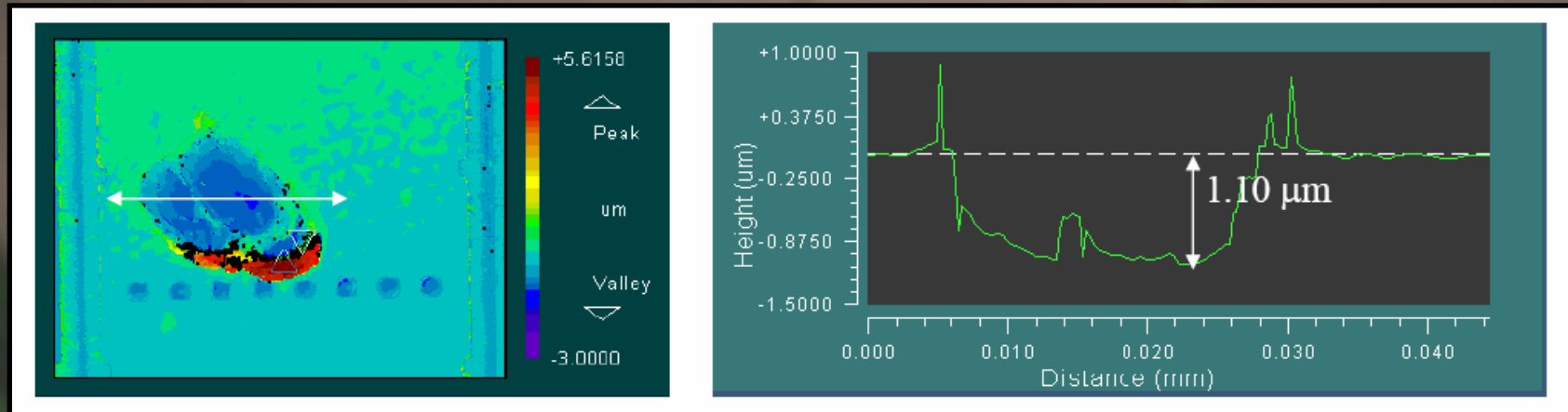


# Scrub depth analysis @ +125°C – 9 TDs

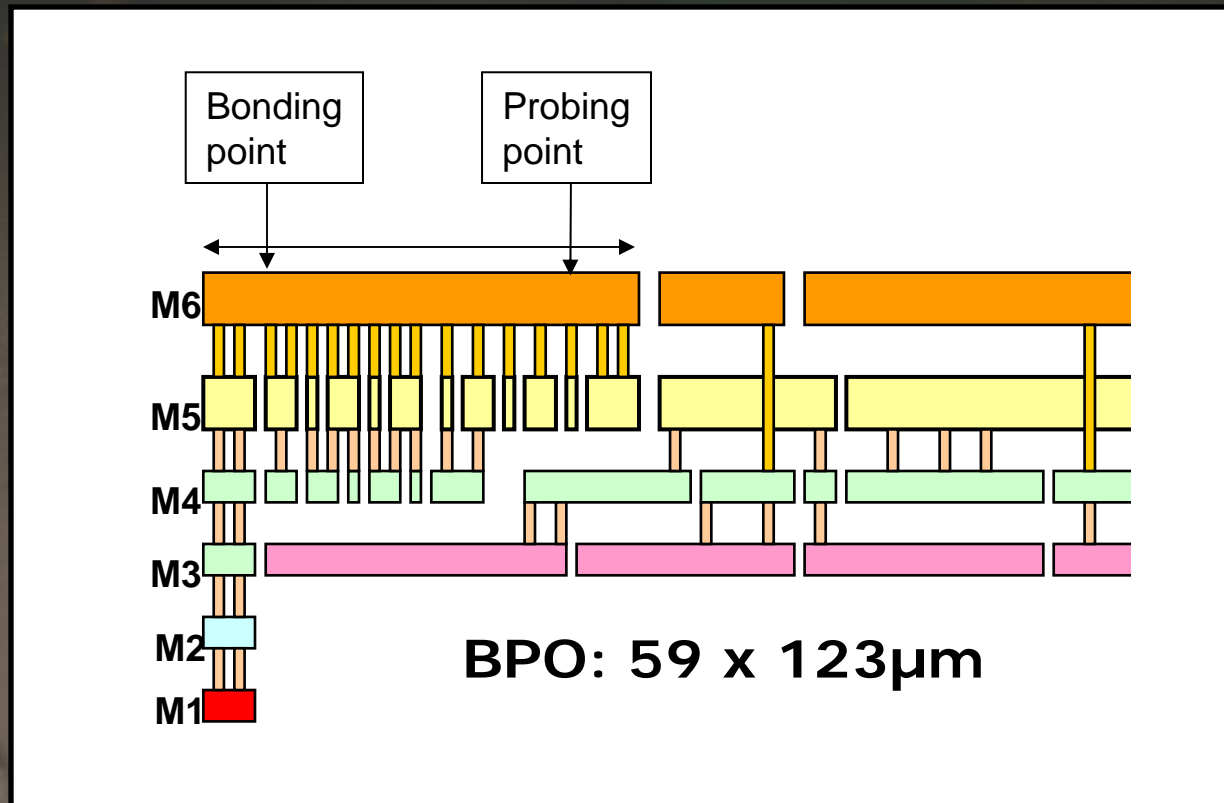
6.5 g PH – Average scrub depth : 1.30  $\mu\text{m}$



5 g PH – Average scrub depth : 1.15  $\mu\text{m}$

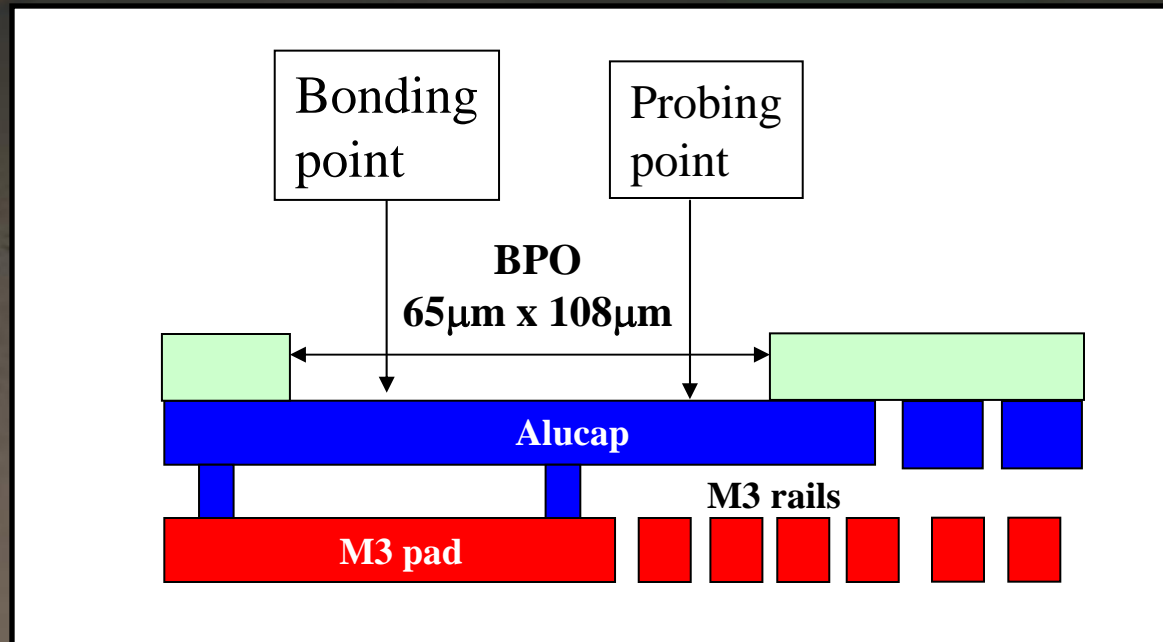


## 6M2T pad over active



**No cracks observed till 125 μm X 6 TDs @ ROOM T**  
with both **8g** and **6.5g** probe heads

## 3MOT pad over active area



**No cracks observed** with **8 g probe head** till:

- ◆ **100  $\mu\text{m}$  OD  $\times$  9 TDs** (6 @ ROOM T + 3 @ +150°C)
- ◆ **125  $\mu\text{m}$  OD  $\times$  6 TDs** (4 @ ROOM T + 2 @ +150°C)

## Conclusions

- ◆ **ROUTE60™** is the **first vertical probing technology** successfully **released to production** in ST, down to **65  $\mu\text{m}$  pitch**
- ◆ The **benchmark with Epoxy** probe cards showed:
  - ◆ Better electrical contact
  - ◆ Lower pad area damage
  - ◆ The possibility to **probe on active areas** playing on the gram force
- ◆ This technology seems **very promising to probe at 60  $\mu\text{m}$  pitch and on low-k dielectrics**



## Follow-on work

### 1. Probing:

- ◆ **Automotive** products, with up to **3 EWS Test** and up to **+ 125°C / + 150°C**
- ◆ **Copper metals** and **Low-k dielectrics**
- ◆ **Probing area** down to **50 × 50 μm**

### 2. Evaluations at lower pitch, down to 60μm:

- ◆ **Life test in progress** on test cards at +125 °C

### 3. On-line cleaning optimization

# Acknowledgements

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- ◆ **ST Castelletto EWS** Engineering Team
- ◆ **ST Rousset EWS** Engineering Team
- ◆ **ST FTM EWS Europe** Organization
- ◆ **ST FTM R&D** Agrate
- ◆ **ST Automotive Product Group**
- ◆ **ST Corporate Package Automation**