AFP & SEM based nanopробing: comparison

Andreas Altes
Thomas Schweinböck
Florian Kerschl
Zyvex dProber with Zeiss Supra 55

- 6 probes
- mechanical stage
- T stage
SEM based probing – Zyvex dProber

- 6 probes available
- Active voltage contrast
- Contact resistance typically 20Ω
- Samples with high topography can be measured easily
- Electrical measurements at high or low temp (-20...120°C)
Multiprobe AFP

- MP1 heads
- SW Multiscan 2.5.5
- 4 probe heads
- SNAP stage
- Keithley 4200
Case study AFP– Open gate contacts 130nm

- SDL spot
- No tunneling current at gate
- Open contacts
Case study AFP: SRAM Single Cell fail

AFP: Weak access transistor
FIB: Poly particle masking implant step
Comparison AFP-Zyvex – Transfer char.

Measurement of 20 C11 SRAM transistors

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<tr>
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<th>$&lt;I_{\text{sat}}&gt; \sigma$</th>
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<tbody>
<tr>
<td>AFP</td>
<td>100,8 µA 4,8µA</td>
</tr>
<tr>
<td>Zyvex</td>
<td>101,8 µA 3,4µA</td>
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$<|\Delta|>=4,0\mu A$

No increased $I_{\text{off}}$ for SEM probing at 1kV!

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<tr>
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<th>$&lt;V_{\text{th}}&gt; \sigma$</th>
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<tr>
<td>AFP</td>
<td>527mV 36mV</td>
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<tr>
<td>Zyvex</td>
<td>544mV 33mV</td>
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SEM nanoprobing: AVC

-1V bias left

-1V bias right

no bias
SEM nanoprobing: $I_{\text{leak}}(T)$

- Thermal stage at 100°C
- No isolating p-substrate between depletion region of n-well
SEM-based Probing

**Strengths:**
- Samples with high topography can easily be measured
- Shorts between probes can be excluded by optical inspection
- Electrical measurements at high or low temp (-20°...+120°C)
- Probing on fast oxidizing metal lines (Cu, Al)
- Active voltage contrast
- More than 4 probes
- Faster for measurements of series of devices

**Applications:**
- Test structures (drawback: beam shift limitation!)
- Characterization of complex logic gates (6 probes)
- Measurements of metal interconnects (open Via?)
- Measurements at variable Temperature
AFP Nanoprobing

**Strengths:**
- No influence of electron beam on transistor characteristics
- Current imaging gives more detailed information as PVC
- Easy sample and probe exchange
- Faster for measurements of single devices

**Applications:**
- Preferred method for measurements on contact level
- Transistor characterization
- Inspection for leaky gates / diodes using current imaging
- 2nd order transistor parameters
- Characterization of gate oxides (tunneling current)
Summary

- Nanoprobing is an indispensable tool for probing $\leq 250$ nm node
- Atomic Force Probing and SEM based probing have their specific applications
- Both tools are capable for measurements on 45 nm technology
- For future technology nodes up to now no clear trend is visible which method will be better

Never stop probing...
We commit.
We innovate.
We partner.
We create value.