Advantest's PhotoFinger™ Probecard

By
David Yu, Hubert Yu Zhou, Bob Aldaz, Keith Lee, Jeff Raimo
Custom Design Engineering
Advantest America, Inc.

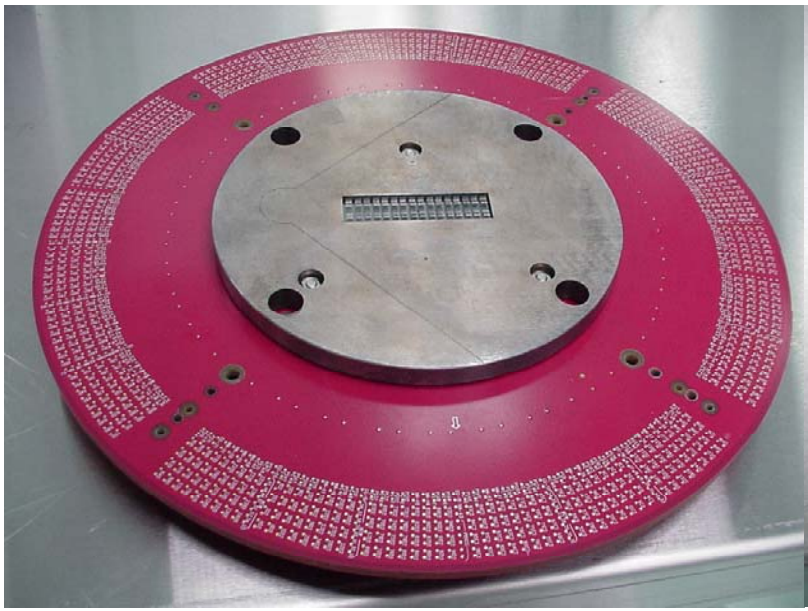
Agenda

I. PhotoFinger(TM) probecard development
II. Probecard structure and stack-up
III. Contactor fabrication
IV. Carrier fabrication
V. Assembling
VI. Test data
VII. Vertical probing
VIII. Future work and roadmap

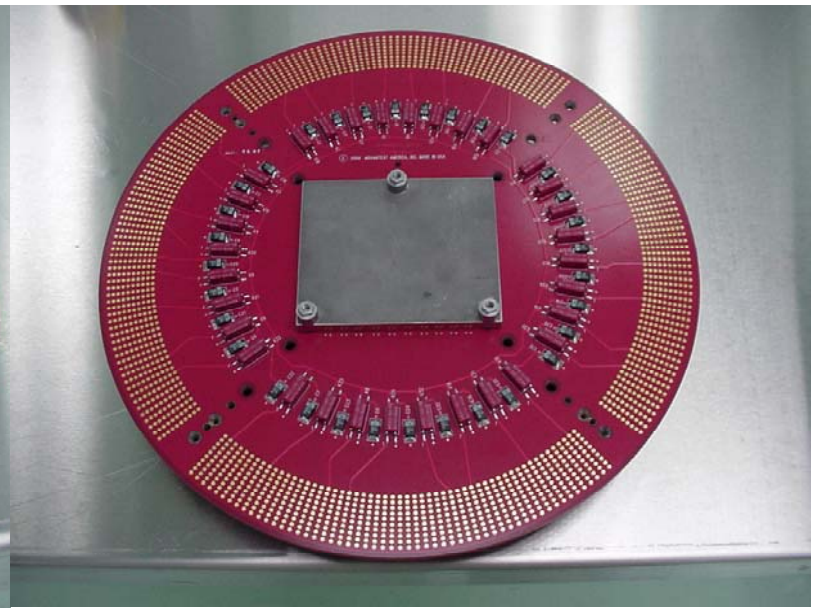
I. PhotoFinger™ probecard development

- Employs Photolithographic MEMS-based technologies
- Allows High Parallelism and High Speed of Test
- Applicable for Periphery and Array Layouts
- Modular Scalability and Reparability

II. PhotoFinger™ probecard structure and stack-up



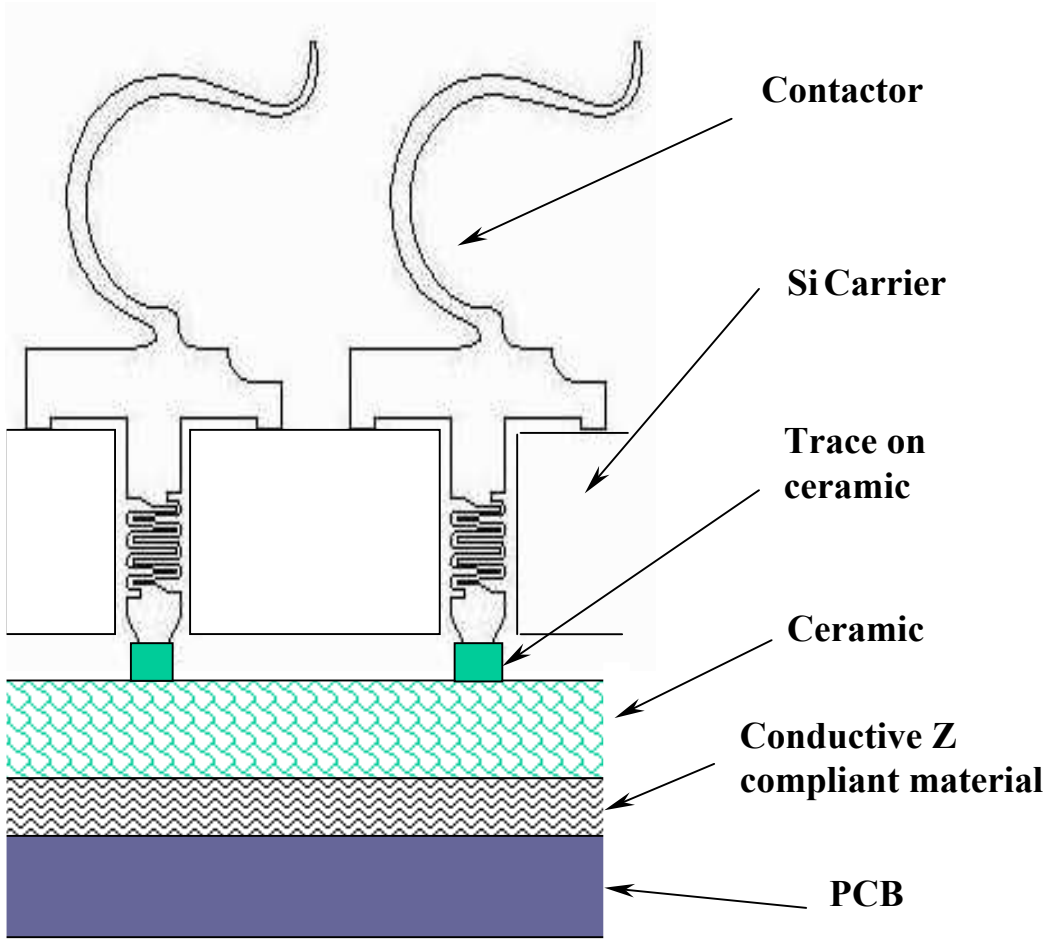
Front (contactor) Side view



Back Side view

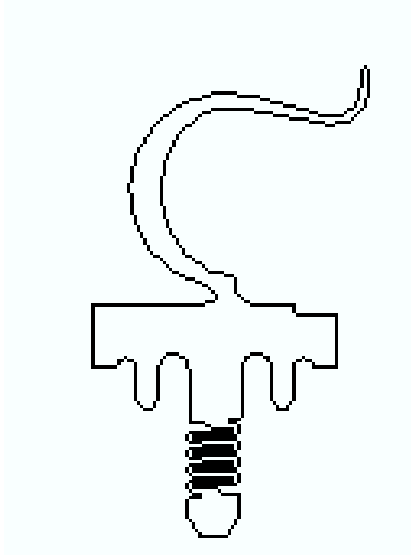
II. PhotoFinger™ probecard structure and stack-up (cont.)

1. Metal contactor
2. Silicon carrier
3. Multilayer routing ceramic
4. Conductive polymer
5. PCB
6. Mounting frame

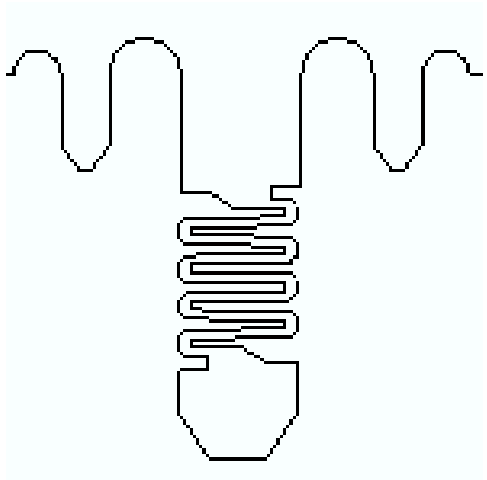


III. Contactor fabrication

1. Pattern generated by photolithographic processes
2. Any 2D geometry design
3. Electroplating produces finite thickness and fine metal crystal structure
4. Low cost fabrication

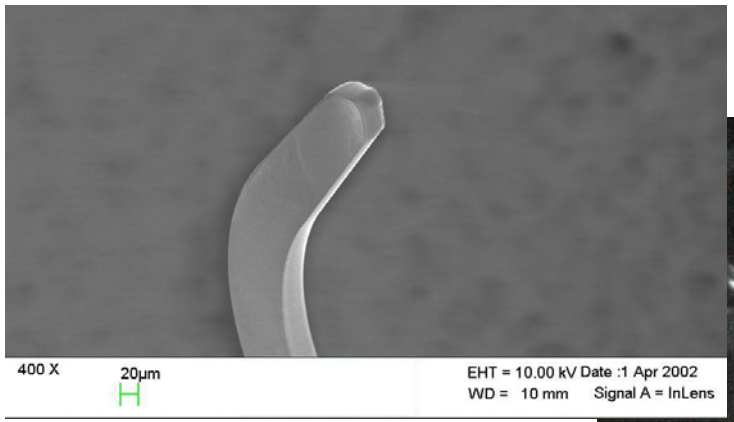


Contactor geometry

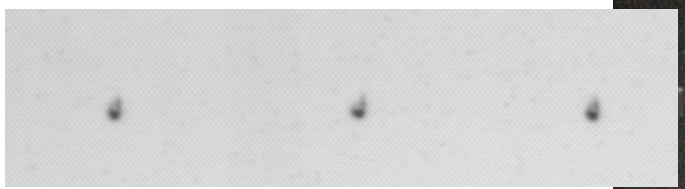


Contactor backside

III. Contactor fabrication (cont.)



Tip shape of the contactor



Scrub marks: 15x25µm

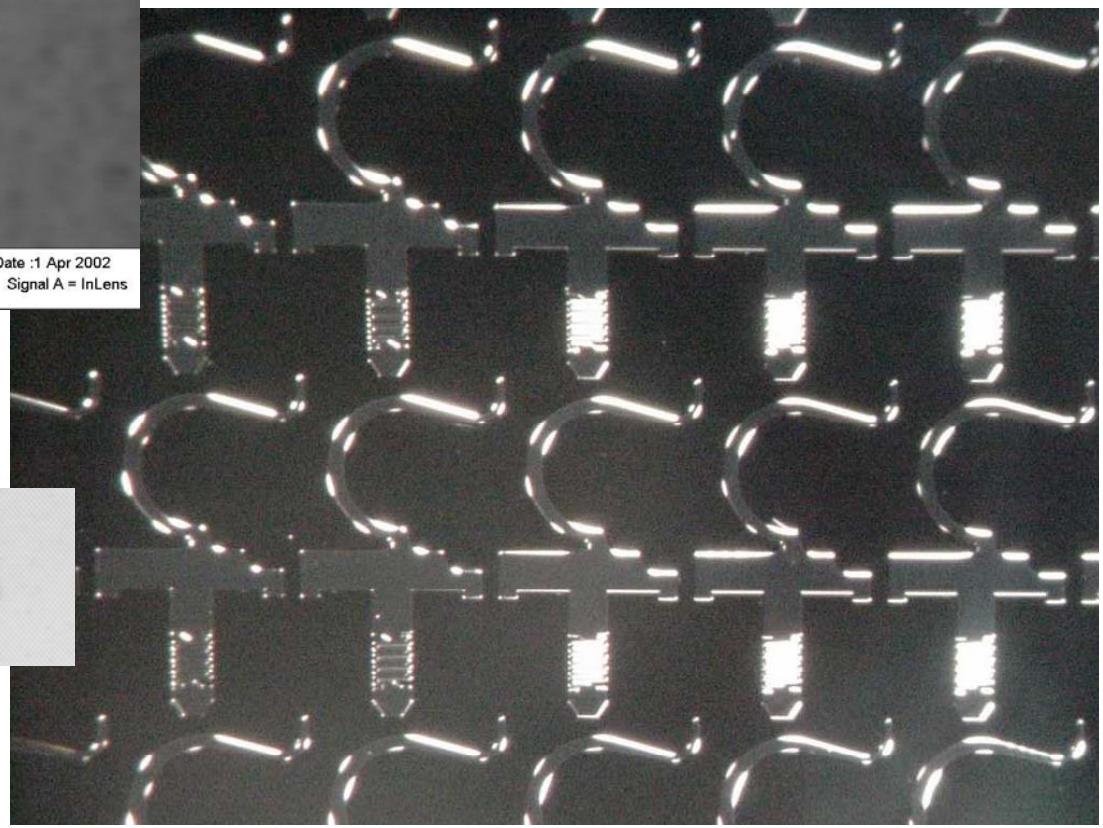


Photo-defined contactor fabrication

III. Contactor fabrication (cont.)

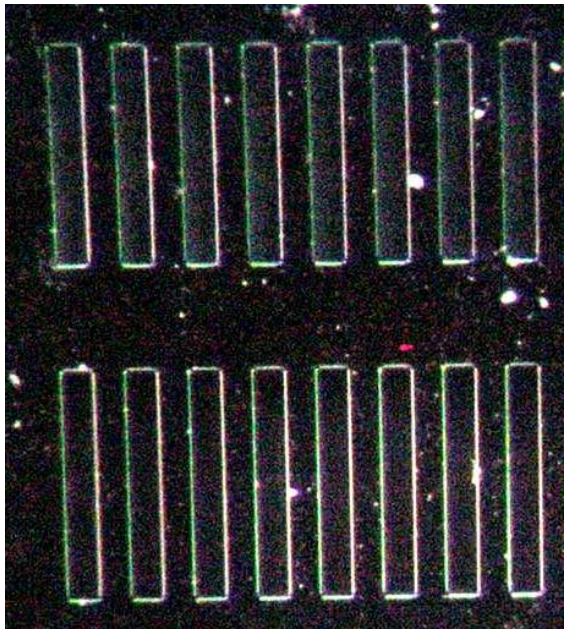
1. Probe force:	2-3gram/pad
2. Overdrive:	30-60 μm
3. Thickness:	30-50 μm
4. Temperature:	~ 100°C
5. Electric current capability:	900mA

6. Backside spring interconnects to ceramic

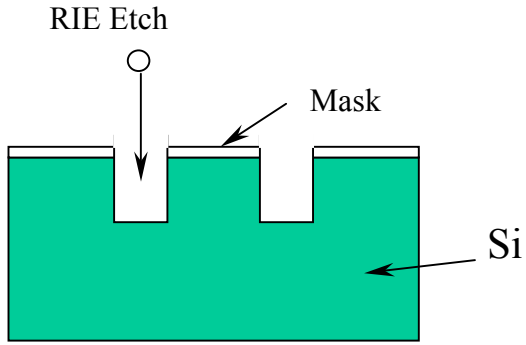
IV. Carrier fabrication

1. A Si substrate holding contactors in place
2. CTE matching with the wafer under test
3. Photolithographically defined hole positions
4. DRIE (Deep Reactive Ion Etching) removes material to form holes
5. Thermal growth of Si oxide film on carrier's surface as electrical insulator
6. Additional layer of Si oxide film by chemical vapor deposition
7. Multilayers of Si substrate through fusion bonding

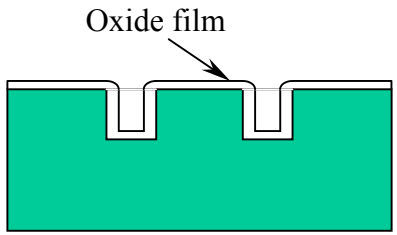
IV. Carrier fabrication (cont.)



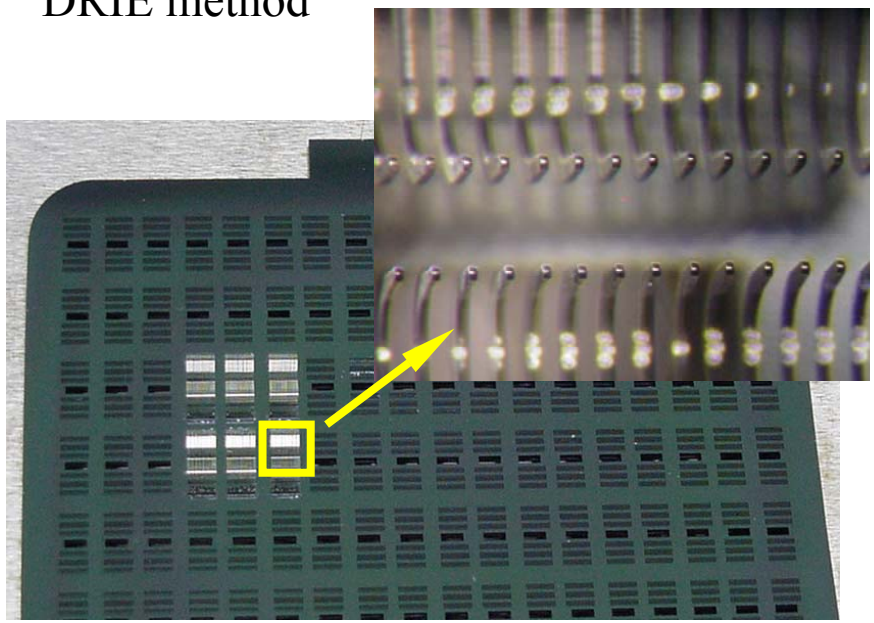
Holes generated by DRIE



DRIE method

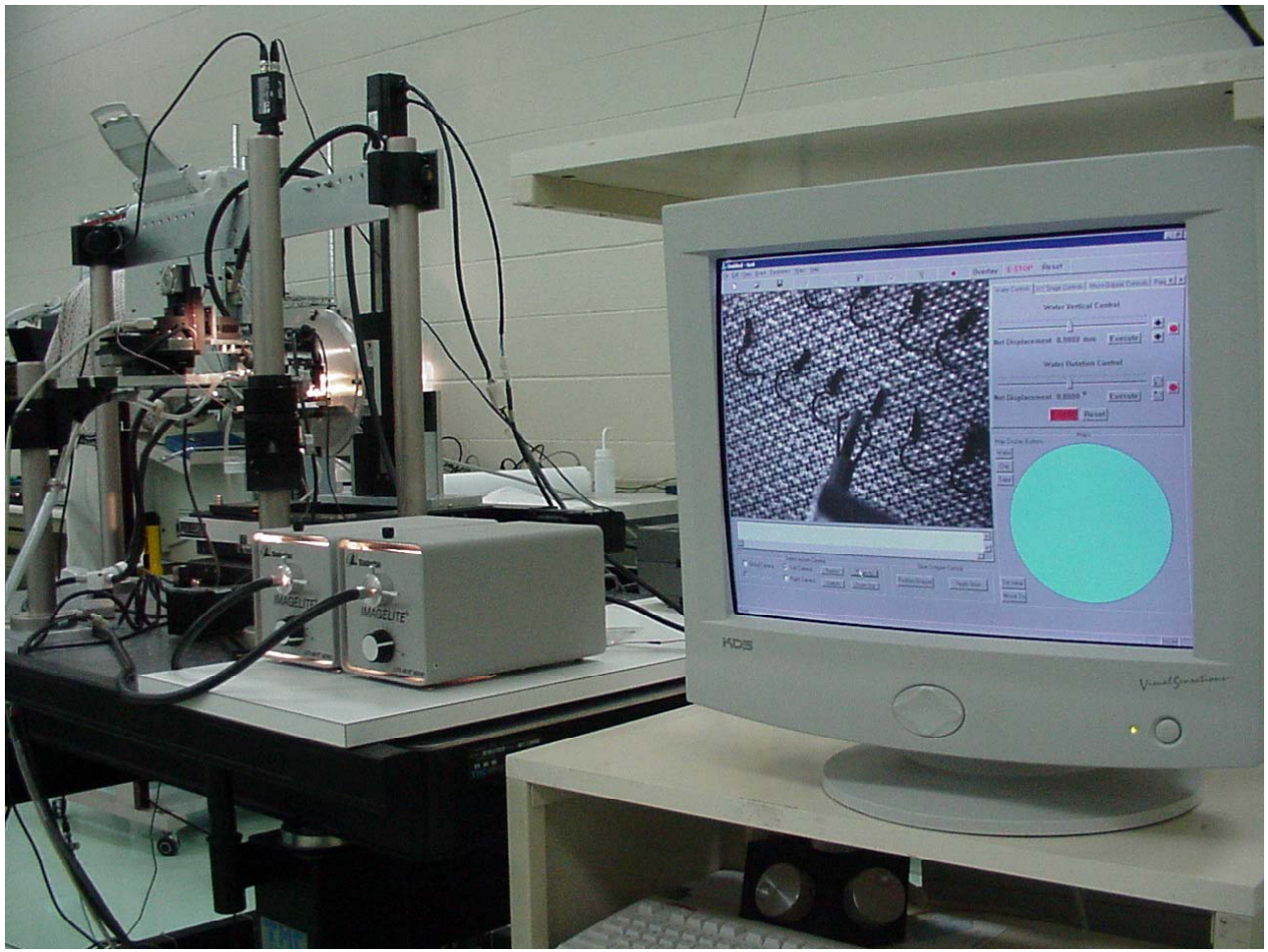


Si oxide film as insulator



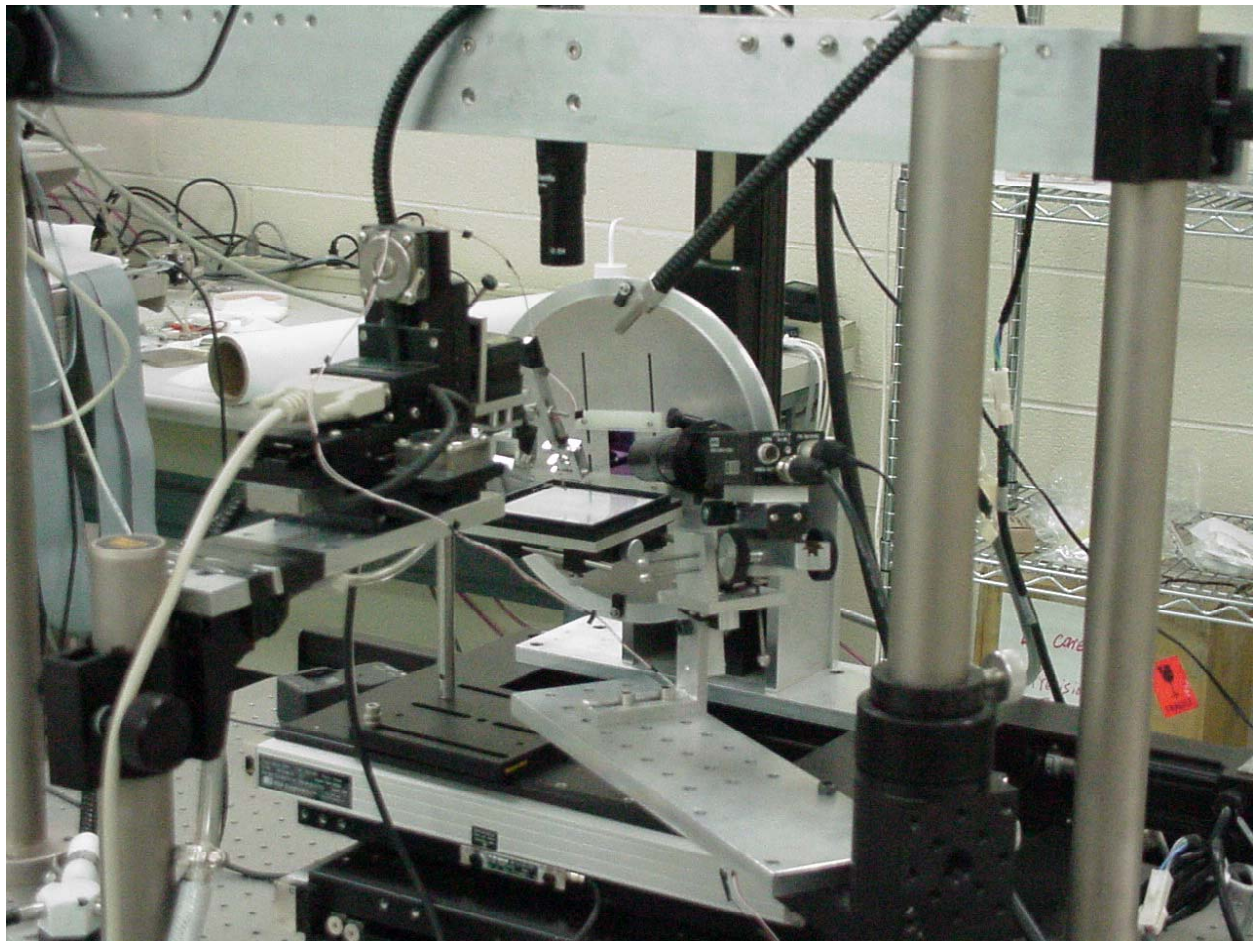
Contactor population

V. Assembling



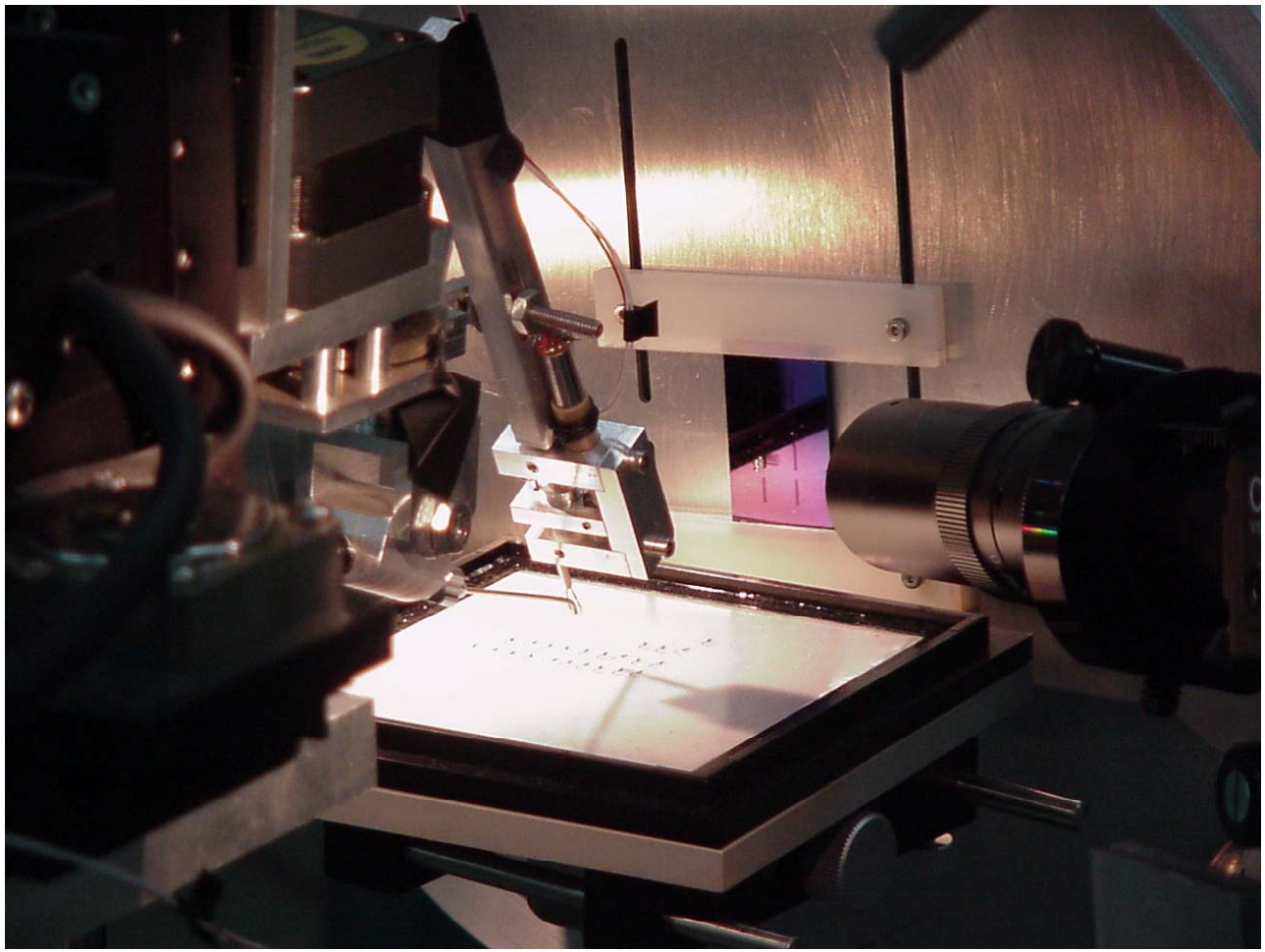
Contactor pick and place equipment

V. Assembling (cont.)



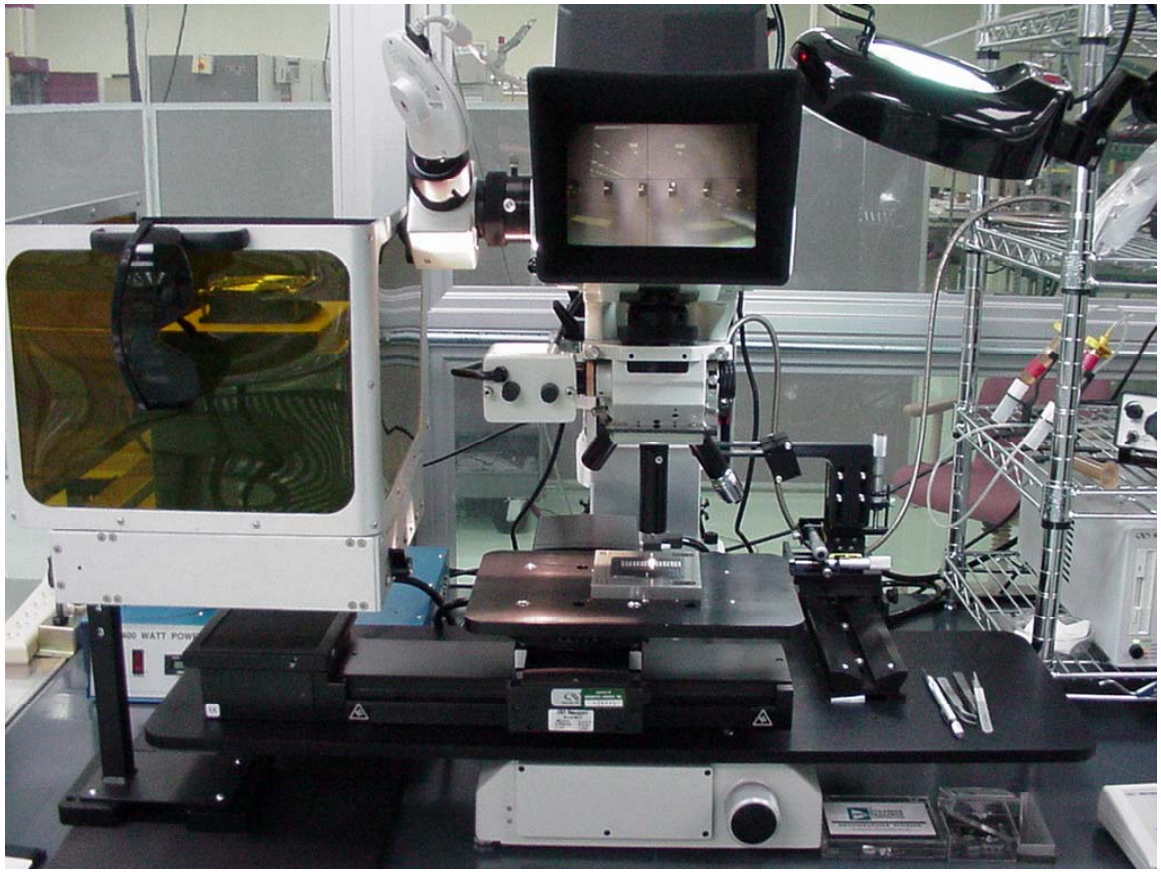
Micro-assembly set-up

V. Assembling (cont.)



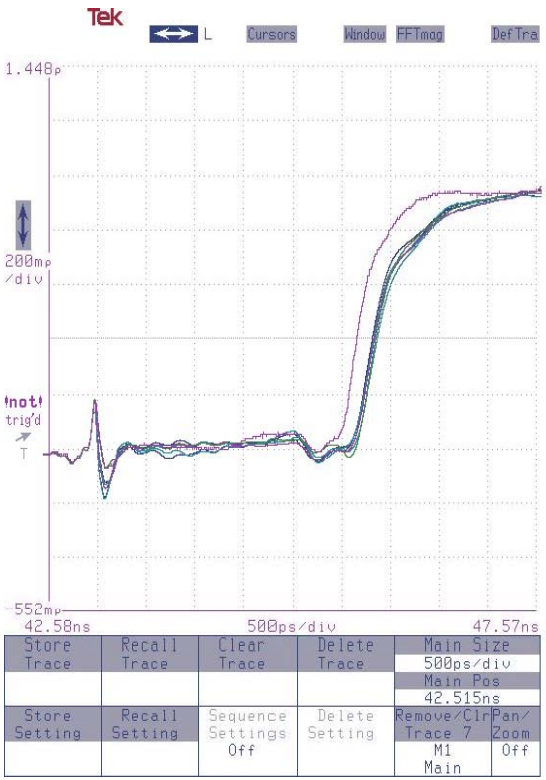
Contactor is picked by micro-gripper

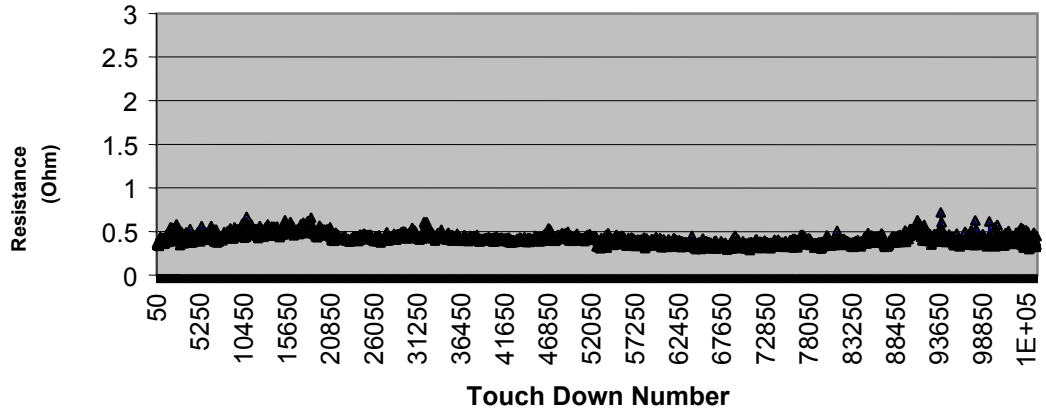
V. Assembling (cont.)



Adhesive dispensing system

VI. Test data





Contact resistance in 100K touchdown on Al film

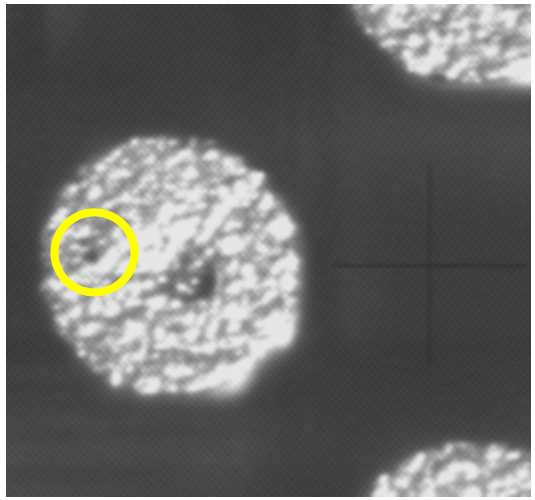
TDR Measurement

Rise time: 545 ps (10%-90%) for lines without contactors and 820 ps with contactors

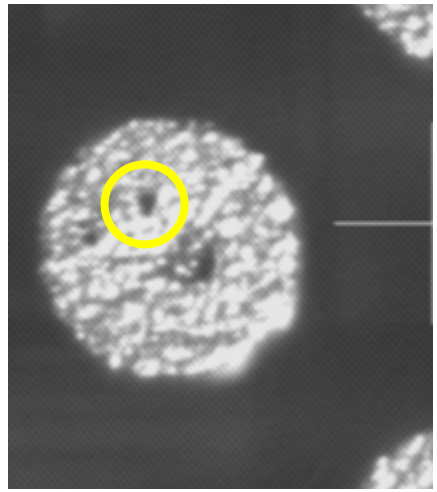
VII. Vertical probing

1. Photo-defined spring contactor
2. Bump array probing applications
3. Same probecard stack-up

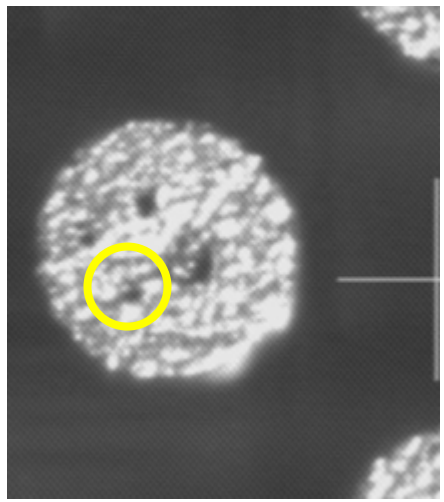
Vertical contactor



20µm OT



50µm OT

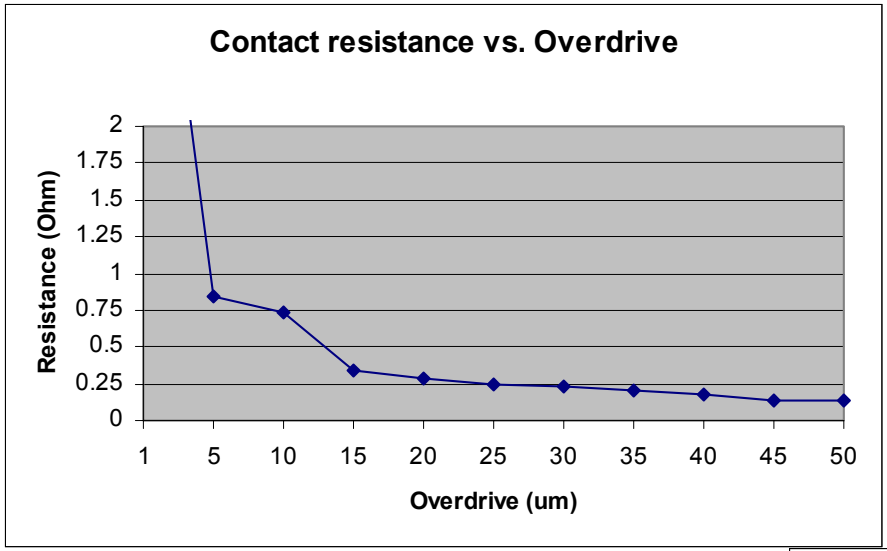


70µm OT

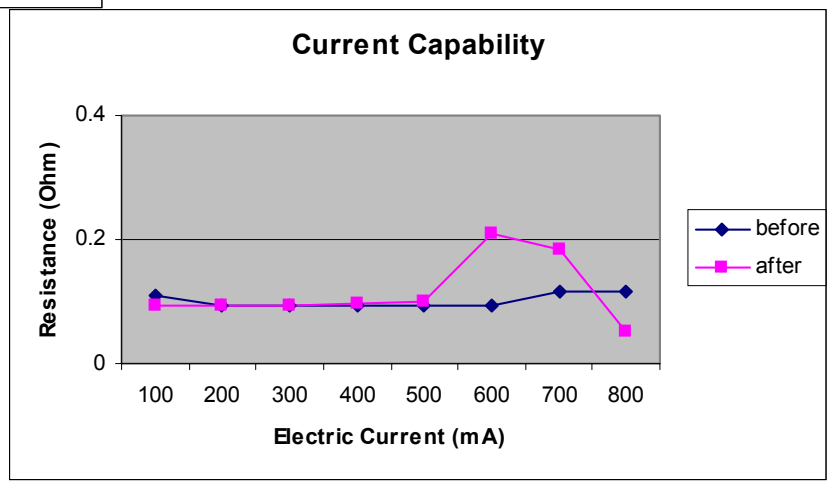
Probing marks on
the same flat top bump
for comparison at different
over travels

(Bump diameter:130µm)

VII. Vertical probing (cont.)



Contact resistance in probing Cu bump

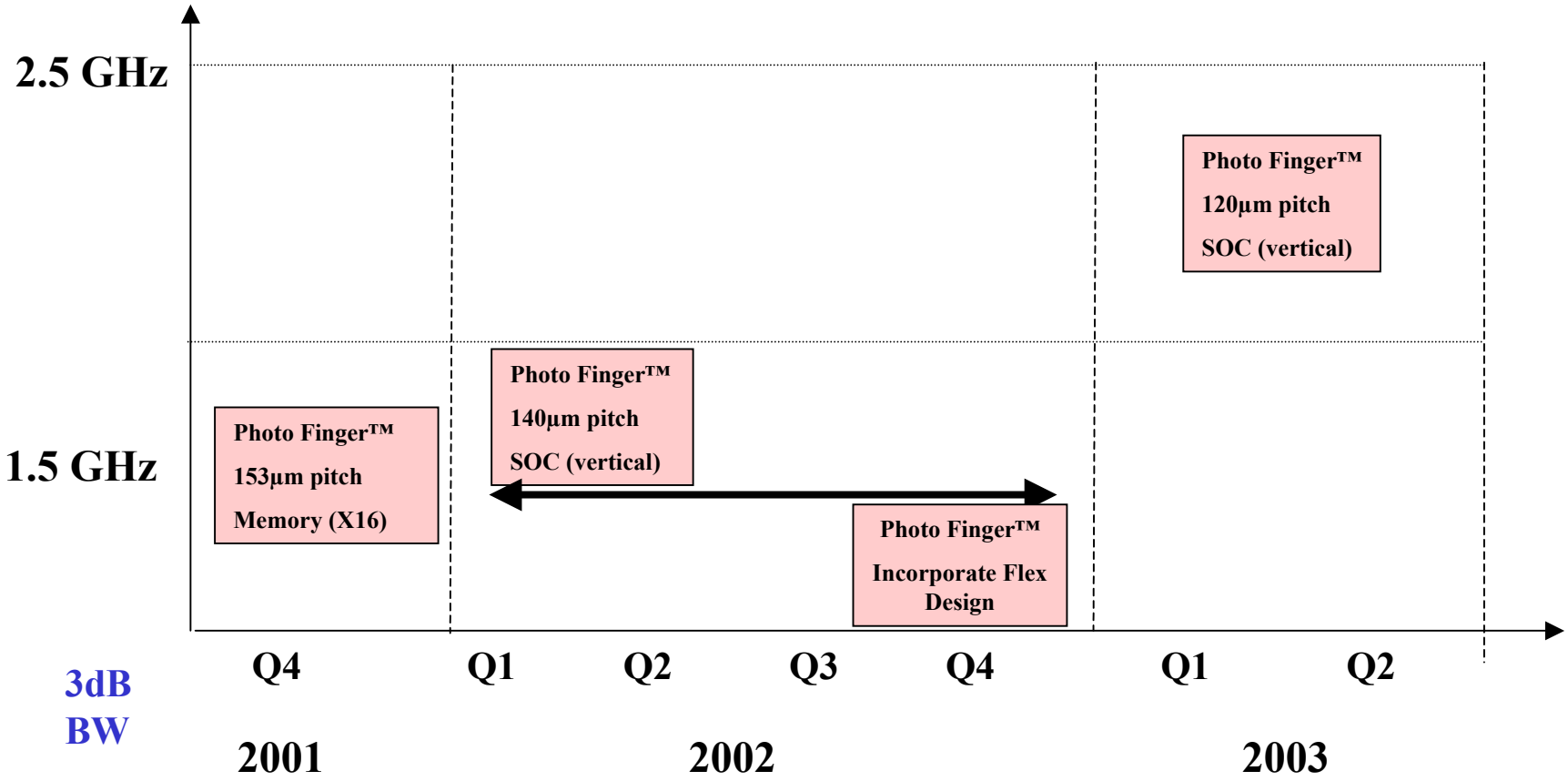


Contact resistance before and after current flow

VIII. Future work and roadmap

1. Contactor Profiles for Bump Array Applications
2. Integrated High Performance
3. Low Cost Space Transformer
4. Implement High Volume Manufacturing

VIII. Future work and roadmap (cont.)



Acknowledgements

Special thanks to Dr. Gert Hohenwarter for his advice and contributions to the Photofinger(TM) project