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Submicron Probing Techniques Based on AFM Technology

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I. **Introduction / Motivation**

II. Principle

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Introduction

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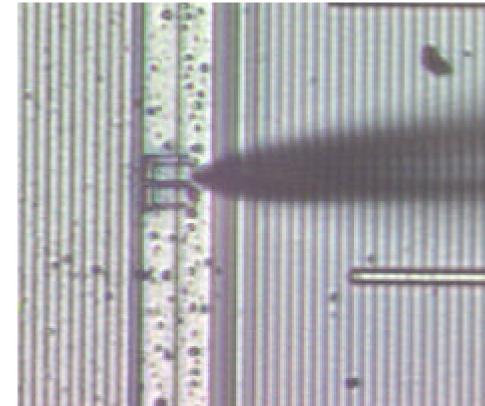
Motivation

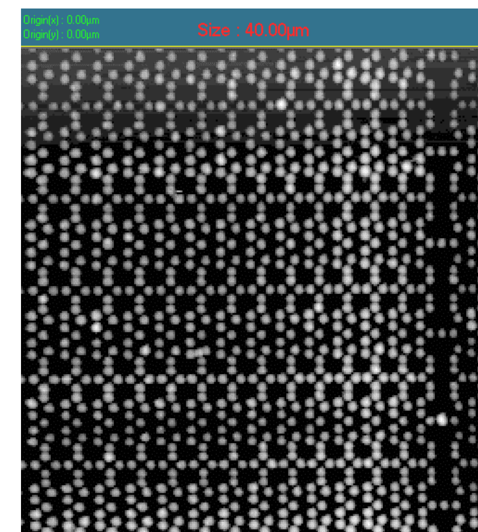
- Visual location
- Probe placement



Optical

Challenges

- Time to data
- Device damage
- Circuit charging
- Standard environment



AFM

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Principle of AFM Probing

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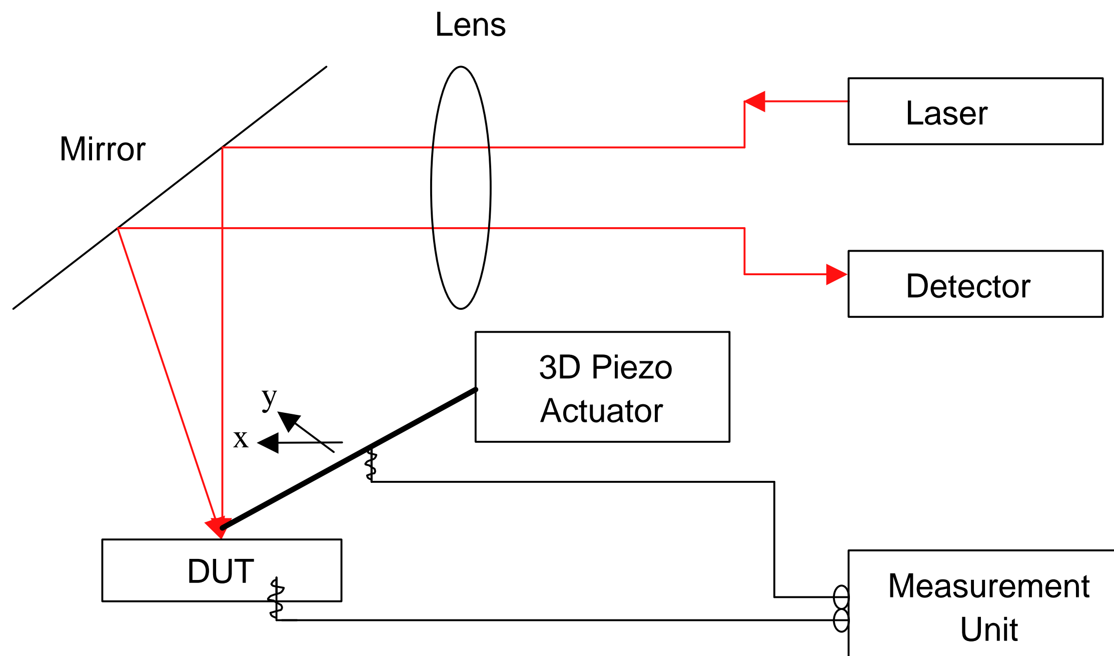
- Basic AFM principle for imaging
- Use of the AFM tip to make electrical contact



GOAL:

Collect electrical data quickly for Failure Analysis and Design Verification

Probing Procedure

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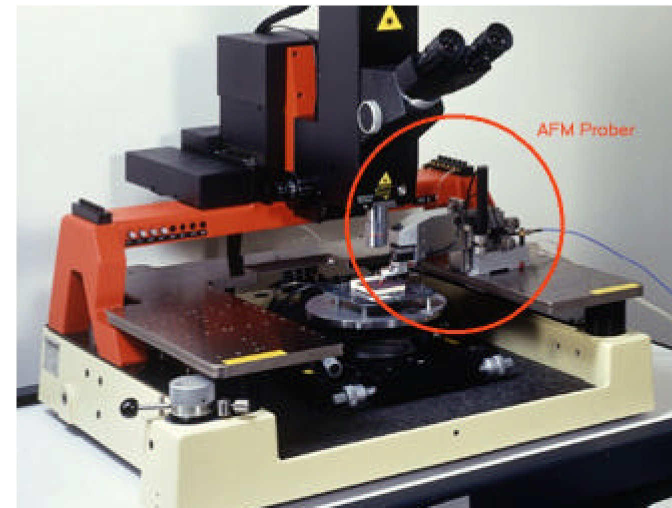
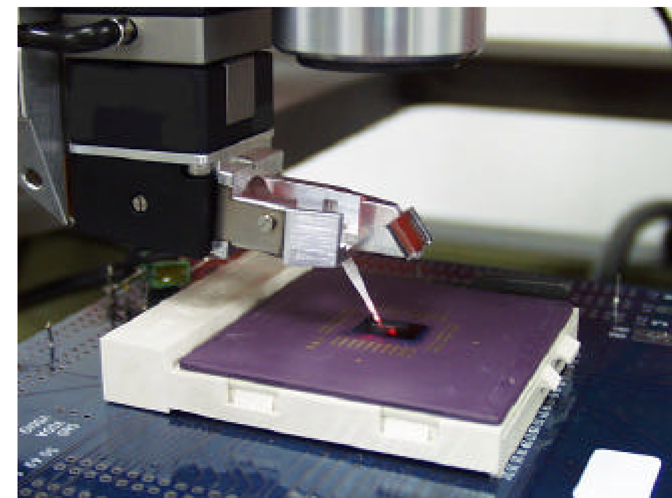
- Setup standard probe station
- Place sample on chuck
- Coarse positioning of AFM ProbeHead(s)
- Measurement equipment setup
- AFM navigational scan (38 µmx38 µm)
- AFM positional scan (approx. 10 µm x 10 µm)
- Probe placement(s)
- Measurement





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Complete Submicron Probing Setup

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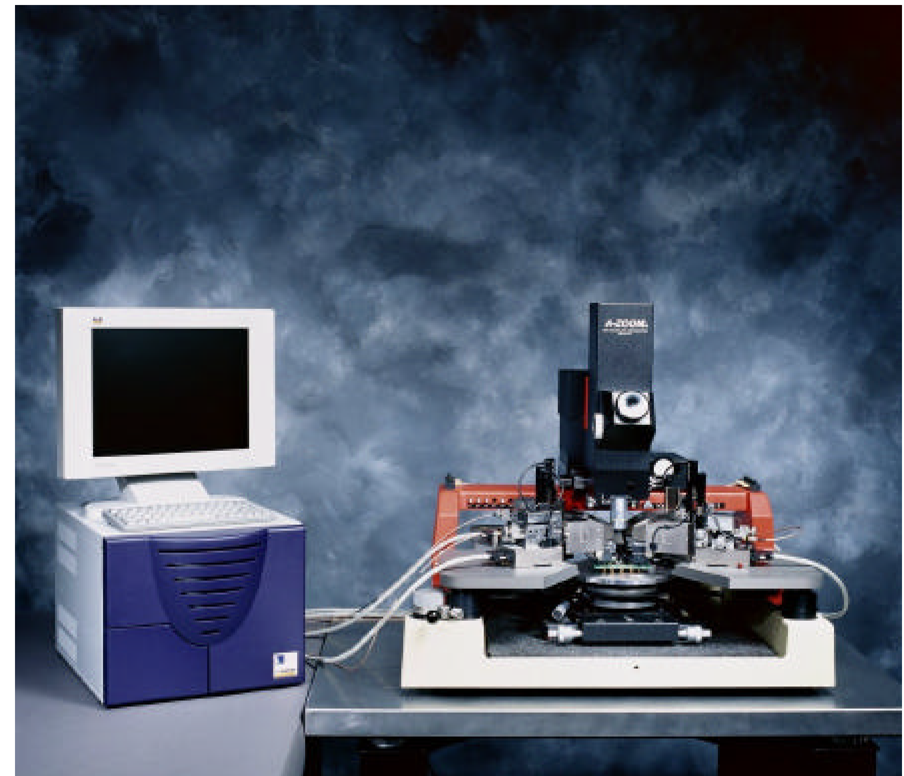
- ProbeHead with AFM Technology
- PC-based controller
- Fits to all SUSS probe stations
- Vibration isolation table required
- Up to 3 probes can be placed within 1x1µm area
- Easy to use software



AFP Probehead

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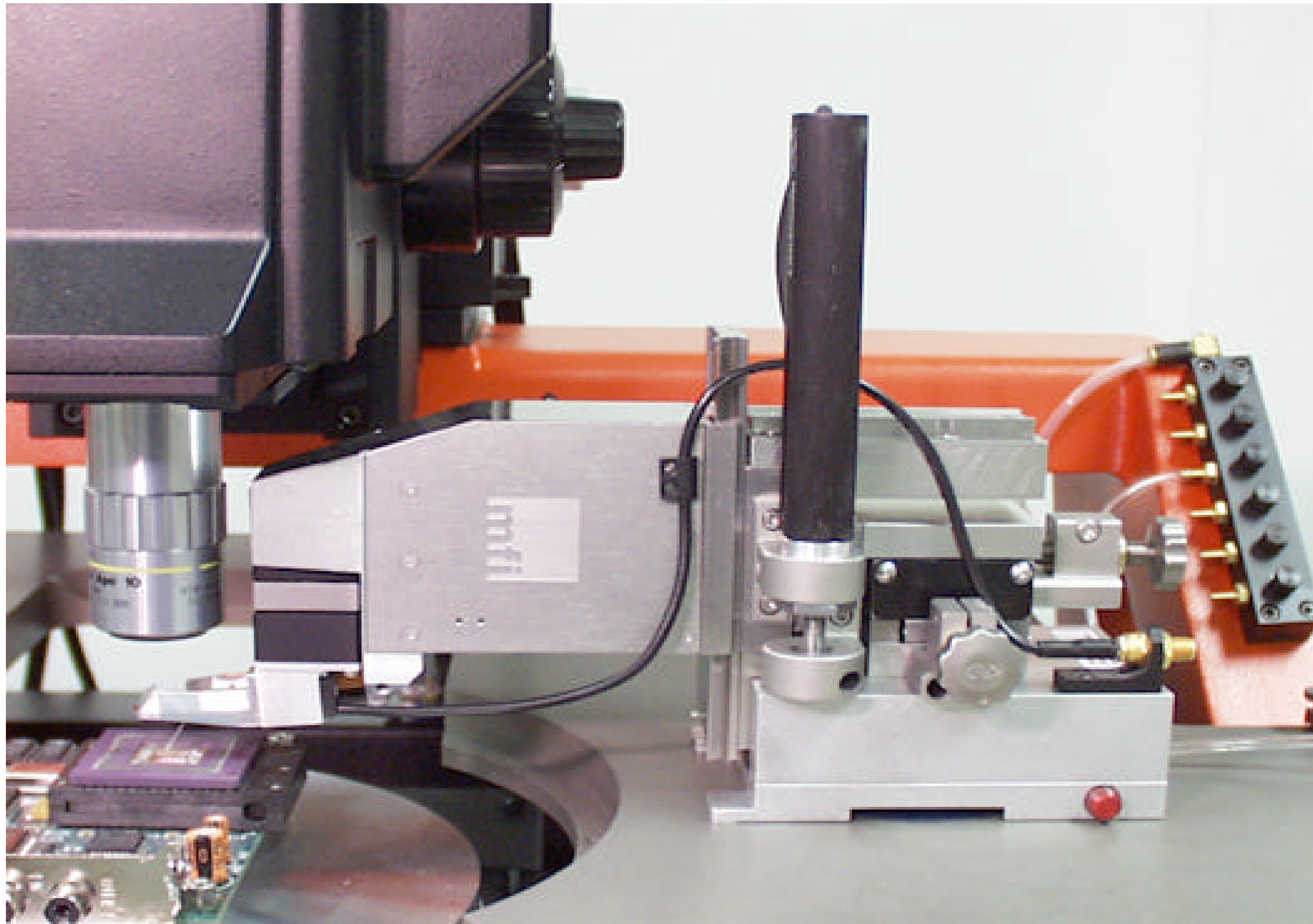

Cartridge & Probe Tip

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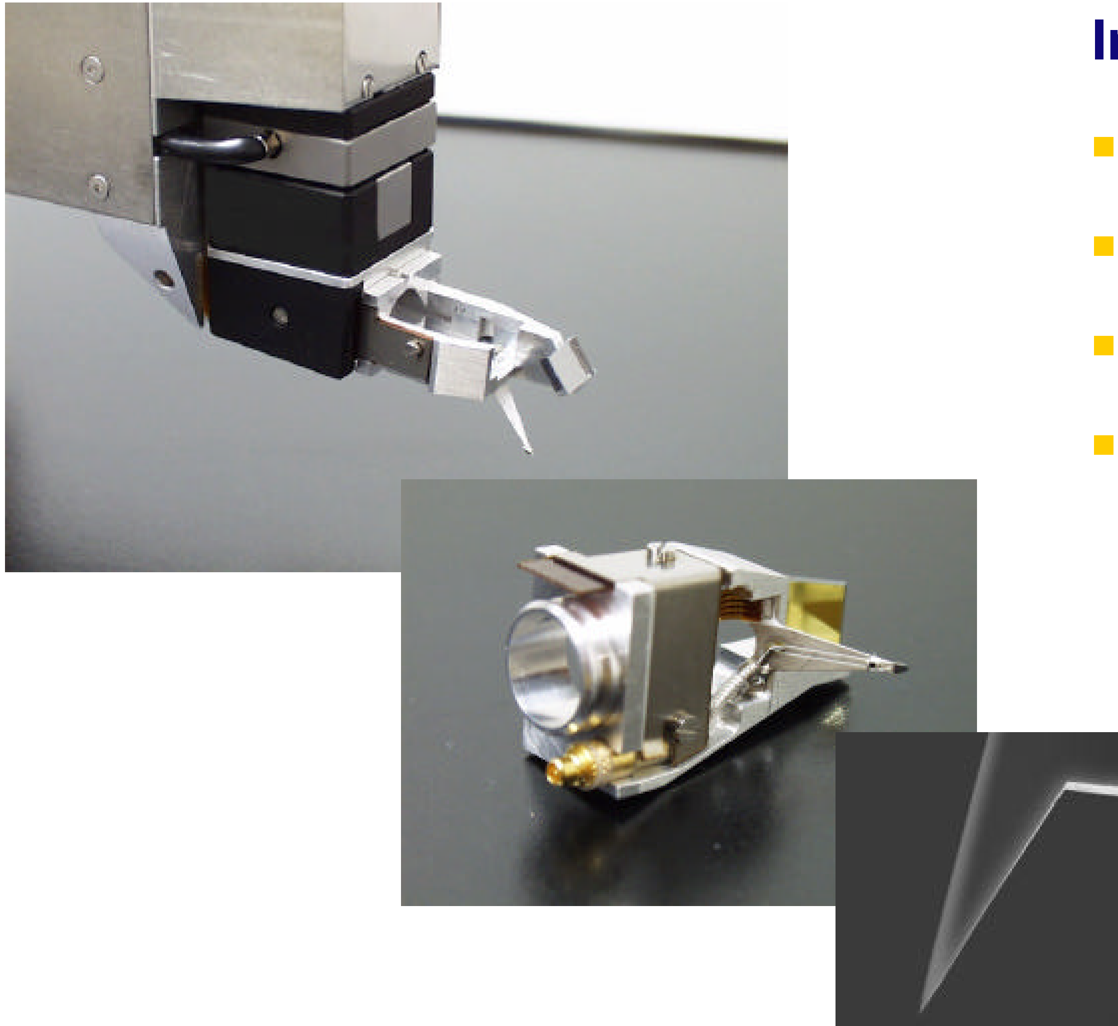

Intelligent cartridges:

- Application decides type
- Frequencies up to 3 GHz
- Active and passive probes
- Equipped with EEPROM covering
  - Statistics (e.g. lifetime)
  - Type
  - Calibration data

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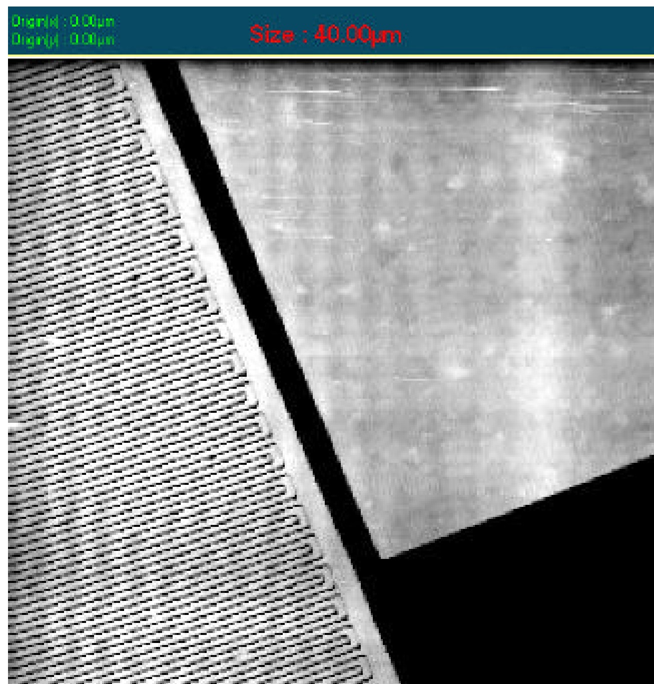
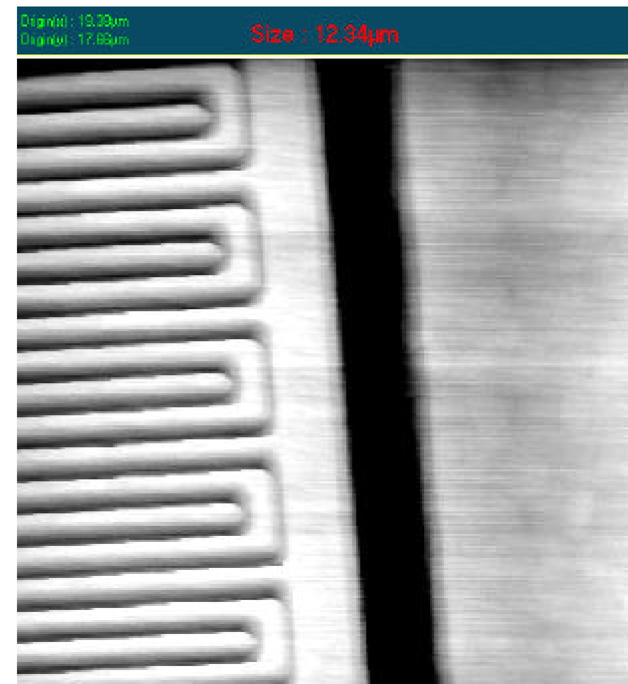
Performance: Imaging

- Placement accuracy: R=90 nm
- Image resolution: 50 nm
- Zoom function
- Damage free imaging using constant force scan



38 x 38 µm scan



12 x 12 µm scan

Performance: Contact Stability

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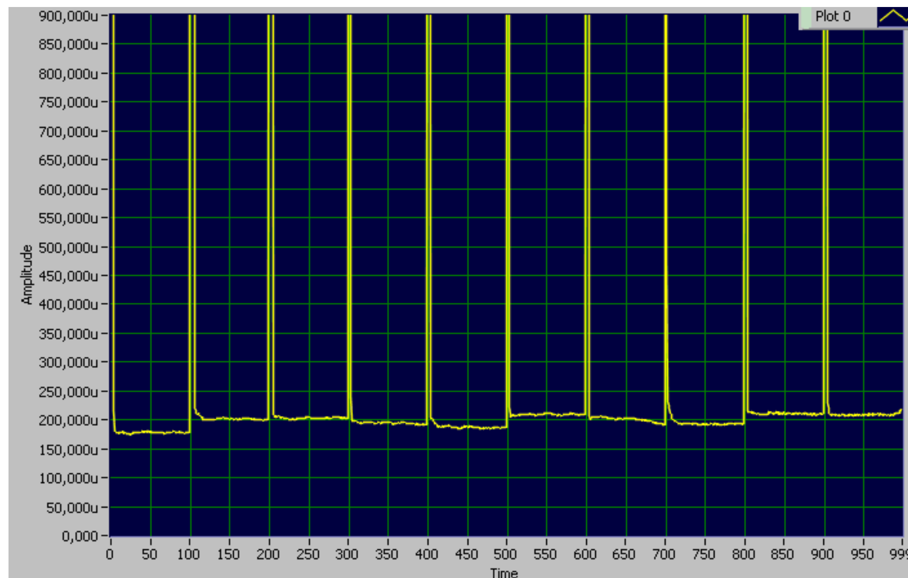
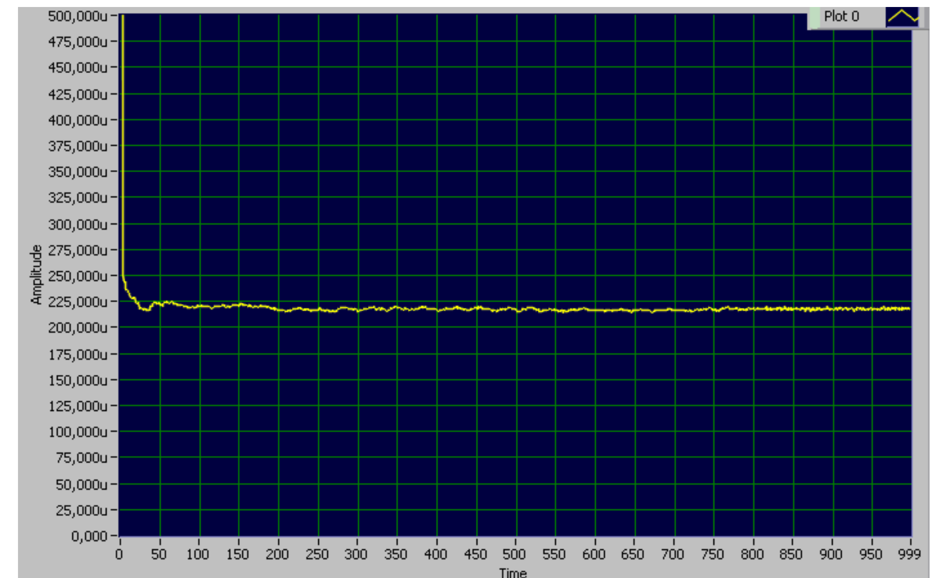
Test Procedure: Resistant Measurement



10 x 60sec contact on aluminum metal wafer



1000sec contact on aluminum metal wafer

Performance: RF Measurements

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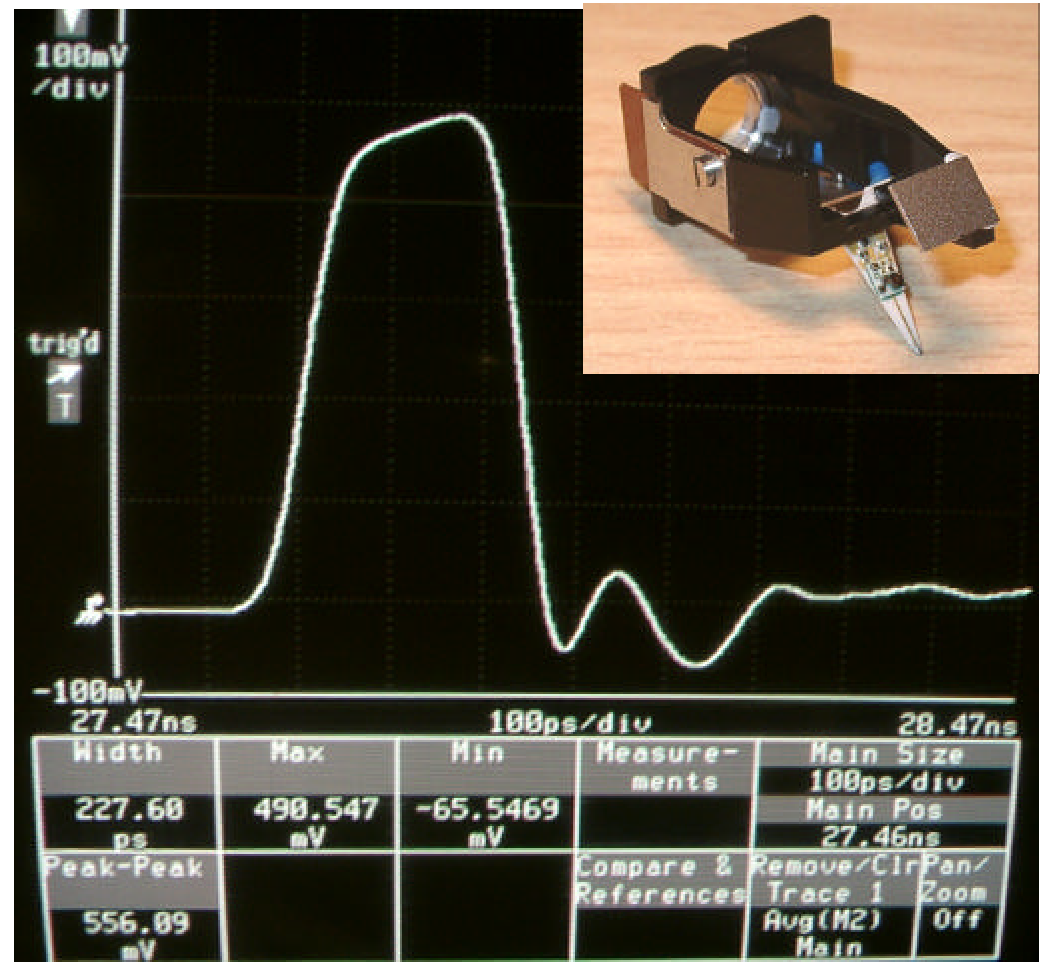
"AP3" performance

Response
Rise time

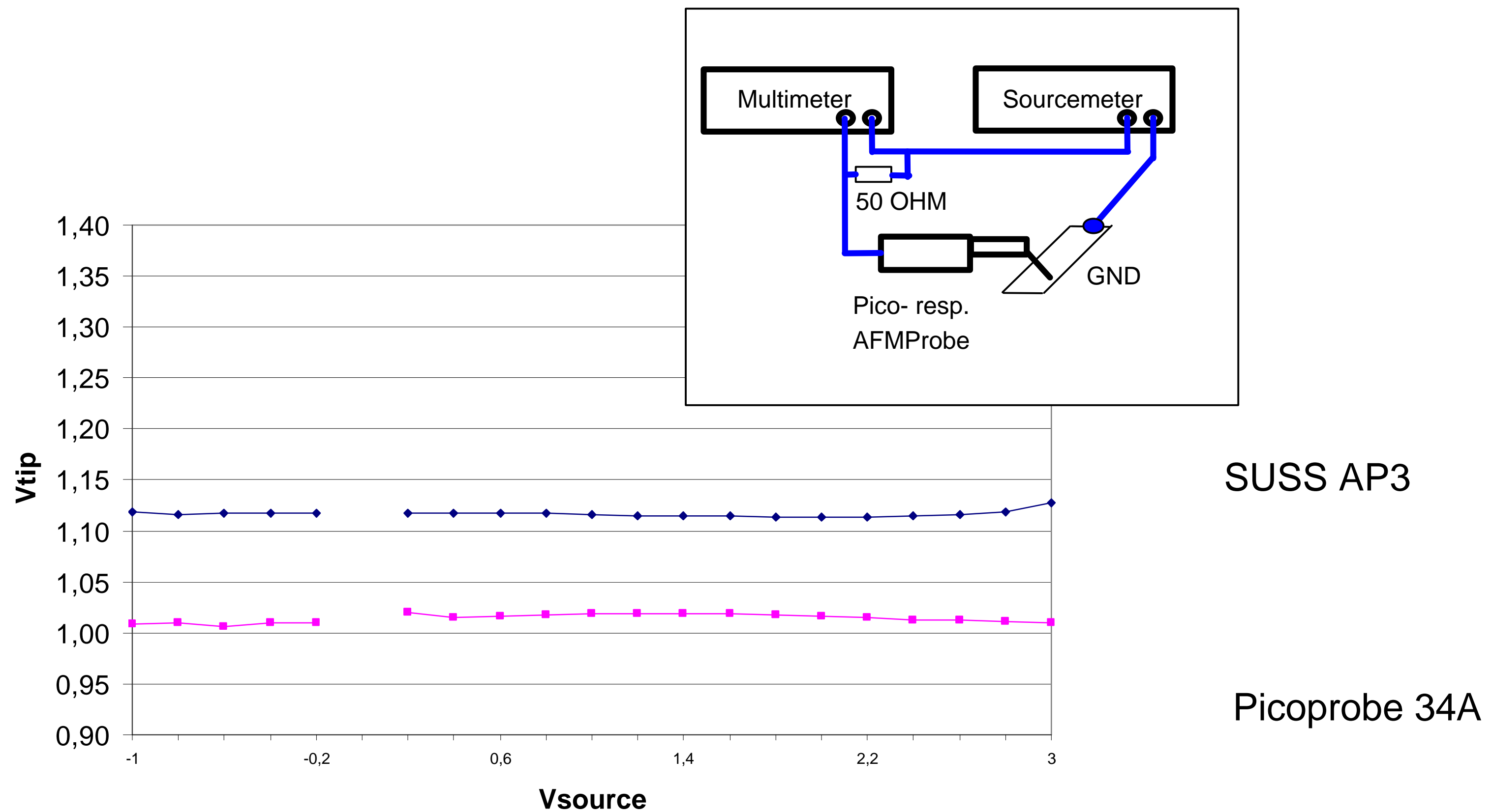
120 ps

(3 Ghz)

@ 10 MOhm
input impedance



Performance: Active Probe Linearity



SUSS AP3

Picoprobe 34A

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Applications: Surface Submicron Probing

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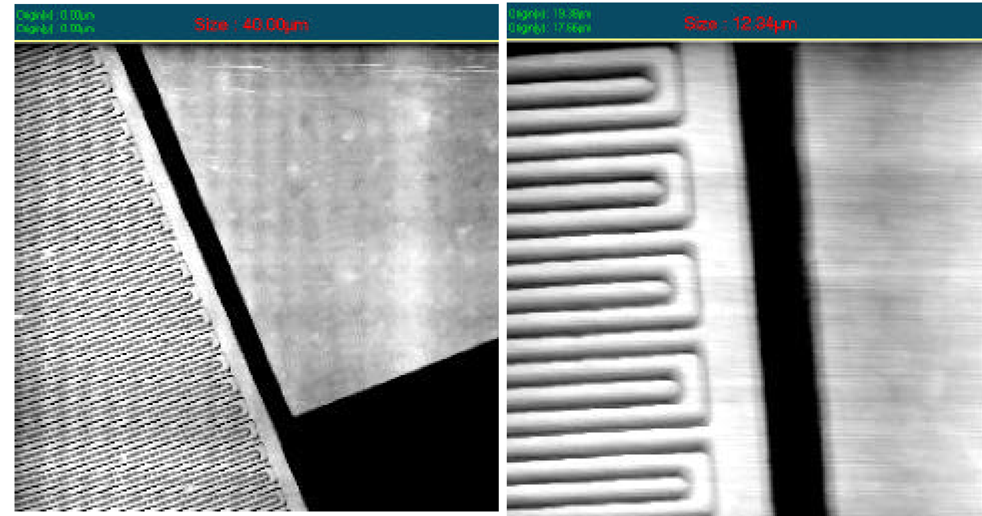
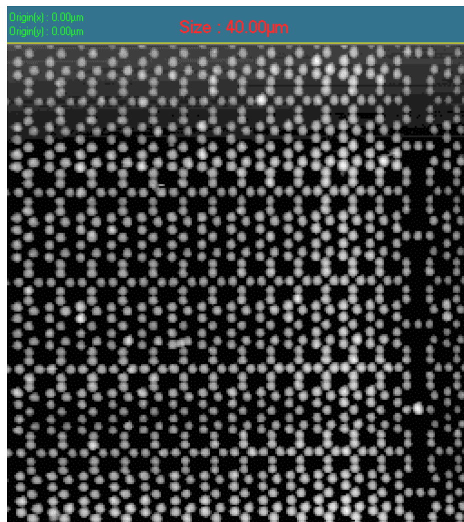
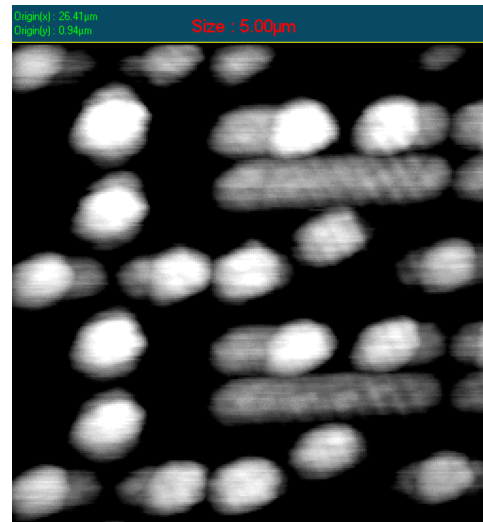


- Metal layers (live part)
  - Failure analysis
  - Design verification
  - Device characterization





- Contact level (dead part)
  - Transistor characterization
  - Failure analysis
  - Design verification

Applications: Fib – Hole Probing

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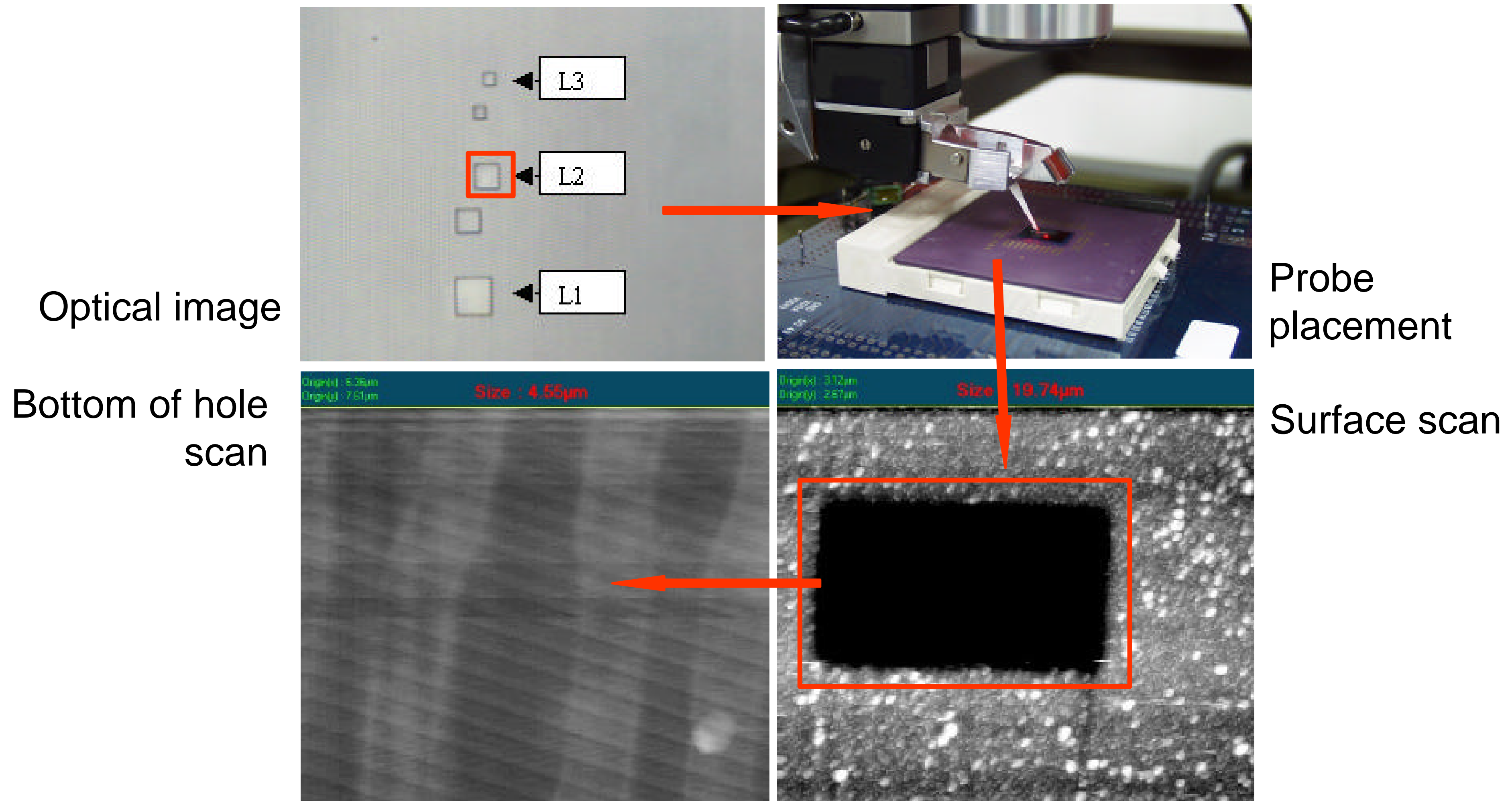

Application: CAD Navigation

- Software supported Area Of Interest (AOI) search
- Basing on CAD chip layout

SUSS PA 200 with Raith CAD Navigation Software

Conclusions

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- Atomic Force Micro Probing is a useful tool to master the next generation test challenges.
- Compared to other submicron test technologies AFM Probing offers the following major advantages:
  - Extremely short time to data
  - Use under standard environment conditions
  - Portable
  - Tester independent
  - Easy to use
  - Usual probing interfaces useable (e.g. CAD Navigation)