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\textsuperscript{(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: 2-3 gram/pad
2. Overdrive: 30-60 µm
3. Thickness: 30-50 µm
4. Temperature: ~ 100°C
5. Electric current capability: 900 mA
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

Oxide film as insulator

Si oxide film as insulator

Contactor population

David Yu, Hubert Yu Zhou, Bob Aldaz, Keith Lee, Jeff Raimo
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

Probing marks on the same flat top bump for comparison at different over travels
(Bump diameter: 130μm)
VII. Vertical probing (cont.)

Contact resistance vs. Overdrive

Contact resistance in probing Cu bump

Current Capability

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.)

2.5 GHz

1.5 GHz

Q4 Q1 Q2 Q3 Q4 Q1 Q2

2001 2002 2003

3dB BW

Photo Finger™
120µm pitch
SOC (vertical)

Photo Finger™
140µm pitch
SOC (vertical)

Photo Finger™
153µm pitch
Memory (X16)

Photo Finger™
Incorporate Flex Design
Acknowledgements

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