

IEEE SW Test Workshop

Semiconductor Wafer Test Workshop

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



June 8-11, 2008
San Diego, CA USA

Overview

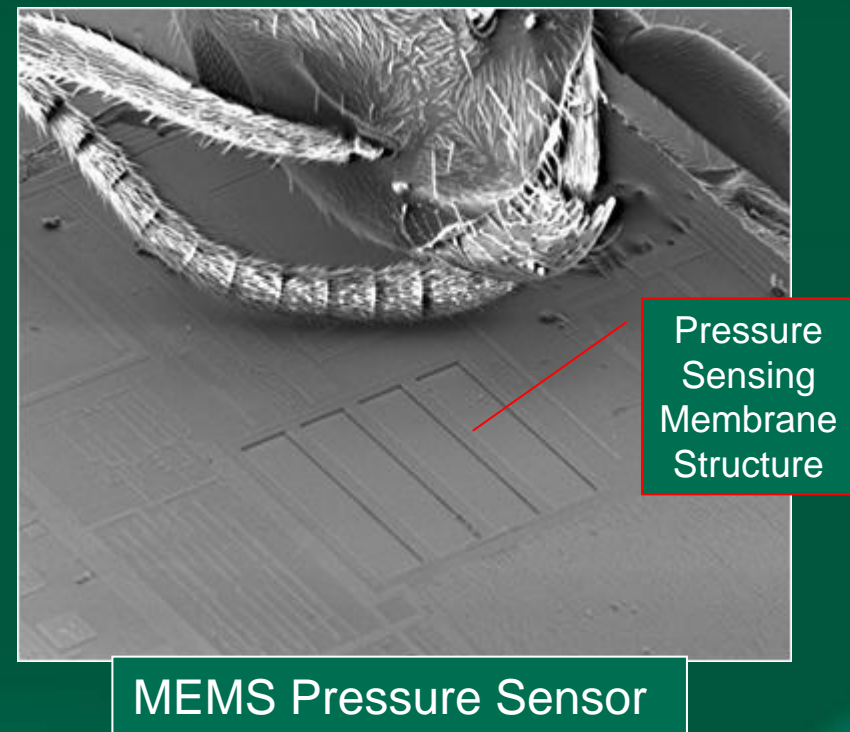
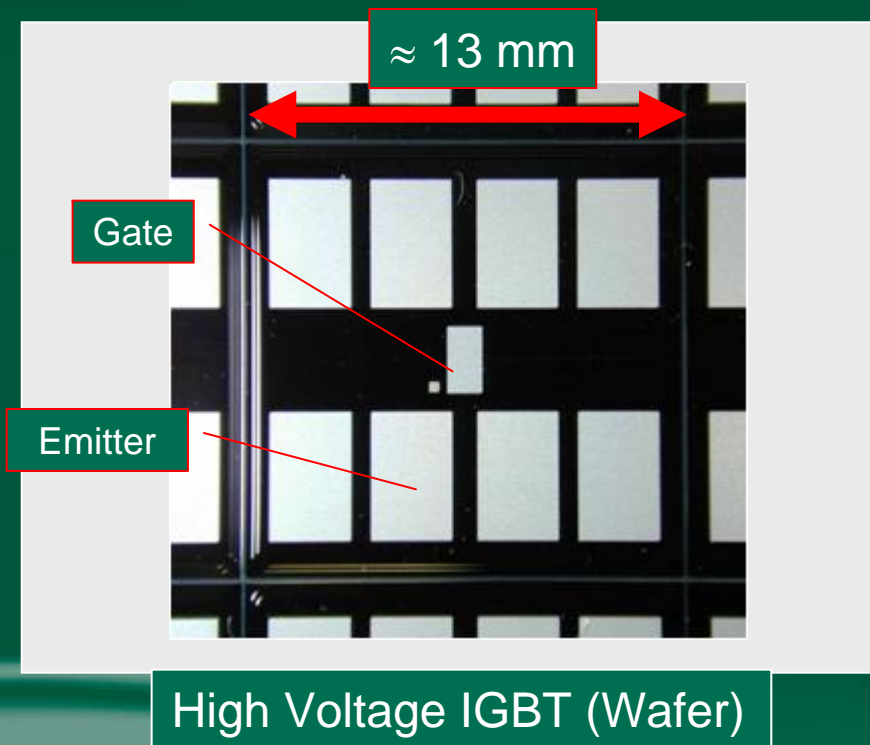
- High Voltage Devices vs. MEMS Pressure Sensors – the D.U.T.
- HV Wafer Test - overview
- MEMS Pressure Sensors
- Probe Card Concept
- Features
- Summary



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The D.U.T.

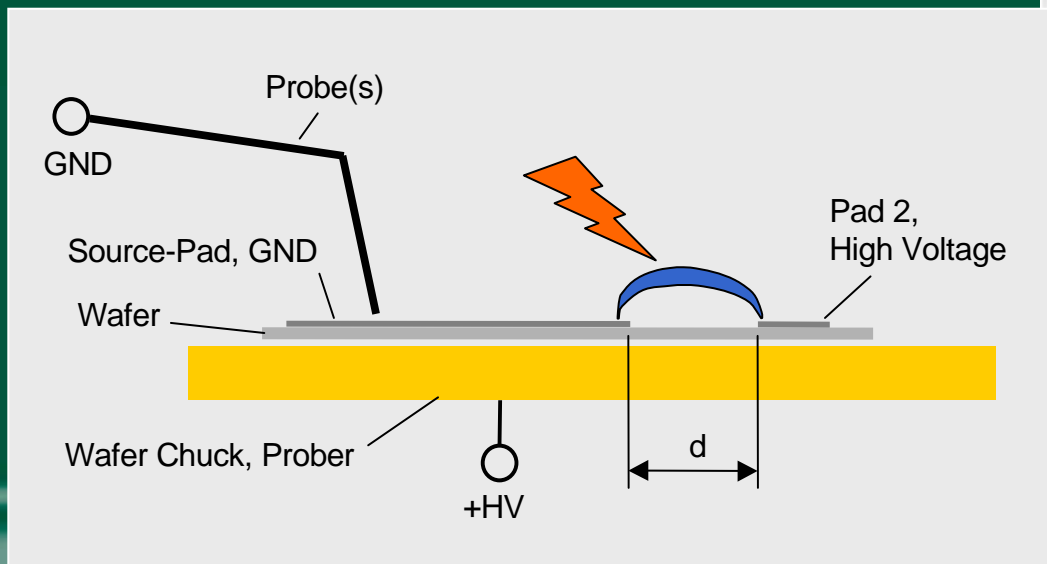
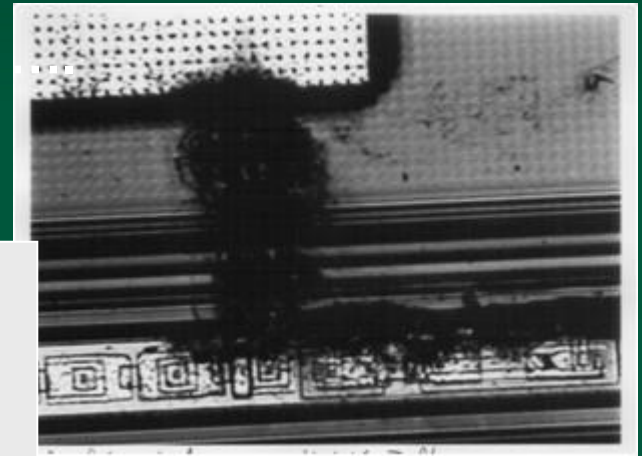
- High Voltage Devices vs. MEMS Pressure Sensors



High Voltage Devices

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

Challenge: flashovers 



... when field strength

$$E=U/d$$

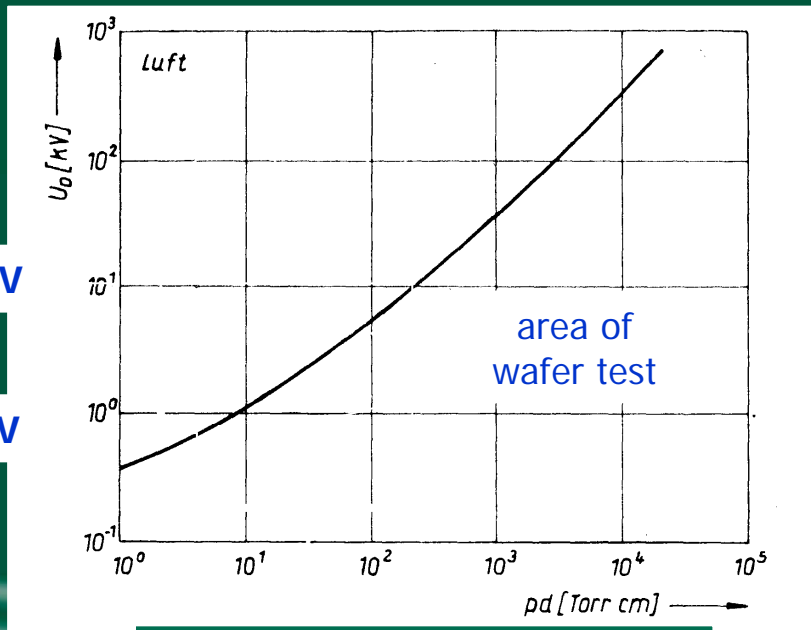
exceeds breakthrough
limit of atmosphere



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Avoiding Flashovers....

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

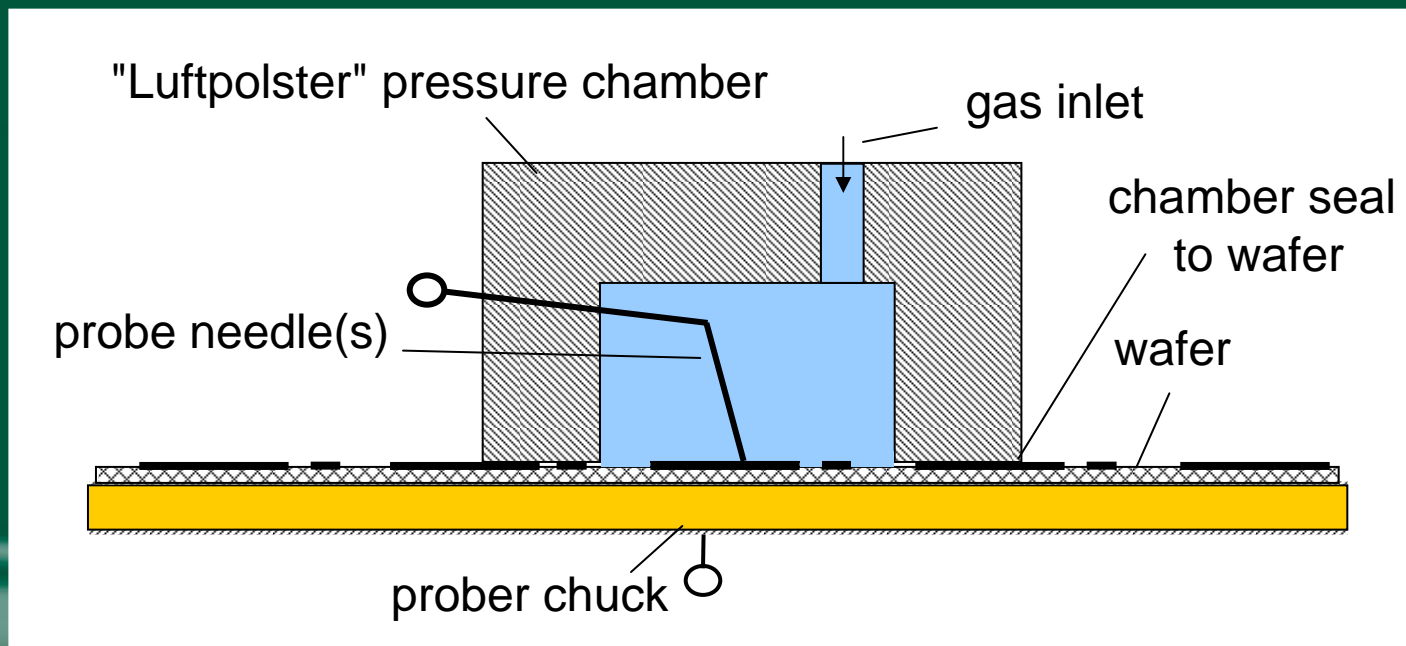


Paschen Diagram for Air

....by
application of
pressure !

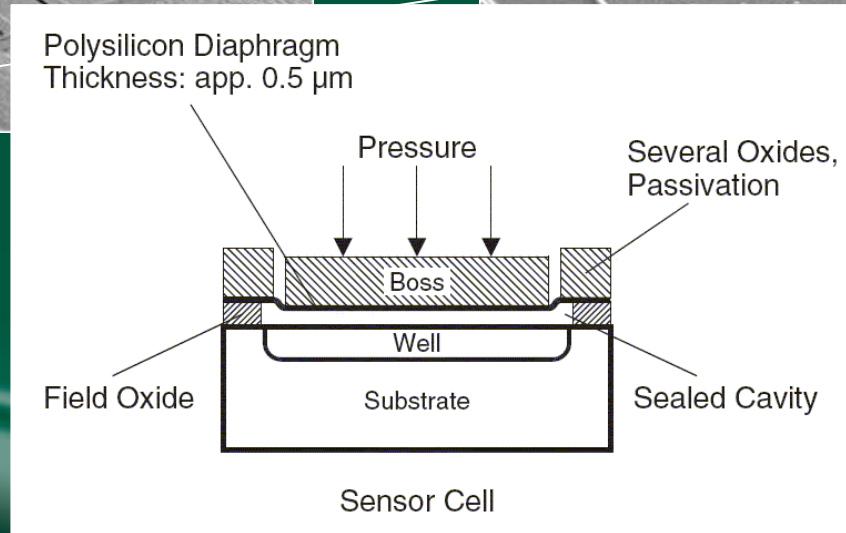
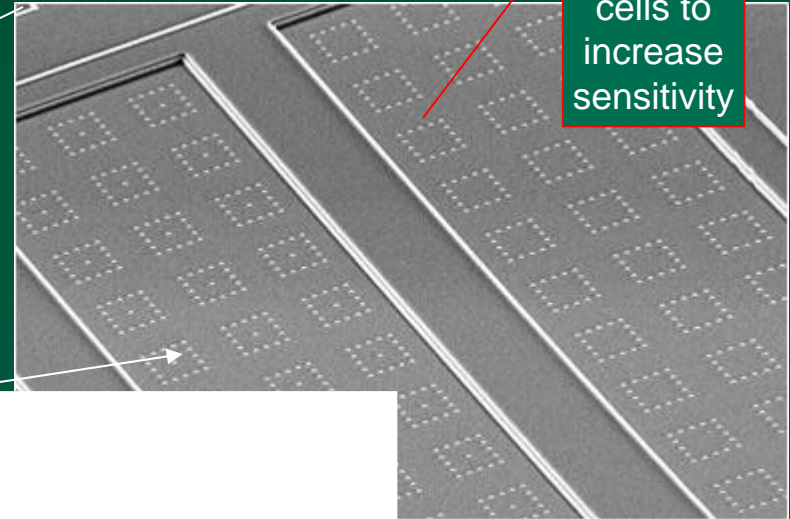
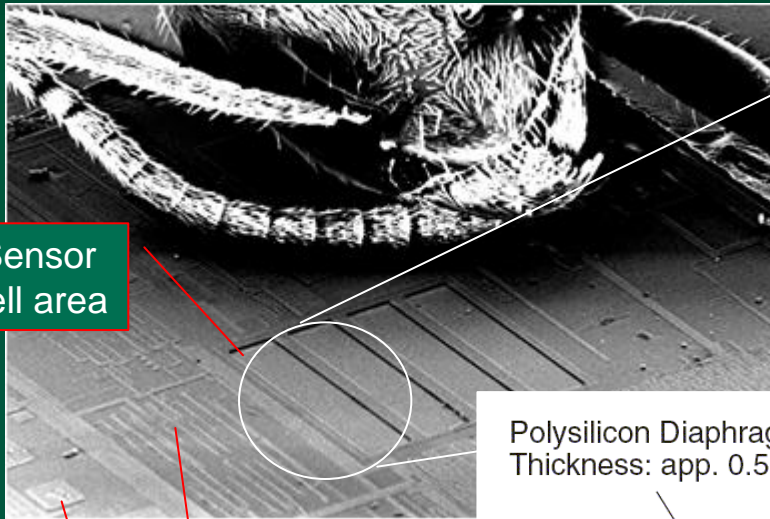
High Voltage Probe Card

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

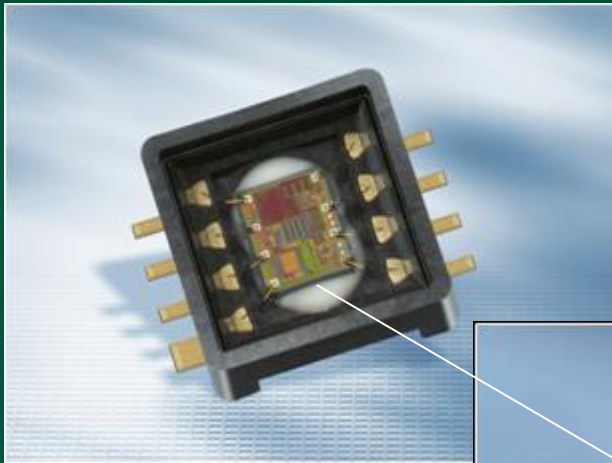


MEMS Pressure Sensors

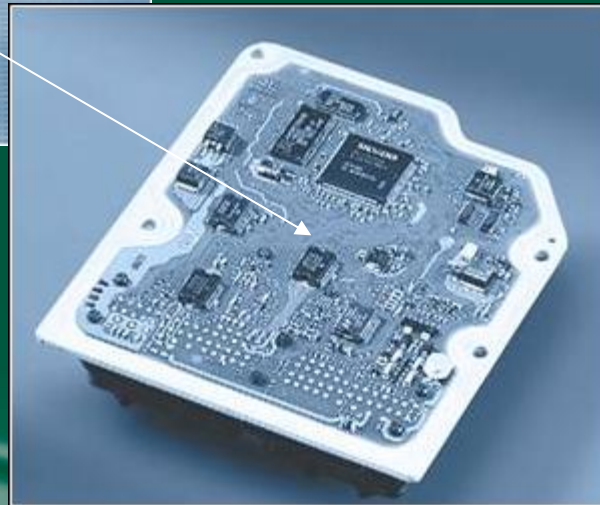
- Technology: surface micro machined sensor cell



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

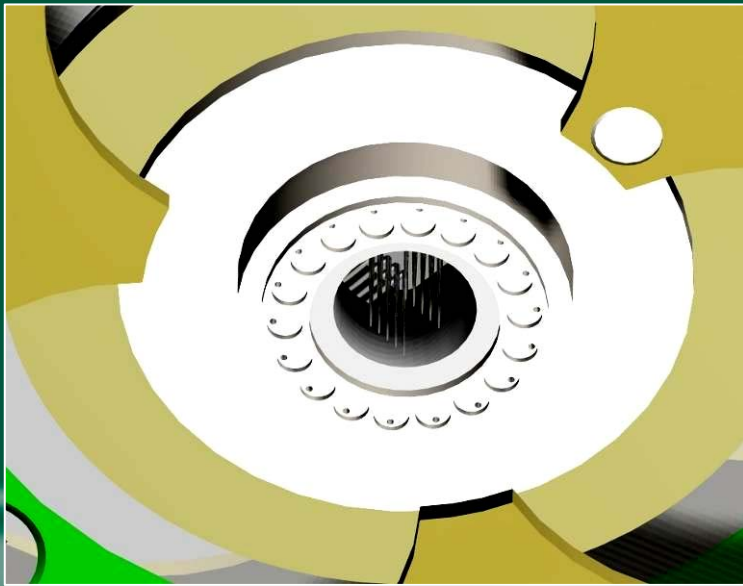


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Probing MEMS Pressure Sensors...

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

....by application of pressure !

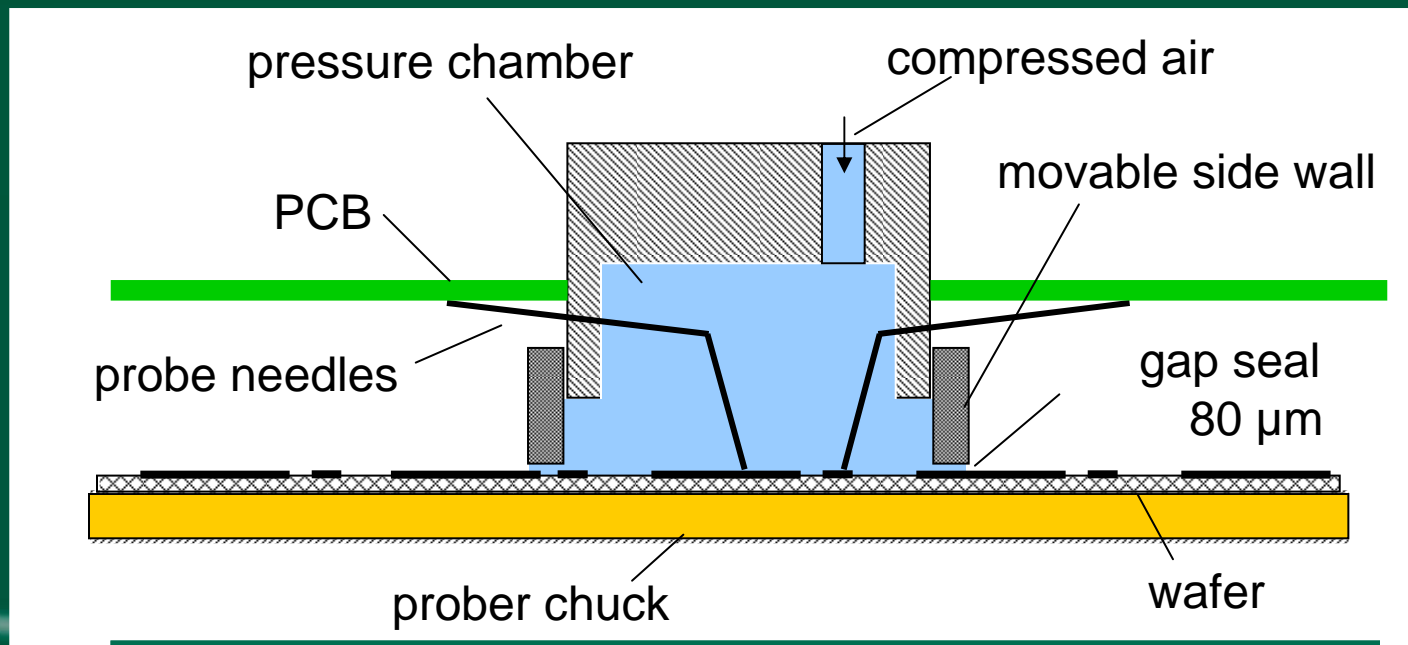


Same concept
(though refined) as
for High Voltage
Wafer Test can be
employed:

"LuPo-ABS"
Probe Card

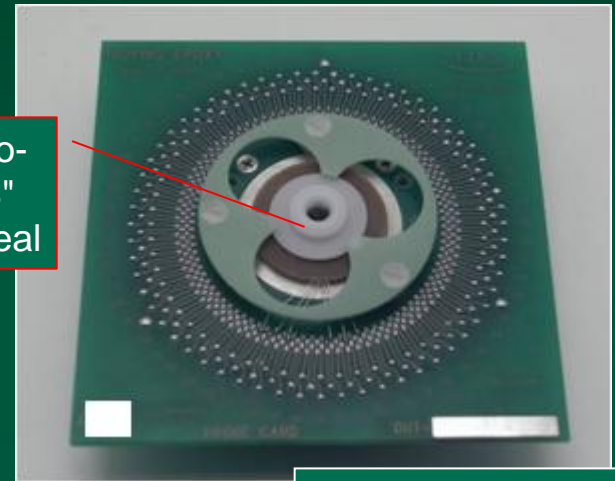
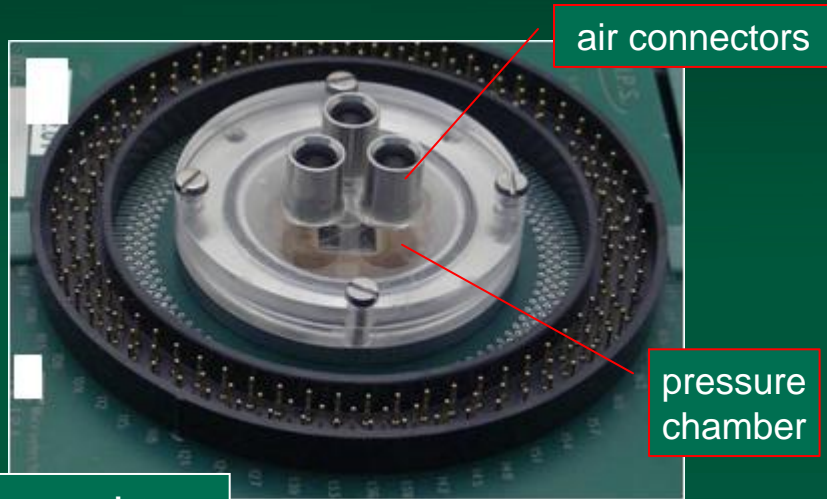
"LuPo-ABS" Probe Card

- "LuPo-ABS": Luftpolster – Air Bearing Seal



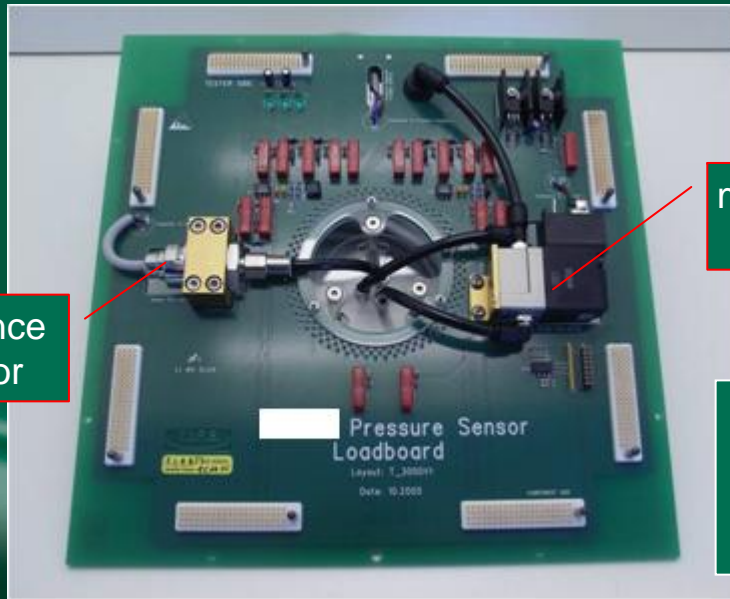
principle setup of "No Touch" – gap seal probe card

"LuPo-ABS" Probe Card



Probe card top view with chip-scale pressure chamber

Probe card bottom view



magnetic valve

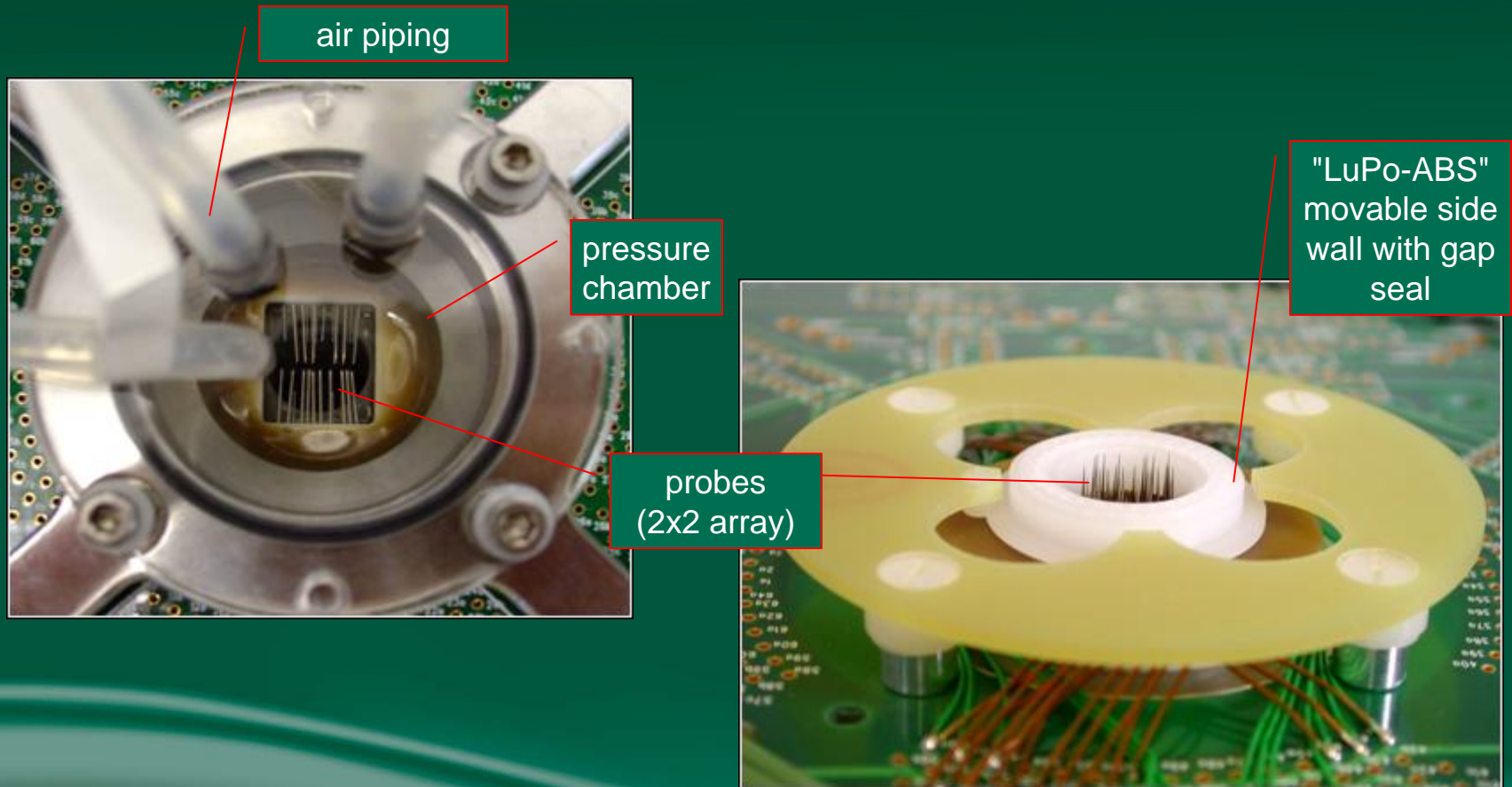
reference sensor

Load board with electro-pneumactical components



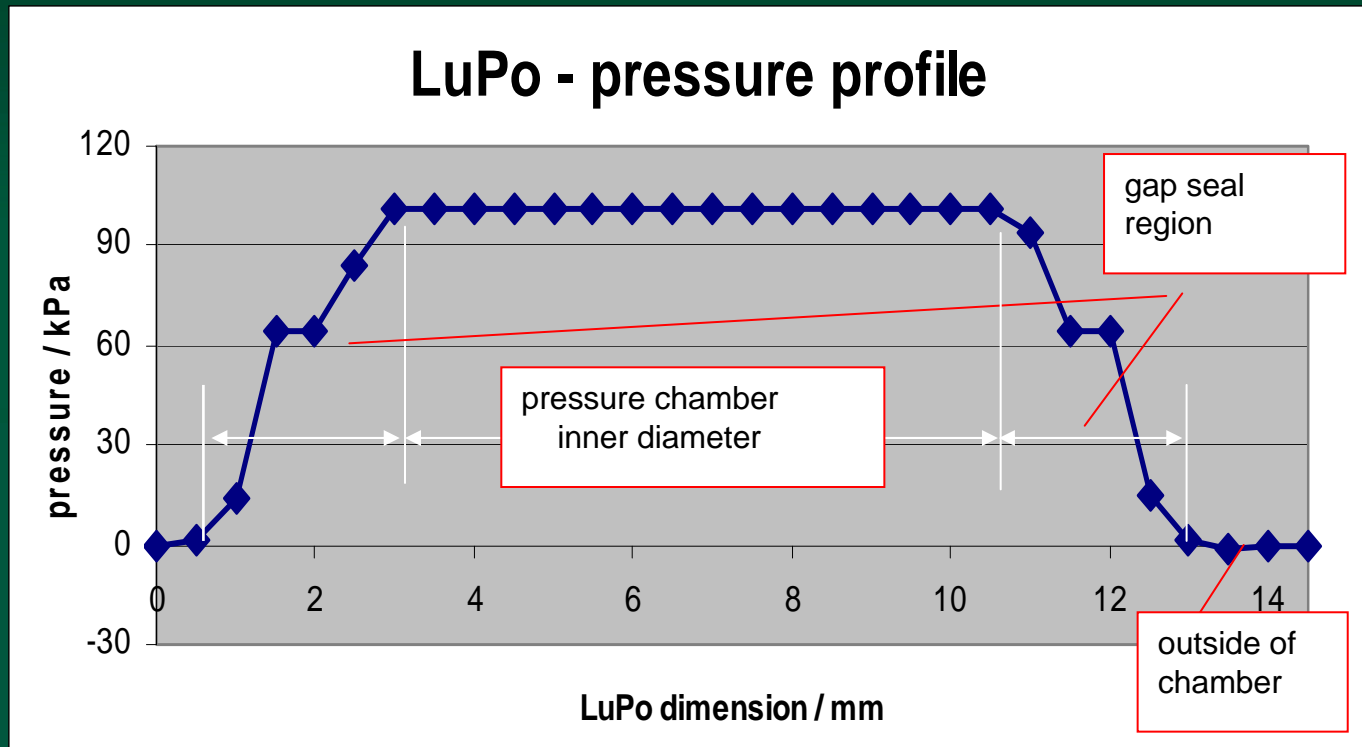
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"LuPo-ABS" Probe Card - details



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"LuPo-ABS" - Features (1)

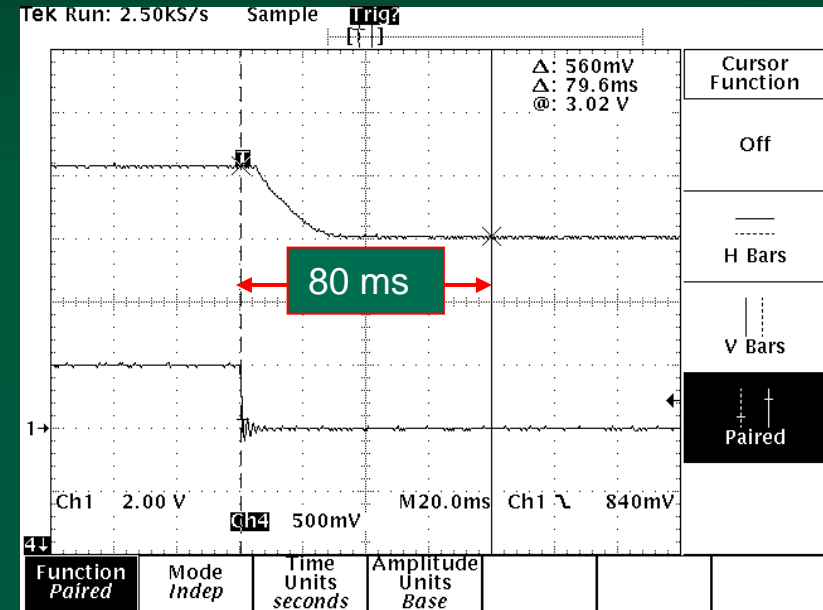
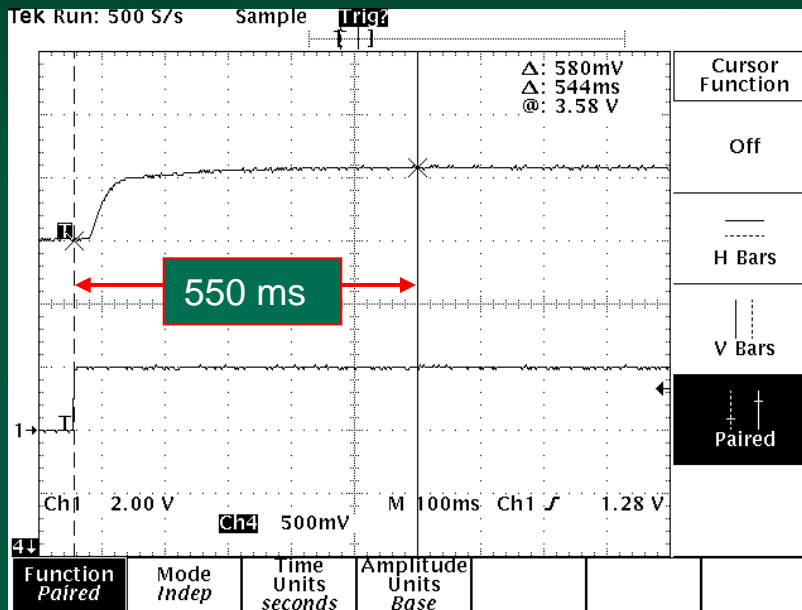


Pressure profile of LuPo pressure chamber (diameter 8 mm)



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"LuPo-ABS" - Features (2)



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



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"LuPo-ABS" - Summary

- Based on a chip-scale pressure chamber with a movable side wall that rests hovering about 80 μ m 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)



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- customers that remain anonymous...



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