Pad damage due to probing: Solutions for the future

Infineon Memory Products Division

Test Development: Munich - Germany

Wafer fabs for memory products:

Dresden - Germany	**Hsinchu - Taiwan** **JV with Mosel-Vitelic**
Richmond - USA	**Essonnes - France** **JV with IBM**

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Pad damage due to probing: Solutions for the future

Problems observed

Cracks in Oxide layers below the pad metal using:

- **Cantilever**

  2.5g/mil OD = 50µm tip ; = 25µm

- **Microsprings™ (FormFactor Inc.)**

  4.5g/mil OD = 35µm tip = 10 x 10µm^2

- **Vertical (JEM: VCPC)**

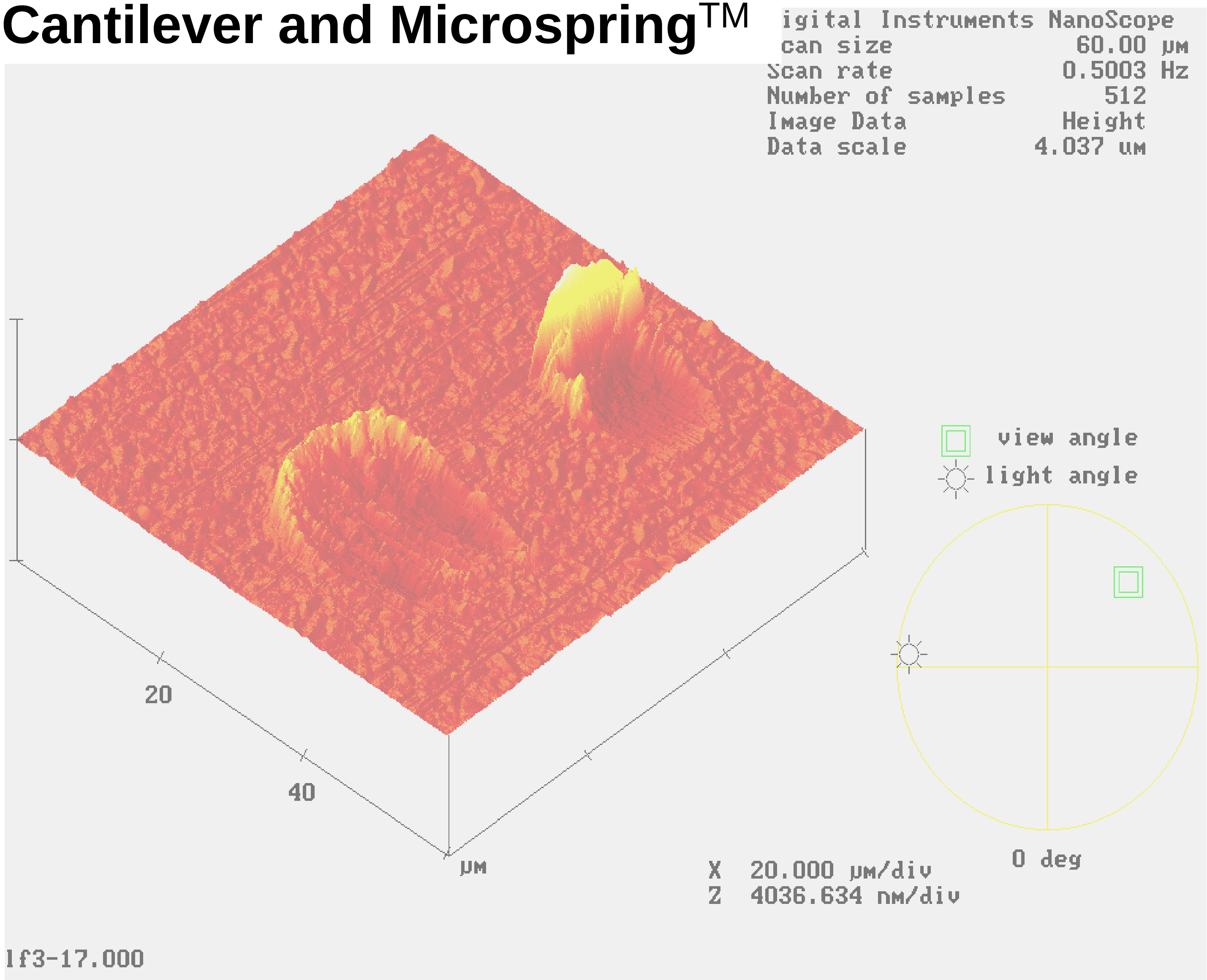
  5g/mil OD = 60µm tip ; = 10µm

Reasons: Depth of scrub marks and probe force!

Pad damage due to probing: Solutions for the future

Depth of Probe Marks

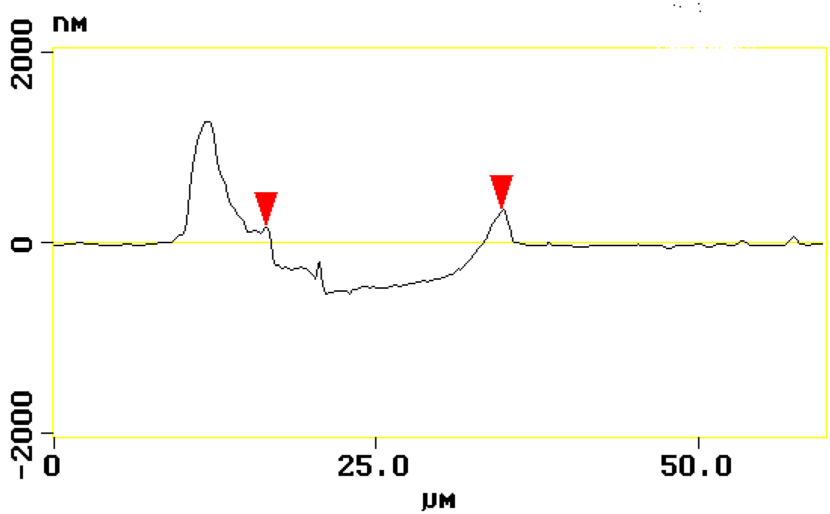
Cantilever and Microspring™



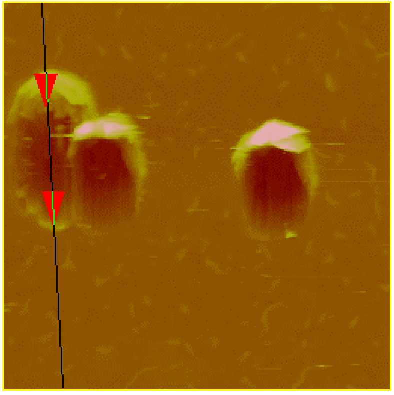
Pad damage due to probing: Solutions for the future

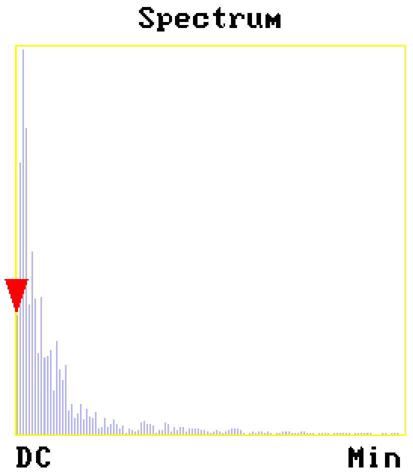
Depth of Probe Marks

Cantilever: 650nm @ 50µm OD



L	18.281 µm
RMS	205.99 nm
lc	DC
Ra(lc)	160.40 nm
Rmax	781.94 nm
Rz	781.94 nm
Rz Cnt	2
Radius	61.732 µm
Sigma	69.950 nm



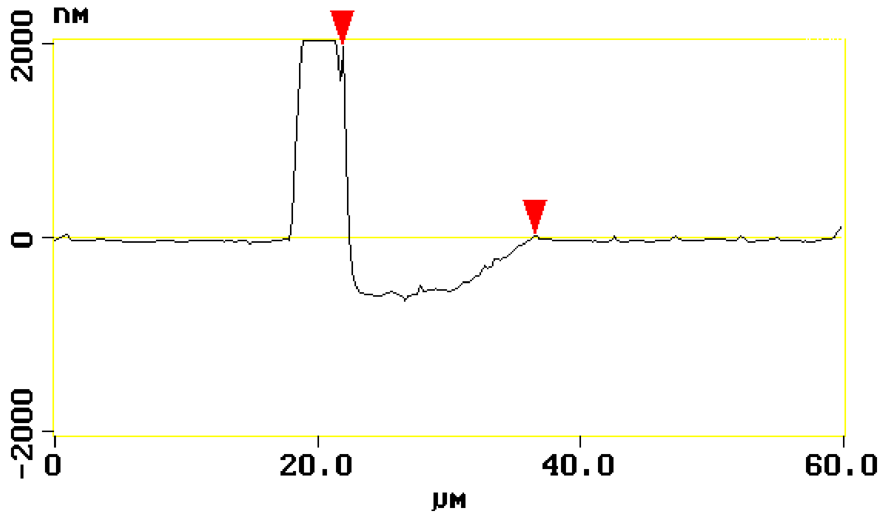


Surface distance	18.664 µm
Horiz distance(L)	18.281 µm
Vert distance	177.29 nm
Angle	0.556 deg
Surface distance	
Horiz distance	
Vert distance	
Angle	
Surface distance	
Horiz distance	
Vert distance	
Angle	
Spectral period	DC
Spectral freq	0 Hz
Spectral RMS amp	0.105 nm

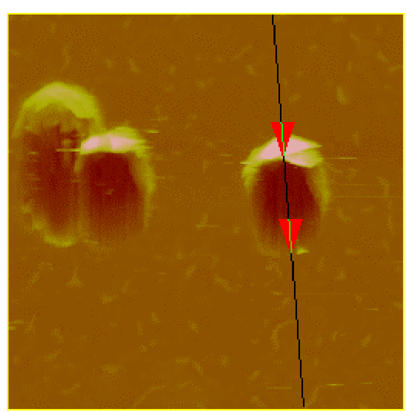
Pad damage due to probing: Solutions for the future

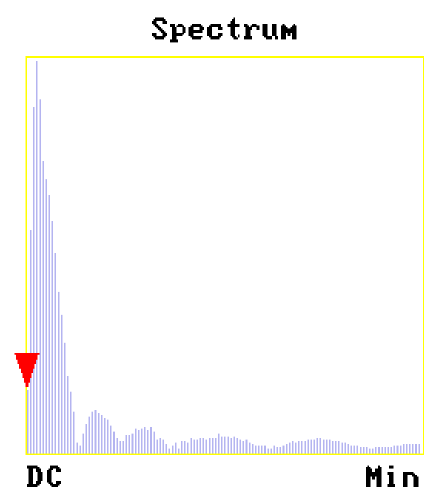
Depth of Probe Marks

Microspring™: 850nm @ 35µm OD



L	14.648 µm
RMS	351.64 nm
lc	DC
Ra(lc)	187.54 nm
Rmax	2.680 µm
Rz	2.680 µm
Rz Cnt	2
Radius	16.098 µm
Sigma	385.96 nm



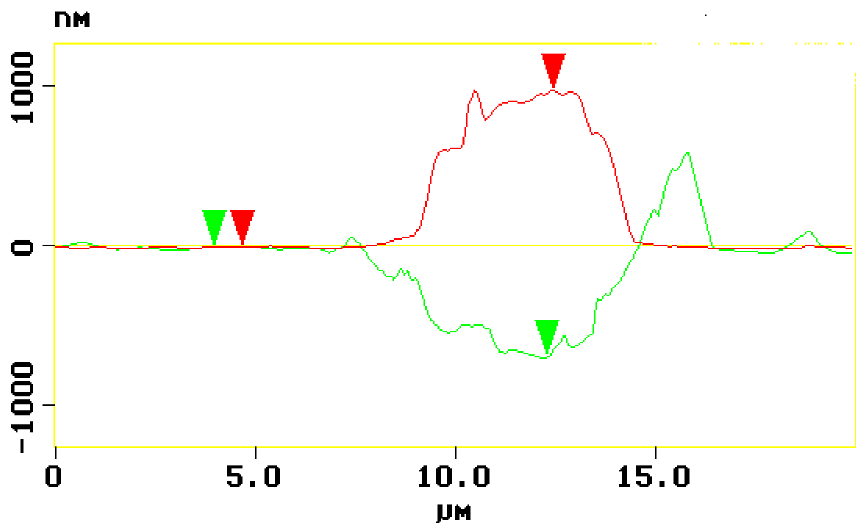


Surface distance	16.530 µm
Horiz distance(L)	14.648 µm
Vert distance	1.950 µm
Angle	7.584 deg
Surface distance	
Horiz distance	
Vert distance	
Angle	
Surface distance	
Horiz distance	
Vert distance	
Angle	
Spectral period	DC
Spectral freq	0 Hz
Spectral RMS amp	0.080 nm

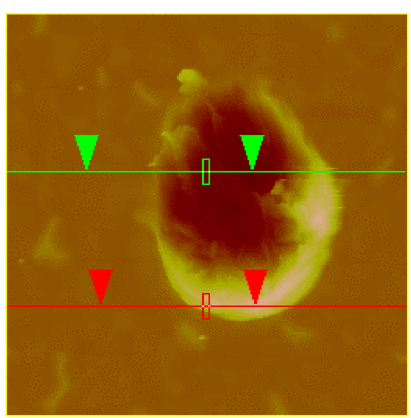
Pad damage due to probing: Solutions for the future

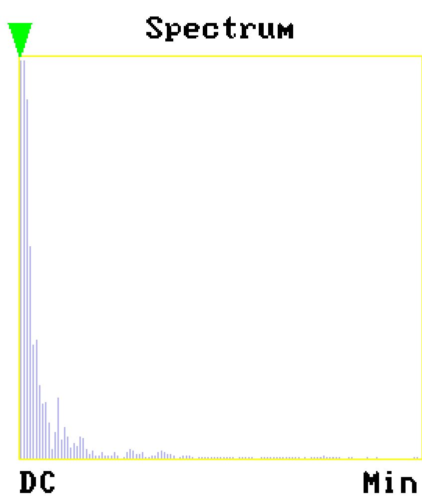
Depth of Probe Marks

Vertical: 700nm @ 60µm OD



L	8.320 µm
RMS	265.45 nm
lc	DC
Ra(lc)	85.984 nm
Rmax	407.64 nm
Rz	218.91 nm
Rz Cnt	6
Radius	11.343 µm
Sigma	146.58 nm





vert1.001

Surface distance	8.248 µm
Horiz distance(L)	7.773 µm
Vert distance	969.06 nm
Angle	7.106 deg
Surface distance	8.574 µm
Horiz distance	8.320 µm
Vert distance	681.36 nm
Angle	4.682 deg
Surface distance	
Horiz distance	
Vert distance	
Angle	
Spectral period	DC
Spectral freq	0 Hz
Spectral RMS amp	0.347 nm

Pad damage due to probing: Solutions for the future

Short term solutions

Reduce the overdrive to the minimum needed

- **Planarity**
- **Uniformity of force**
- **Temperature movement of probes**

$\Rightarrow$ **uniform scrubs**

reduced depth

BUT: Reliable contact needed

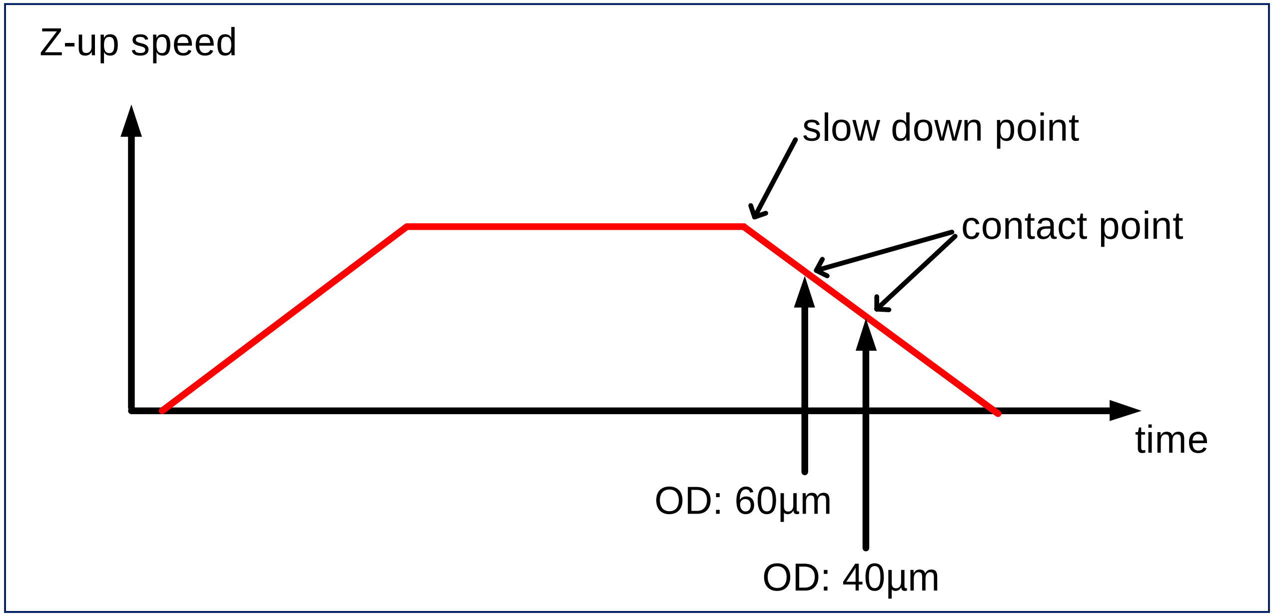
On the long run these parameters have to be improved!

Pad damage due to probing: Solutions for the future

Short term solutions

Adjusting probing parameters (values for TSK):

- **Z-up speed: 6mm/s - 18mm/s - 25mm/s**
- **Acceleration: 0.1G - 0.2G - 0.4G**



Speed at contact point depends on over-drive

typical values: 6mm/s - 15mm/s

Pad damage due to probing: Solutions for the future

Short term solutions

Many experiments were carried out using cantilever and vertical probe cards at various parameters.

Results:

- **Higher Z-up speed is less critical**
- **Slower speed causes longer scrubs**
- **Docking has an influence**
- **Process variations have an influence**

⇨ many parameters - difficult analysis

Pad damage due to probing: Solutions for the future

Long term solutions

Reduction of probe force

Evaluation of new probe card technologies

- **JEM VCPC with low force (1.3 g/mil)**

  increased diameter ; 15µm ⇨ ; 30µm

  tip diameter seems to be most critical!

- **FFI microsprings with ultra low force**

  (0.41g/mil, 0.69g/mil, 1.02g/mil)

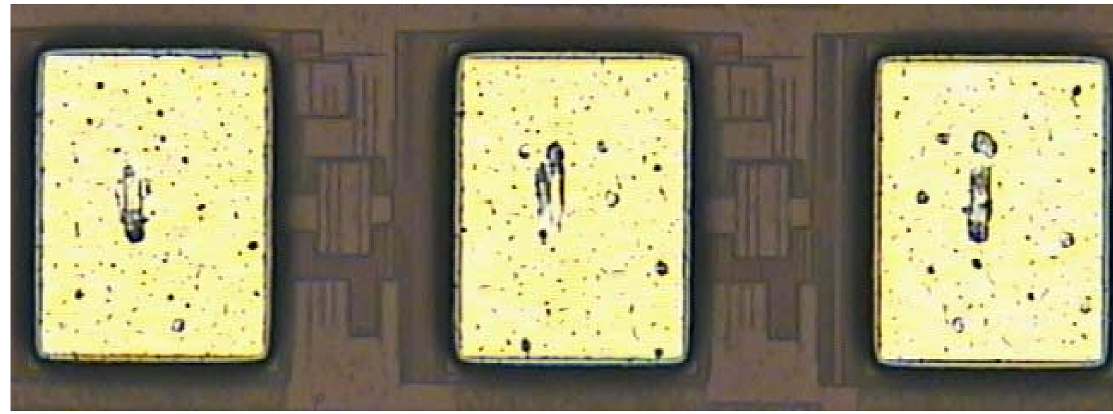
- **FFI T2 probe cards (1.8 g/mil)**

Pad damage due to probing: Solutions for the future

Ultra low probe force microspring @ 40 µm OD

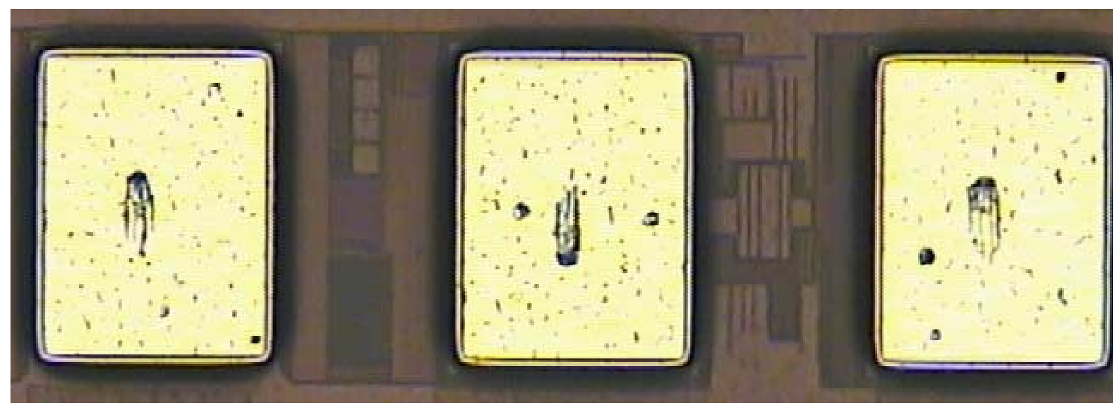
0.41 g/mil

420nm



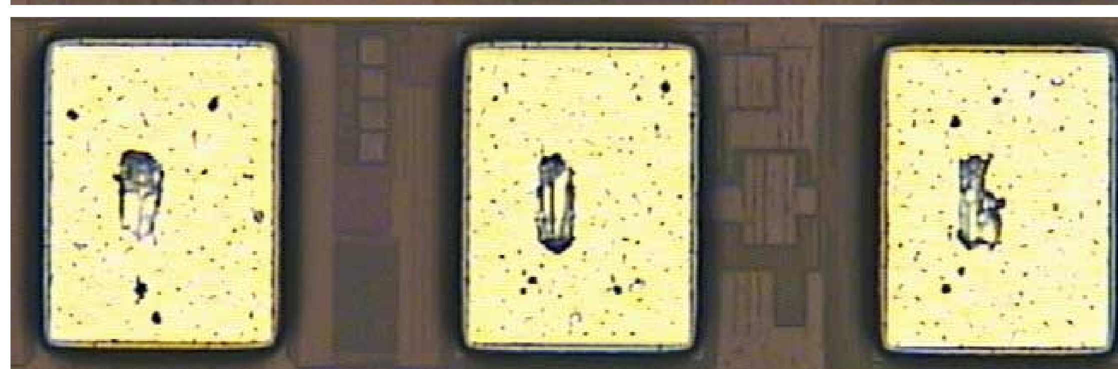
0.69 g/mil

550nm



1.02 g/mil

620nm

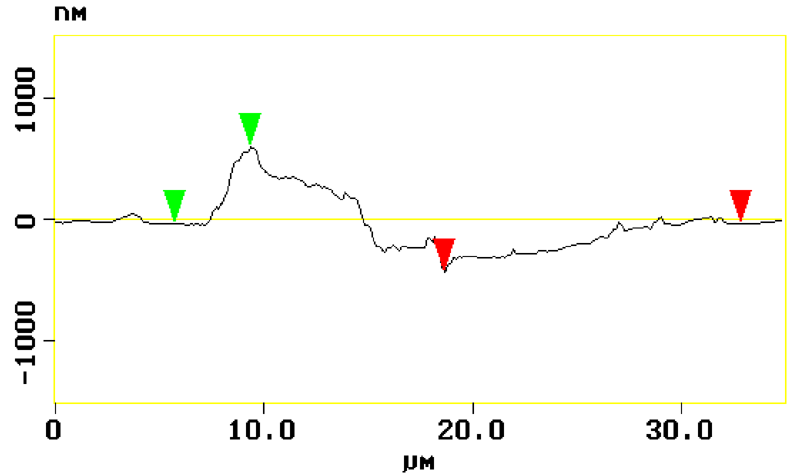


Pad damage due to probing: Solutions for the future

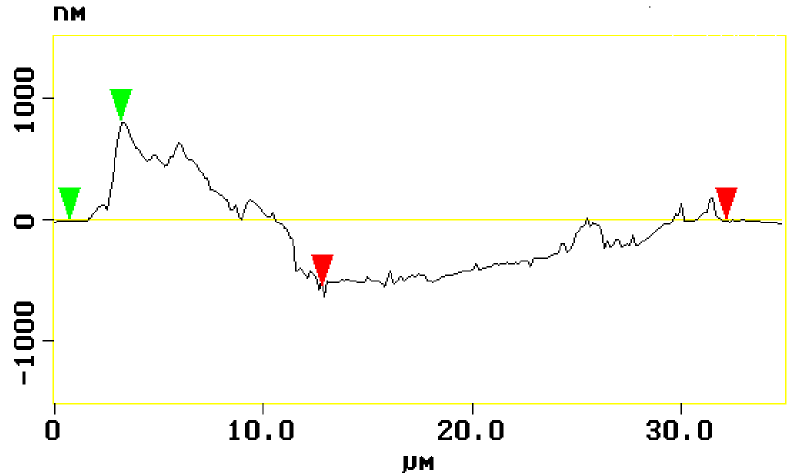
Ultra low probe force microspring

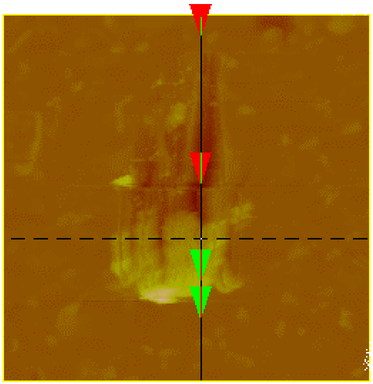
Example: 0.41g/mil

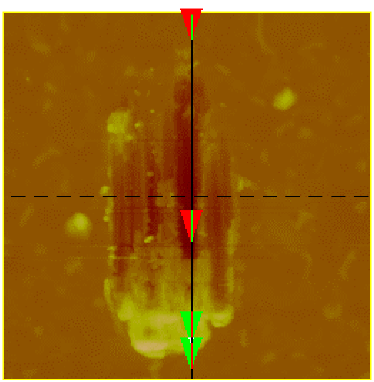
40µm OD (390nm)



60µm OD (550nm)



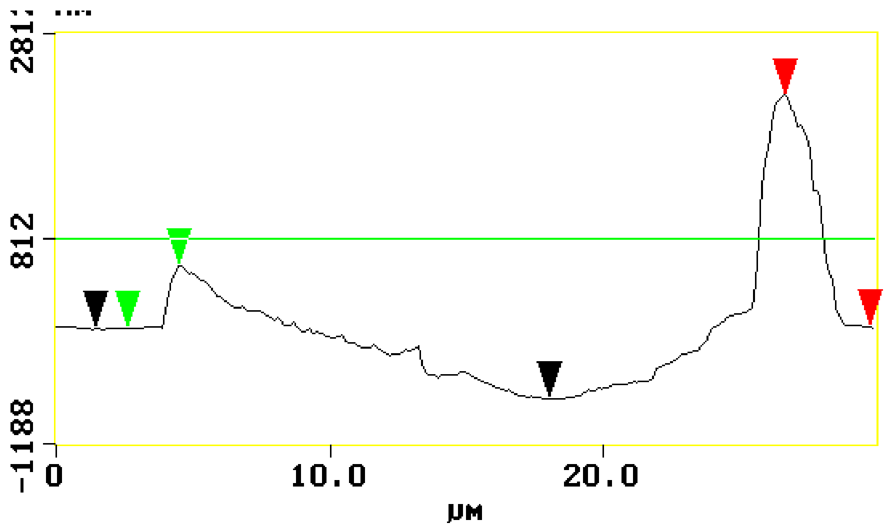


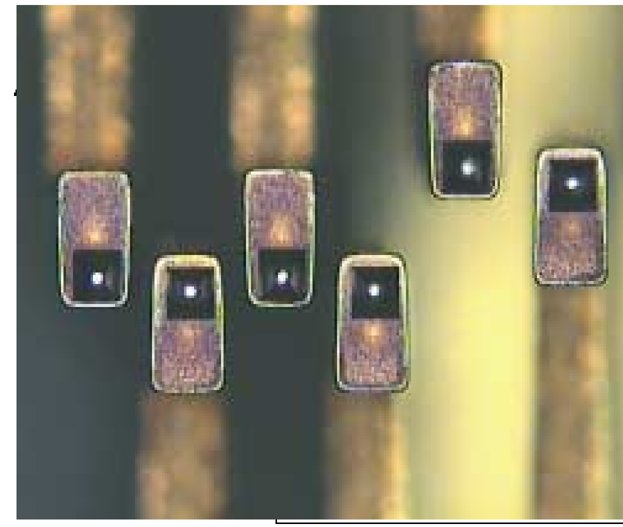


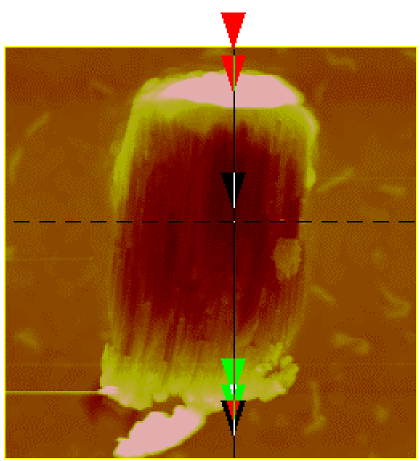
Pad damage due to probing: Solutions for the future

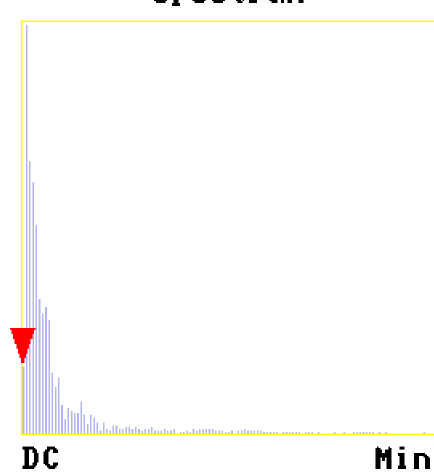
FFI T2: Generation 2 microspring (1.8g/mil)

680nm @ 40µm OD









t2p6.001

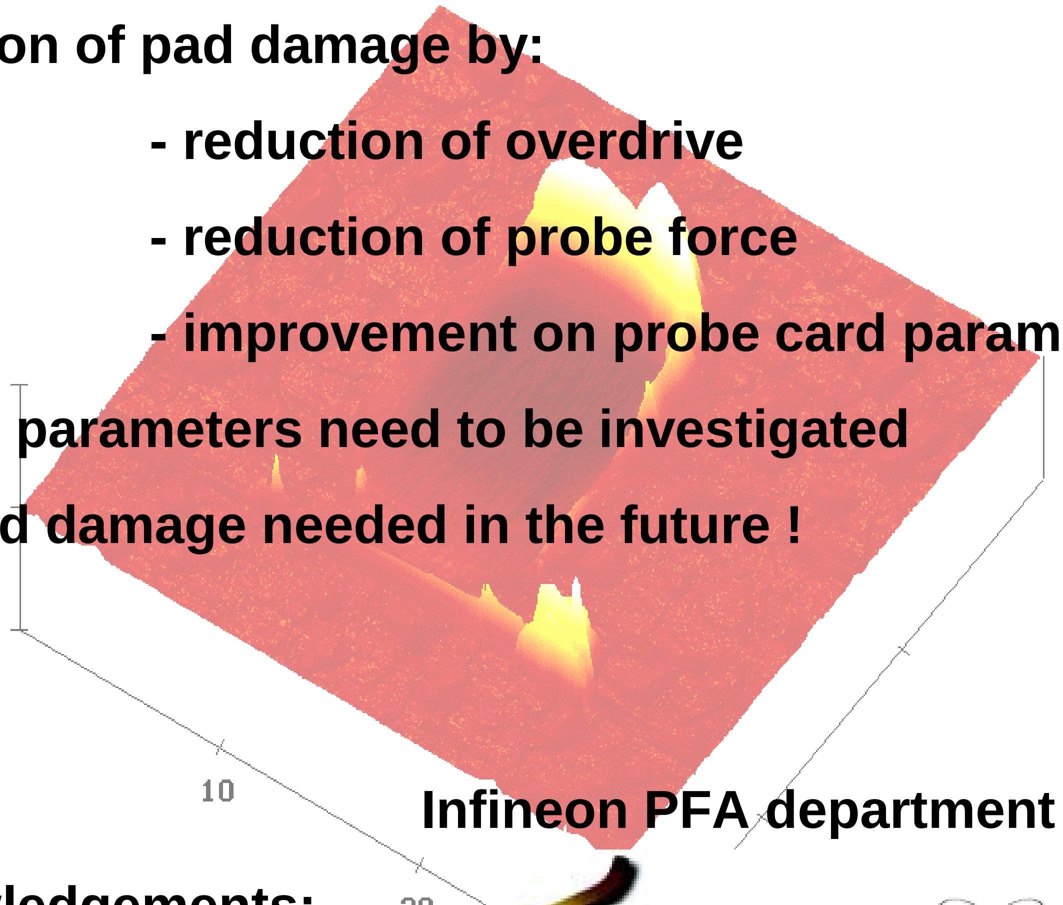
Surface distance	4.361 µm
Horiz distance(L)	3.105 µm
Vert distance	2.254 µm
Angle	35.970 deg
Surface distance	2.152 µm
Horiz distance	1.875 µm
Vert distance	616.73 nm
Angle	18.207 deg
Surface distance	17.174 µm
Horiz distance	16.582 µm
Vert distance	682.10 nm
Angle	2.356 deg
Spectral period	DC
Spectral freq	0 Hz
Spectral RMS amp	0.128 nm

Michael Huebner

Pad damage due to probing: Solutions for the future

Summary:

- Depth of scrub marks was measured for different technologies
- Reduction of pad damage by:
  - reduction of overdrive
  - reduction of probe force
  - improvement on probe card parameters
- Probing parameters need to be investigated
- Less pad damage needed in the future !



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formfactor

JEM

TSK