"Under Pressure" - from High Voltage to MEMS Pressure Sensors Wafer Probing
Overview

• High Voltage Devices vs. MEMS Pressure Sensors – the D.U.T.
• HV Wafer Test - overview
• MEMS Pressure Sensors
• Probe Card Concept
• Features
• Summary
The D.U.T. ....

- High Voltage Devices vs. MEMS Pressure Sensors

- High Voltage IGBT (Wafer)

- MEMS Pressure Sensor

≈ 13 mm

Gate

Emitter

Pressure Sensing Membrane Structure

June 8 to 11, 2008
High Voltage Devices

• Test of breakthrough voltage for high voltage IGBTs, Diodes, MOSFETS

Challenge: flashovers

... when field strength

\[ E = \frac{U}{d} \]

exceeds breakthrough limit of atmosphere
Avoiding Flashovers....

• Physics of Gas Discharges:
  – breakthrough voltage increases with atmospheric pressure - "Paschen Curves" – breakthrough voltage vs. pressure

Paschen Diagram for Air

....by application of pressure!
High Voltage Probe Card

- Concept of "Luftpolster" probe card *)
  - device is tested under increased atmospheric pressure (compressed air)

*) presented at SWTW 2002
MEMS Pressure Sensors

- Technology: surface micro machined sensor cell

Array of cells to increase sensitivity

Sensor cell area

CMOS circuitry

Bond pad

Polysilicon Diaphragm
Thickness: app. 0.5 μm

Pressure

Several Oxides, Passivation

Field Oxide

Well

Substrate

Sealed Cavity

Sensor Cell
Applications for MEMS Pressure Sensors (example)

barometric air pressure sensors – e.g. used in engine control unit (ECU)

side crash detection for air bag release
Probing MEMS Pressure Sensors...

- signal capture through electrical probes
- + mechanical excitation of sensor cells.....

....by application of pressure!

Same concept (though refined) as for High Voltage Wafer Test can be employed:

"LuPo-ABS"
Probe Card
"LuPo-ABS" Probe Card

"LuPo-ABS": Luftpolster – Air Bearing Seal

principle setup of "No Touch" – gap seal probe card
"LuPo-ABS" Probe Card

- Probe card top view with chip-scale pressure chamber
- Load board with electro-pneumatical components
- "LuPo-ABS" gap seal
- magnetic valve
- reference sensor
- pressure chamber
- air connectors
"LuPo-ABS" Probe Card - details

- Air piping
- Pressure chamber
- Probes (2x2 array)
- "LuPo-ABS" movable side wall with gap seal
Pressure profile of LuPo pressure chamber (diameter 8 mm)
"LuPo-ABS" - Features (2)

Rise time, fall time of chamber pressure at switching from atmospheric pressure to approx. 1 bar overpressure

550 ms

80 ms
"LuPo-ABS" - Summary

• Based on a chip-scale pressure chamber with a movable side wall that rests hovering about 80µm above the wafer surface - without touching it
• Application in wafer test of pressure sensors and high voltage devices
• Very homogenous pressure profile due to static pressure generation (compared to dynamic pressure generation with nozzles blowing on wafer)
• Fast change of pressure levels: wafer-level sensor calibration feasible
• Suitable for multi-site testing (up to 16x demonstrated)
• Suitable for integration in modern prober environment (probe card changer, automatic docking of air supplies)
Acknowledgements

• A. Reithofer, F. Reinwald, Infineon Technologies
• customers that remain anonymous…