HIGH-PERFORMANCE-SENSORSYSTEME durch Verbindung von Siliziumtechnologie und keramischer Mehrlagentechnik

HIPS | HIGH PERFORMANCE SENSORS

Powered by SiCer – The best of both worlds

Demonstrators of the SiCer Technology

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From technology to applications

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Sicer-based technologies are used for various application scenarios/sensor applications.

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Multi-Lambda-Sensor

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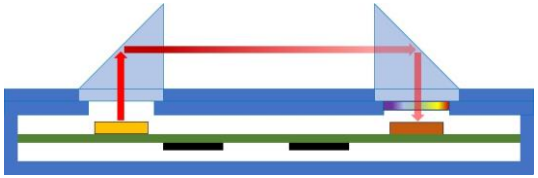
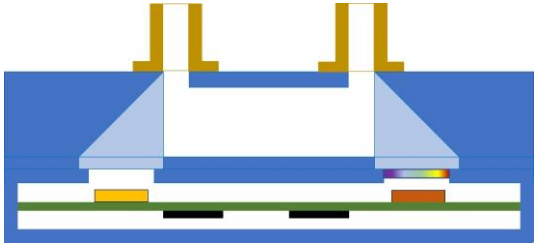
- Application-oriented design through stacking / bonding / sintering of different materials
- Miniaturization

Principle of SiCer-Multi-λ-Sensor

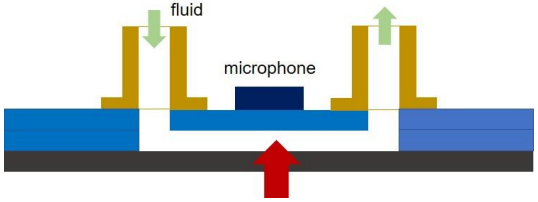
Transmission open water



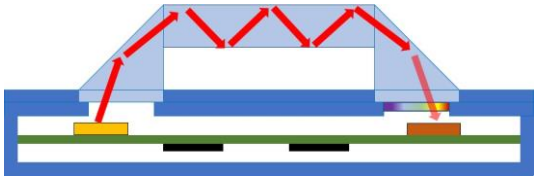
Transmission microfluidic



Photoacoustic



ATR Elektrolyte



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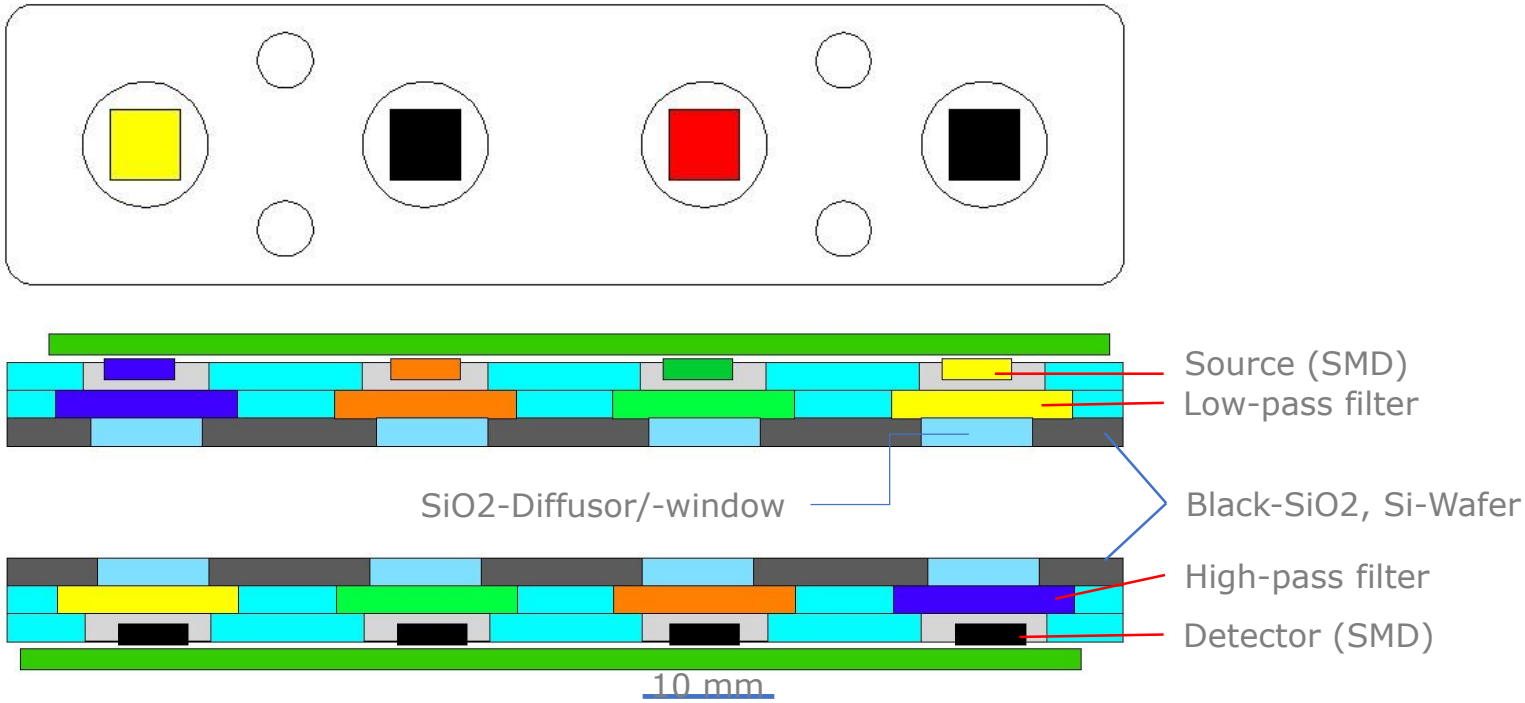
Linear Array- water monitoring



Sandwich design with discrete components

- transferable to SiCer (if available)
- miniaturization with LTCC (PCB)
- Goal: Testing of measurement techniques in situ

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Multi-Lambda-Sensor (Demonstrator)

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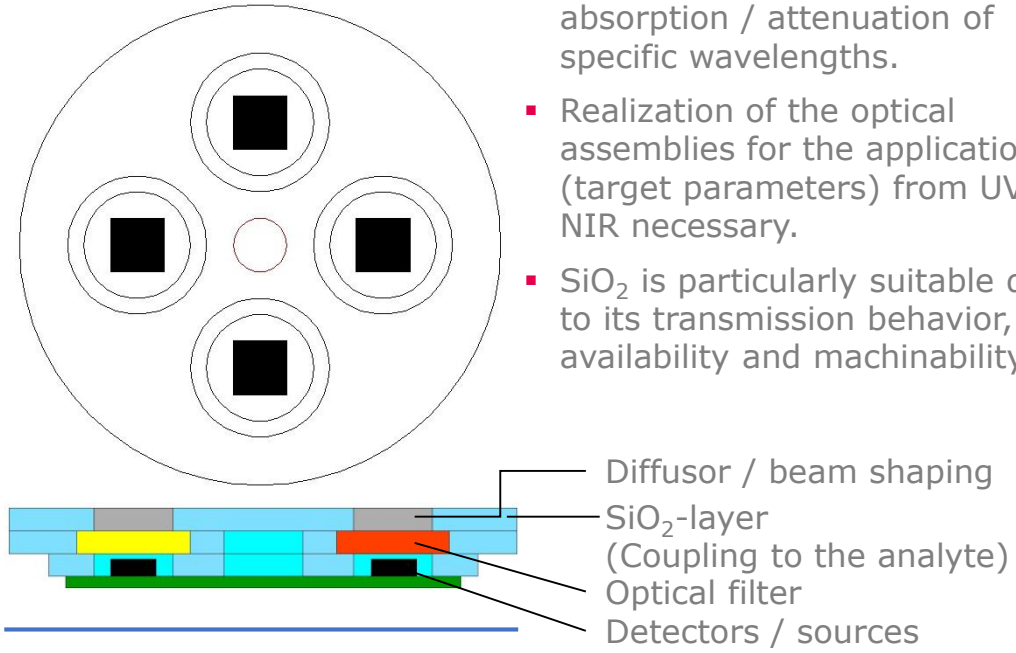
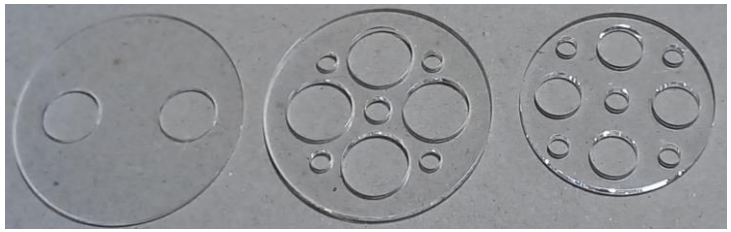
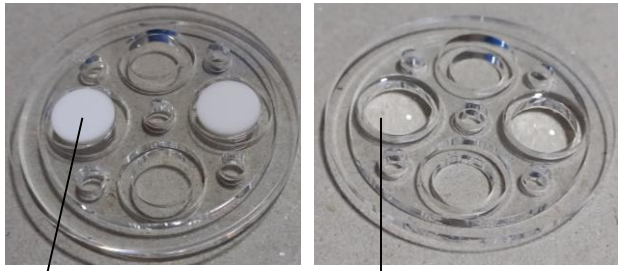
- Determination of target parameters in water by absorption / attenuation of specific wavelengths.
- Realization of the optical assemblies for the applications (target parameters) from UVC to NIR necessary.
- SiO_2 is particularly suitable due to its transmission behavior, availability and machinability.





SiO_2-Layers



SiO_2-Diffusors

SiO_2-Lens

SiO_2-stacked layers

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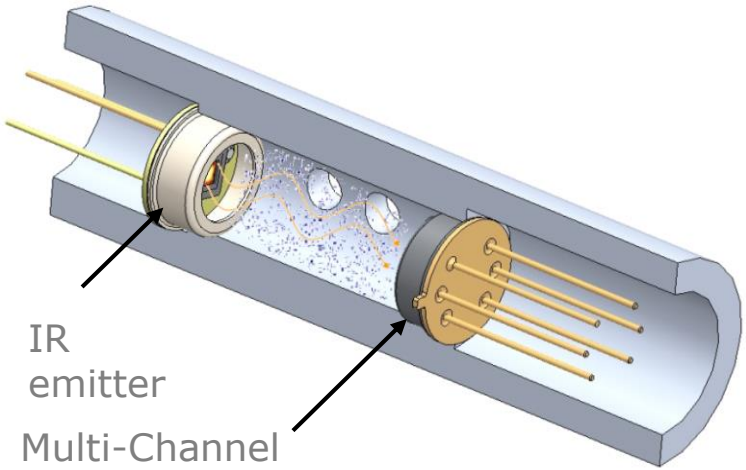
IR emitters and Detectors

Principle

- The measuring cell is filled with a gas mixture to be analyzed.
- IR radiation source and detector at opposite ends
- The detector includes a filter of the absorption wavelength of the gas to be detected.
- Absorption of IR radiation by the gas to be detected results in attenuation of IR radiation of that wavelength.
- The signal depends on the concentration of the gas.



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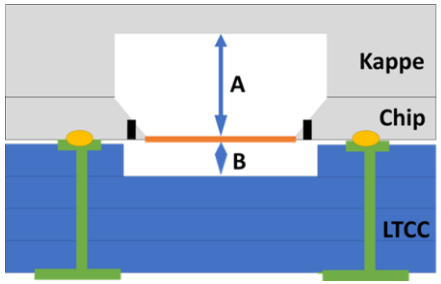
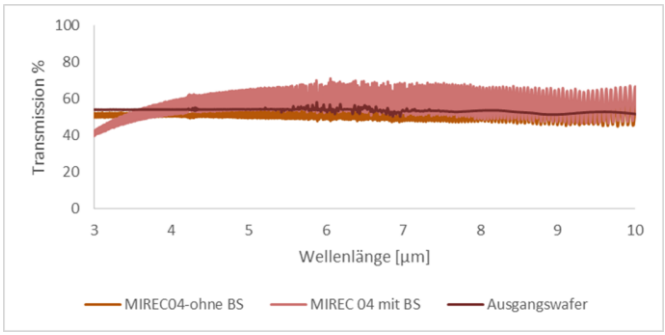
IR emitters and detectors

- Layout for IR emitter (heater) and IR detector as well as processing Si wafers and cap wafers for IR emitter and detector (with/without black Si)
- Reflection/transmission characterization





- Target: highest possible transmission in the range 3-5µm
- Transmission at about 50%
- from 3.5 µm transmission with Si needles approx. 10% higher than without Si needles (black silicon)
- similar transmission in the long wavelength range

Source: MHE

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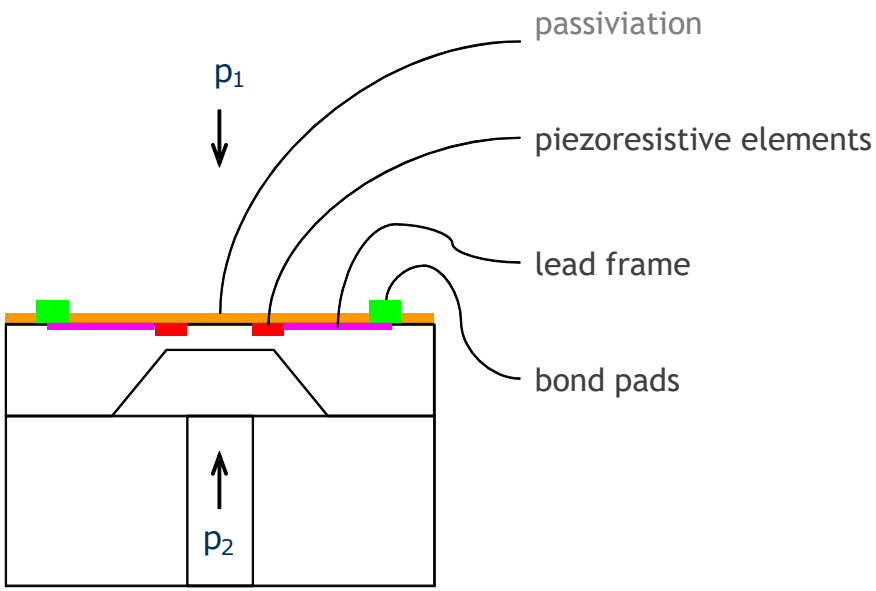
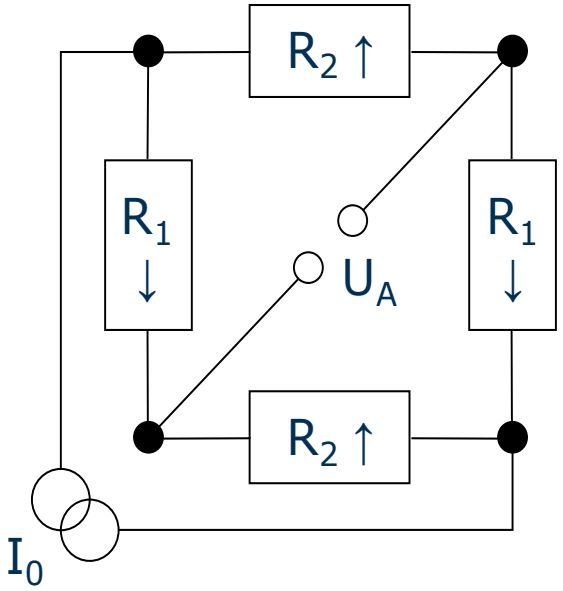
Principle of pressure sensors

Principle

- Implanted resistors in silicon -> Wheatstone measuring bridge
- The silicon membrane is deflected by the applied pressure $U_A \sim p$
- Scalable manufacturing processes





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Pressure sensor

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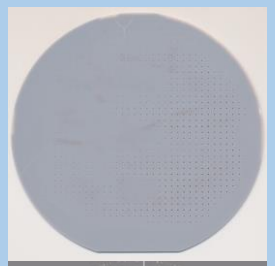
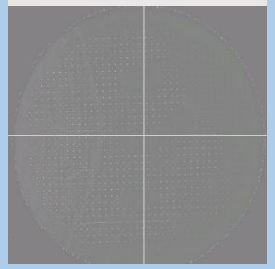
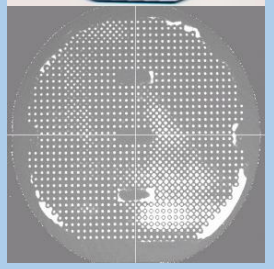
- Layout for Si pressure sensor
- Processing of bare, dummy and pressure sensor wafers
- Technology transition and characterization from pressure sintering to pressure assisted sintering in
- pressure assisted sintering: Interface problems, no dislocation lines in Si.
- pressure sintering: Interface OK, cracks in the composite, dislocation lines in Si

	Pressure sintering	**pressure assisteted sintering**
Ceramic side		
Bonding inderface (SAM)		
	full bonded interface	+ no dislocation lines in Si, no wedge error channel structure remains intact
	Dislocation lines in Si, wedge error, partially squeezed channels	- no fully bonded interface yet

Source: TUIL

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Temperature sensor

Source: UST

- Laboratory samples of the temperature sensor element successfully tested in the laboratory (including rapid temperature changes 30,000 cycles, RT/1100°C, a 60s, measurements characteristic curves, drifts, ...).
- Drift below target temperature deviation of ≤ 1% (from final value).
- Sensor electronics for conversion of the T-dependent resistance of the Pt200 into a frequency signal with compensation of contact and line resistances
- currently integration/miniaturization

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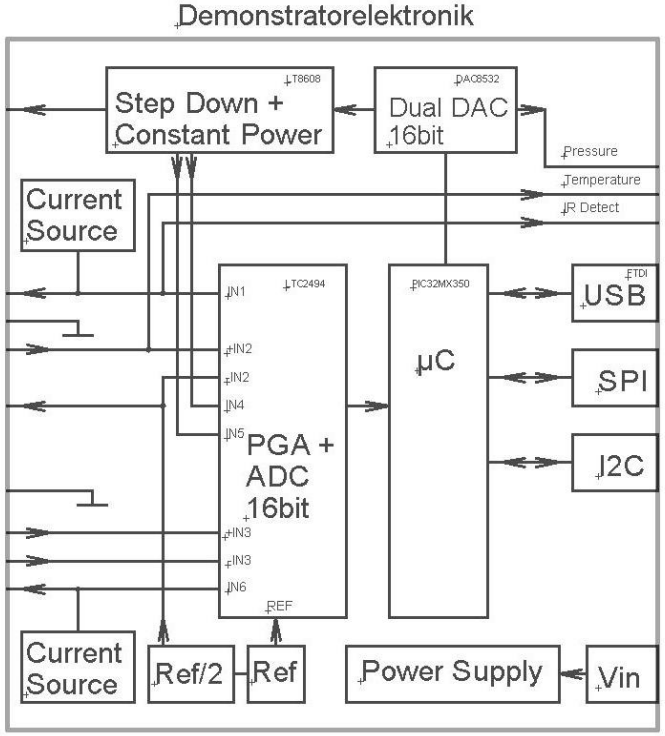
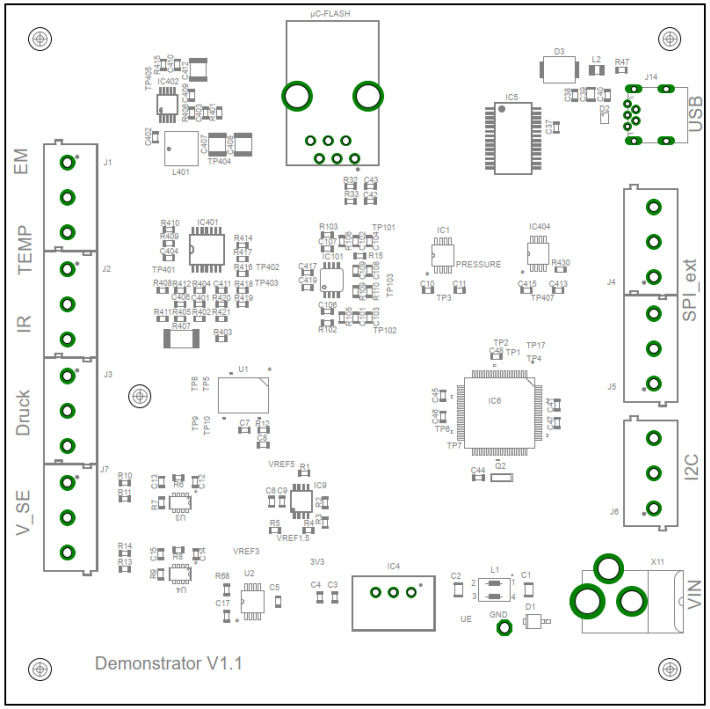
Demonstrator

- Demonstrator -> system design
- Manufacturing and assembly of the electronic components





Source: MSE

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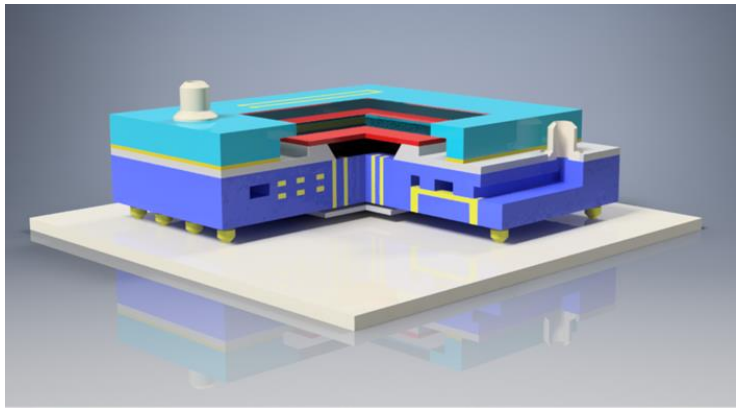
Summary

- The biggest challenge is the SiCer bonding process itself.
- Demonstrators for the various measured variables are in various stages of development.
- The work on the electronics and the system is less affected ->very satisfactory results here.



Source: TUIL

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Thank you!

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