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Implementing Advanced Shaping on Vertical MEMS Probe Technology

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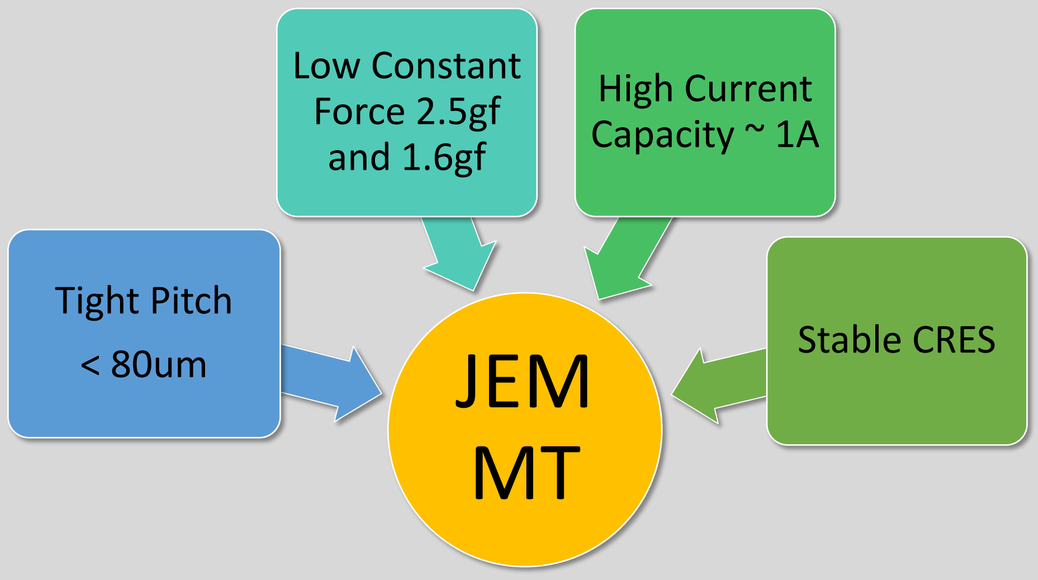
International Test Solutions

Introduction

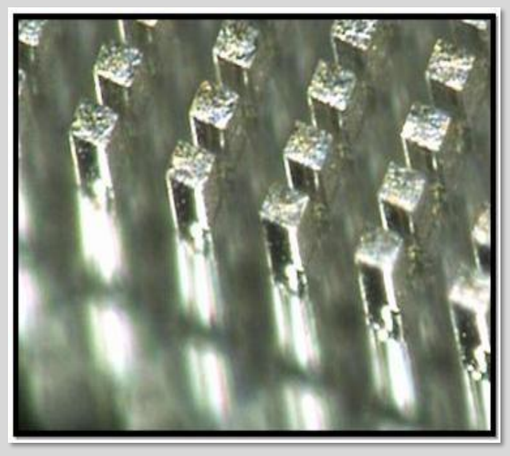
- Analyze offline shaping effect of MEMS Vertical probe arrays with varied pitch.
- Investigate impact of pitch on the probe shaping efficiency at edge vs. center of array.
- Investigate alternative cleaning techniques to achieve desired tip shape.
- Develop JEM probing ability for area array pad configurations with tight pitch.

JEM MT70 Vertical Probes



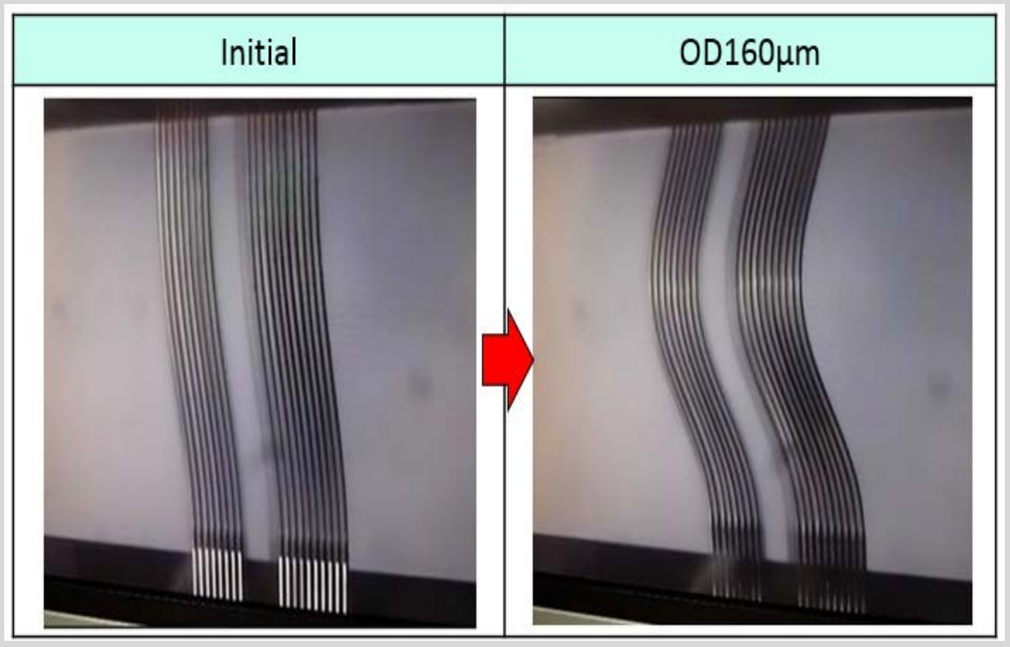
VERTICAL MT PROBES

- Fabricated using MEMS manufacturing process with compositions of various alloys.
- Designed as micro-scale structures with tight tolerances.
- Low damage probing at fine pitches.
- Easy maintenance and probe replacement on-site.
- Long probe lifetime.
- Area array bumps and peripheral pad probing capability.
- Current temperature range: -40°C to 125°C.



MT Area Array Flat Tip Probes

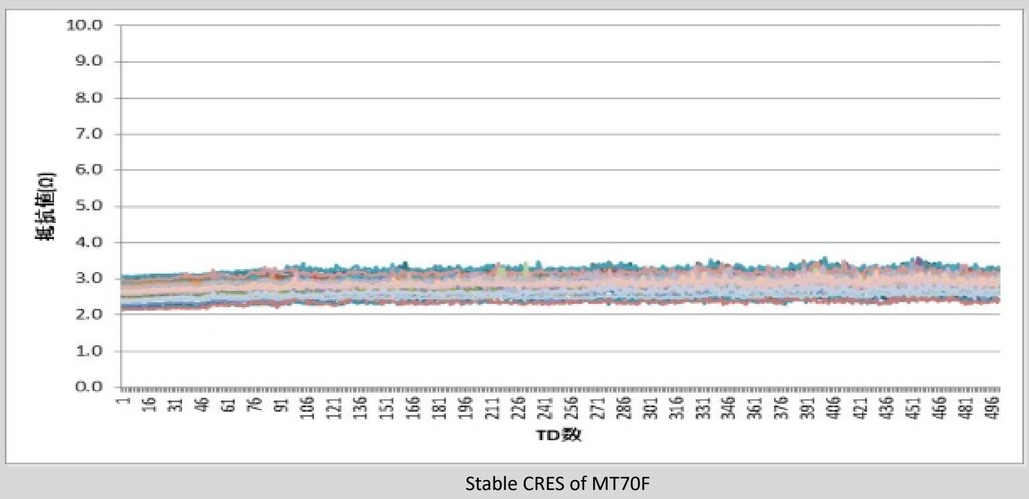
Bump mark of 1.7um depth and 16.7um circumference by MT80F



Probe before overdrive, and probe buckling effect after overdrive.

Area Array Bump Probing

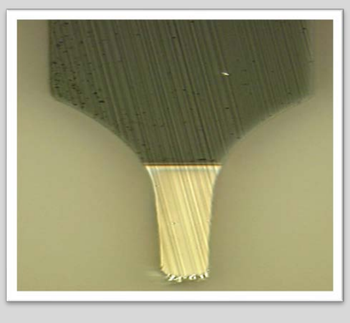
- MT70F and MT80F available.
- Flat rectangular probe tips .
- Pitch >70um for area array bump configuration.
- -40°C ~ 125°C.



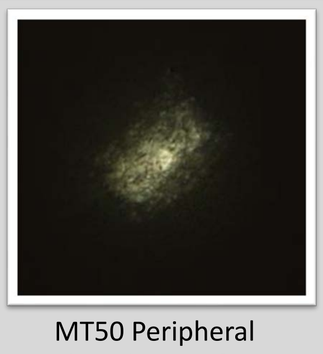
Stable CRES of MT70F

Peripheral Pad Probing

- MT50 and MT60 available.
- Radius probe tips staggered in 3 rows max (for tight pitch).
- Pitch >50um for peripheral pad configuration.
- -40°C ~ 150°C.



MT50 Probe Tip



MT50 Peripheral radius shaping from 20x15 to 9.46x5.26

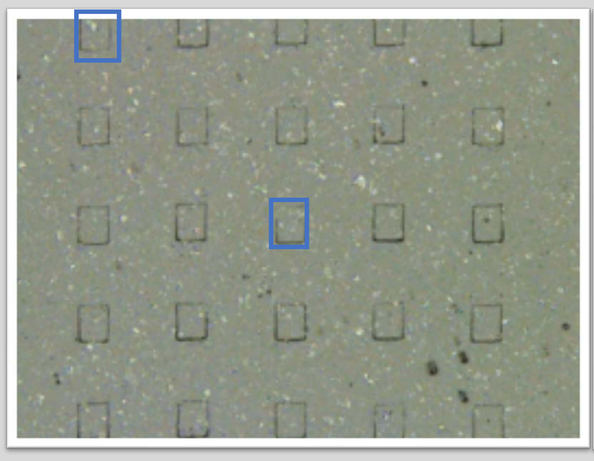
MT50 pad mark

Test Plan

- Observe pin ability to penetrate ITS compliant shaping polymer (PV-OBEE).
- Analyze material deformation with repeated insertions in same location.
- Perform shaping exercises to observe material compliance effects with large vs. fine pitch vertical probe arrays.

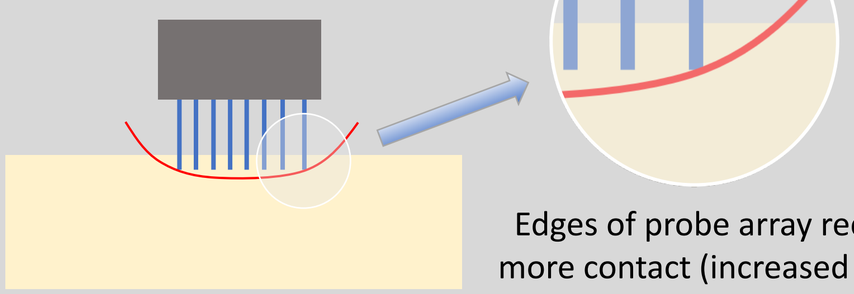
Material Deformation

120um Pitch



80um Pitch

Array geometry (pitch and probe size) impacts the cleaning effectiveness between edge and center probes.



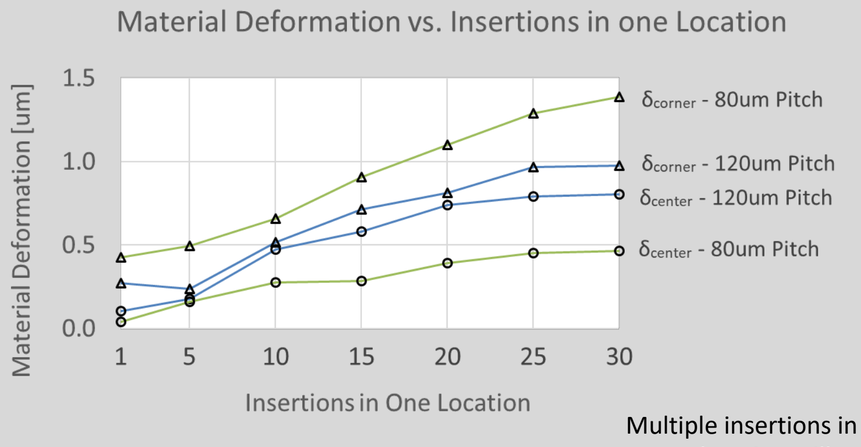
Edges of probe array receive more contact (increased wear) than the center of probe array.

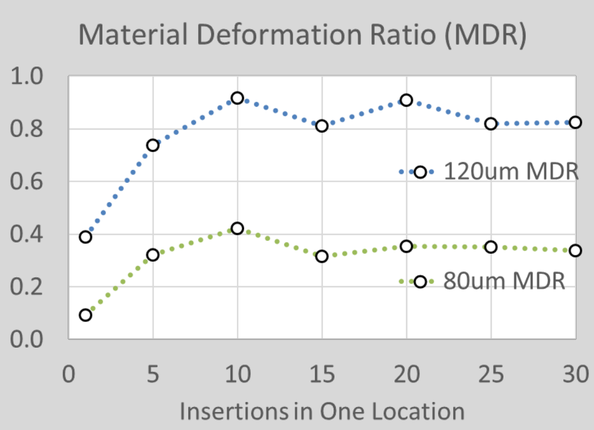
The ratio of the material damage at the center to the damage at the edge is **Material Deformation Ratio (MDR).**

$$MDR = \frac{\delta(Center))}{\delta(Corner)}$$

$$MDR_{Ideal} = 1.0$$

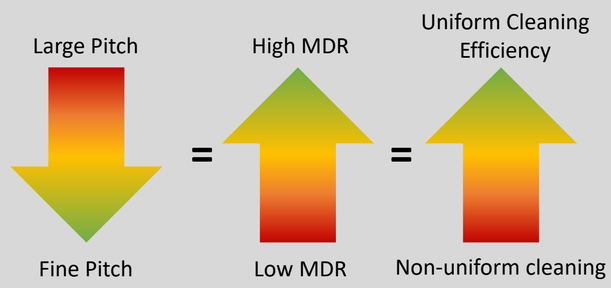
Higher MDR suggests that probe shaping at the center will be closer to probe shaping at the edges.





Multiple insertions in one location will eventually fully compress the material based on overtravel, array pitch, and probe geometry.

$MDR_{120} \rightarrow 0.8$
$MDR_{80} \rightarrow 0.4$

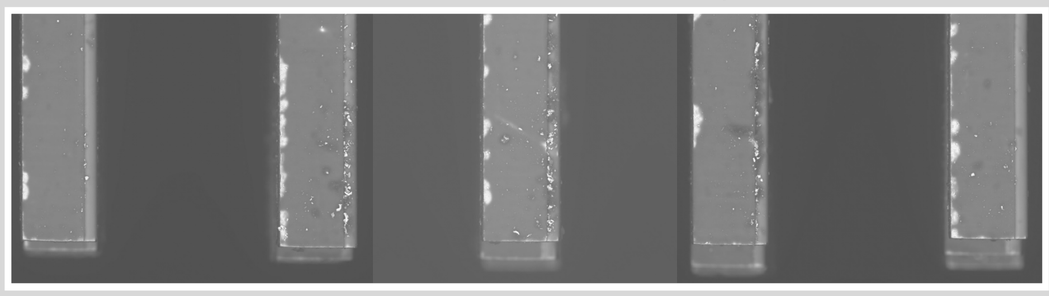


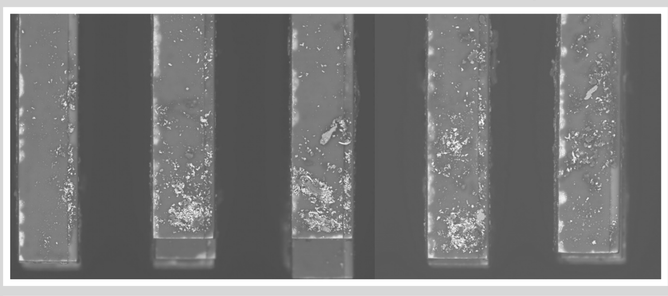
Probe Shaping

120um Pitch Probe Array

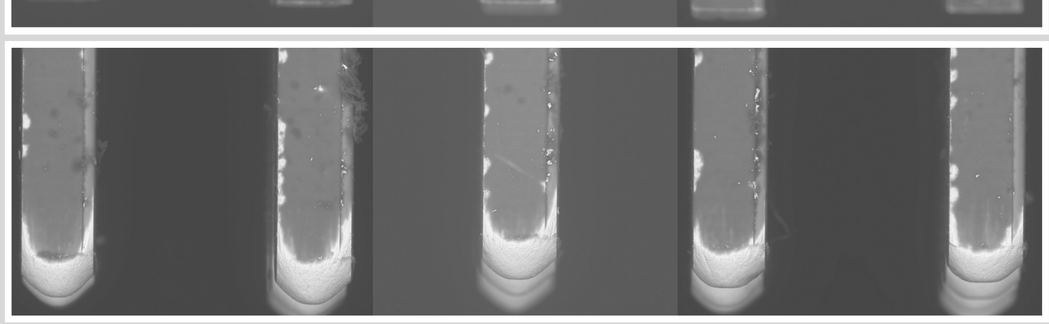
80um Pitch Probe Array

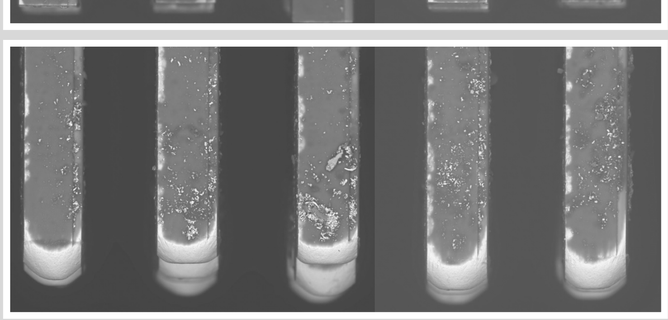
Initial Geometry

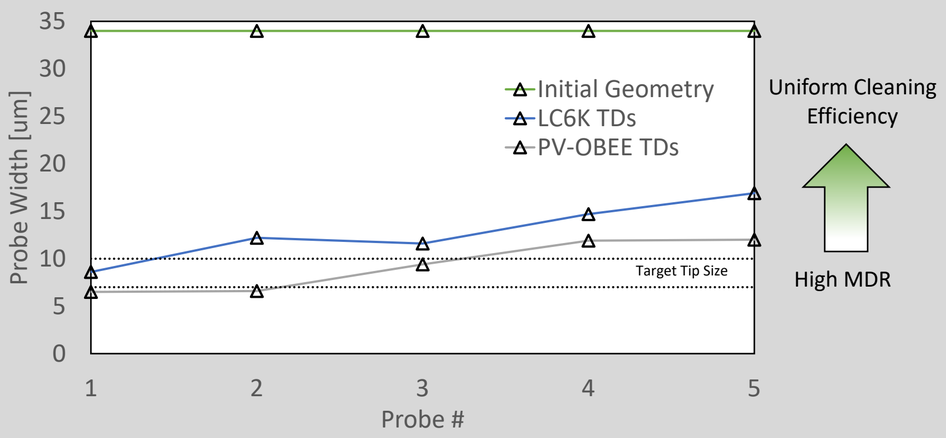




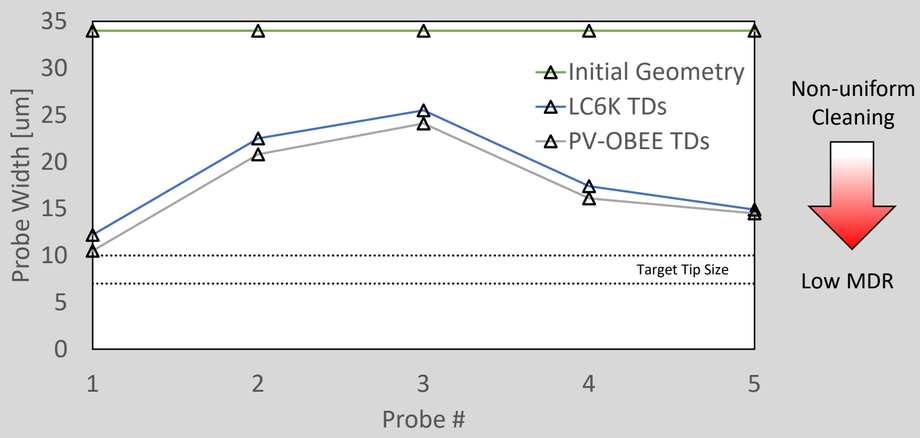
Final Geometry







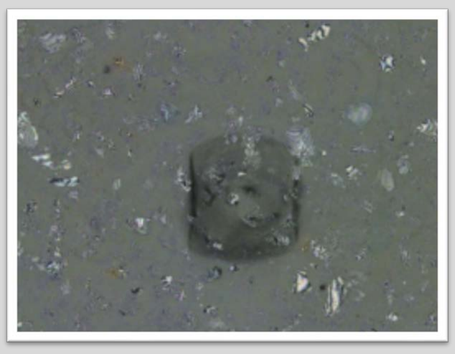
There is adequate shaping of the entire probe array, approaching the target tip size. Fairly even wear rate indicates that the probe array has a high MDR such that the middle and edge probes are similar diameter.



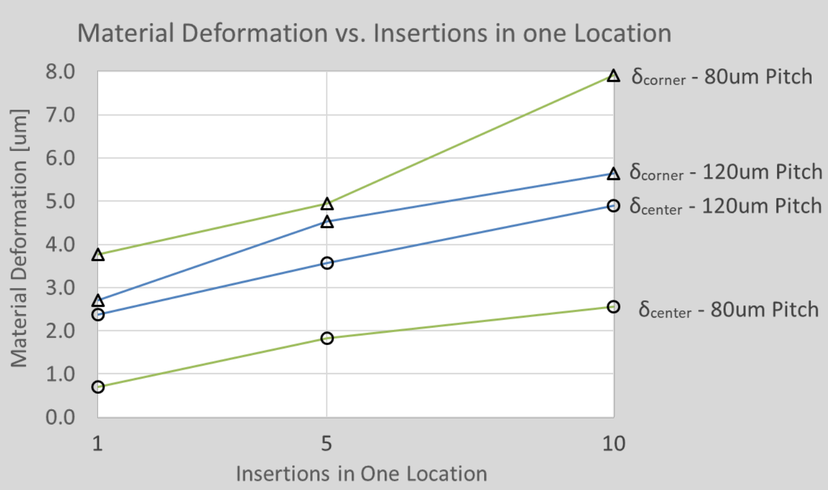
There is minimal wear at the center probe compared with the edge probes. This is indicative of a significant edge of effect which suggests a very low MDR as expected.

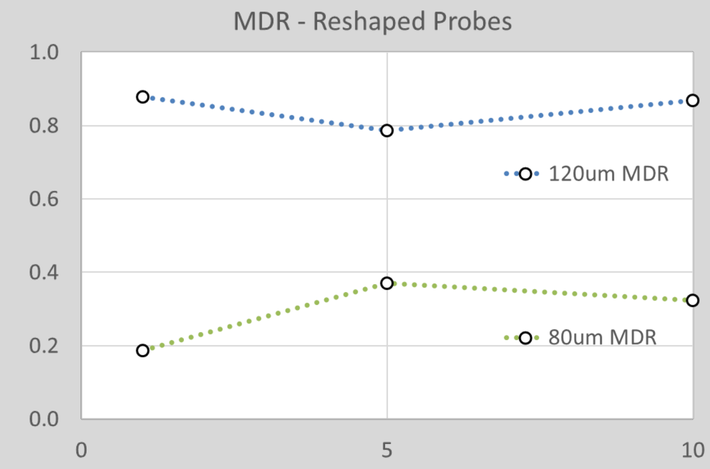
Reshaped Probes – Material Deformation

120um Pitch



80um Pitch





The MDR is primarily dependent on the pitch of the probe card – not probe geometry.

The MDR is correlated with wear efficiency. Higher MDR = Even wear across probe card.

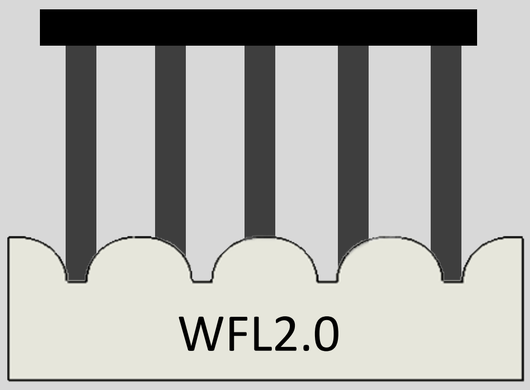
Conclusion

- Probe Card Cleaning on uniformly coated polymers produces an “edge effect” in which outside edge probes receive greater shaping efficiency than center probes – Material Deformation Ratio (MDR).
    - MDR is the relationship between material effectiveness at center of probe array relative to the edge of probe array.
- Multiple insertions in one location can increase the penetration yielding increased wear and cleaning efficiency to probes.
- This performance difference becomes increasingly apparent as probe pitch becomes more fine and the amount of repeated insertions is raised.
- Large pitch arrays will have higher MDR than fine pitch arrays – indicating more evenly distributed cleaning and wear across the array.

Follow-on Work

JEM is now developing MT50R probes for area array pad configurations, concurrently with probe shaping MT70F using different materials.

This will provide probing capability for both types pad and bumps at fine pitches.



ITS is developing functional micro-features on polymer materials that can de-couple the probe array’s effect on cleaning.

This will provide uniformly consistent cleaning to all probes within the probe array.

Contact

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