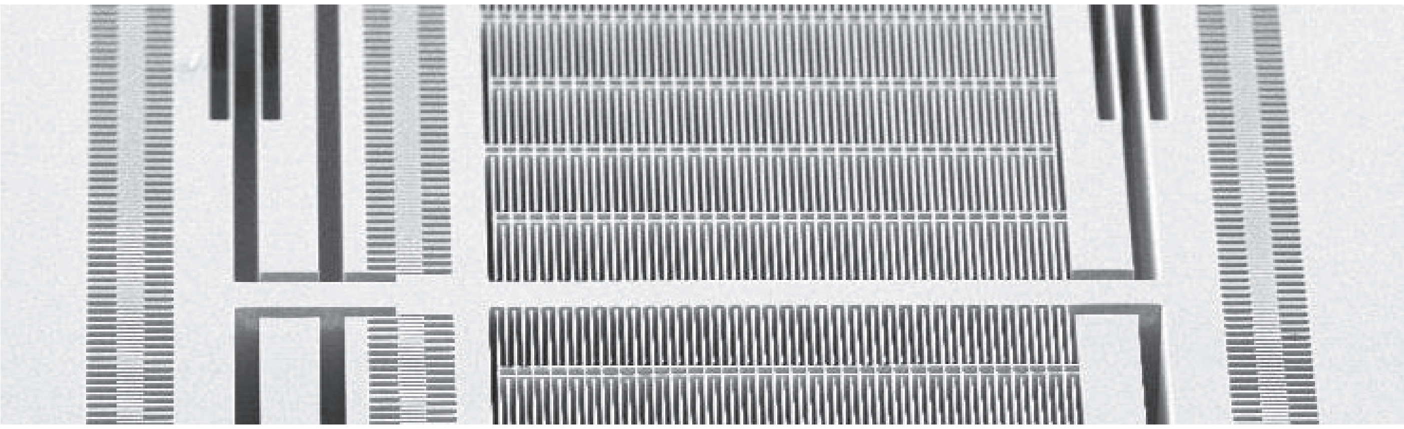
HERMETICITY CHARACTERIZATION OF PACKAGED MICRO CHIPS



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Description

Most microelectromechanical systems such as acceleration sensors, pressure sensors, gyroscopes or optical and fluidic elements consist out of two or more bonded substrates. All devices share the demand on gas tightness at the bonded heterogeneous or homogeneous interfaces. A parameter to express the level of gas tightness is the hermeticity and the leakage rate therefore. The value describes the change of pressure by time for a defined, encapsulated volume. Hence, the quality of the bonding interface needs to be characterized in order to predict the lifetime of a device, since a change of the internal atmosphere or pressure will influence the function of the device significantly and will cause a failure as worst case. The process of hermeticity characterization therefore defines a crucial process within the production sequence of a MEMS or associated product.

Applicable substrates

- Wafer-level packages (silicon, glass, ceramic, lithium niobate, lithium tantalite)
- Chip-sized package (QFN, TO, customer defined)

Characterization techniques

Different measurement techniques have established at Fraunhofer ENAS addressing different packages volumes and accuracy levels.

- Techniques basing on the utilization of a tracer gas (helium leakage test and spectrometric analyses)
- The application of resonant microstructures with a pressure dependent vibration characteristic

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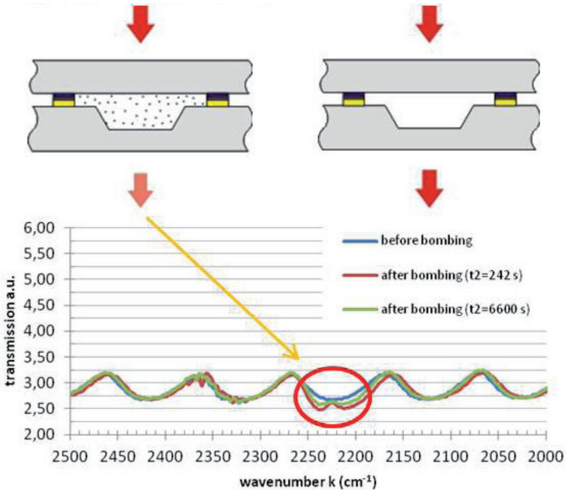

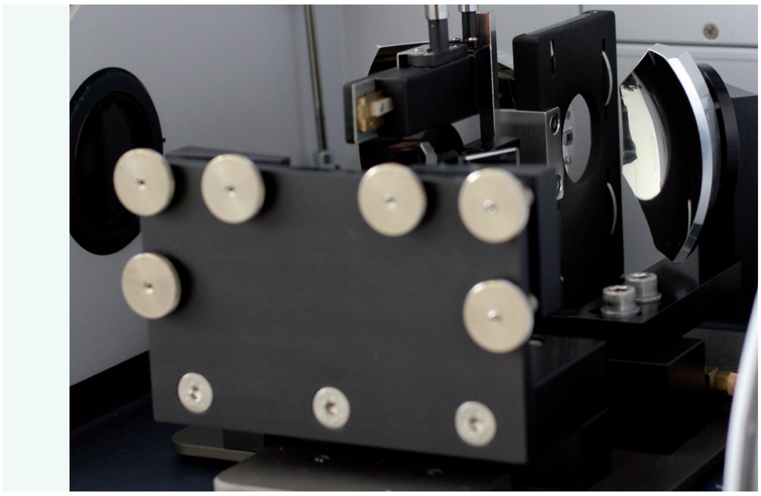

Measurement methods:

Helium leakage test	Spectroscopic analyses	Micro resonator
According to MIL-STD 883	Direct method for tracer gas partial pressure determination within the package	Highly precise determination of the leakage rate
High degree of freedom in respect with specimen geometry	Calculation of leakage rate and deviation of standard leakage rate	Minimal detectable leakage rate 1×10^{-16} mbar · l / s
Applicable to packaged micro chips and devices with a minimal encapsulated volume of 20 mm³	Min. measurable leakage rate 1×10^{-14} mbar · l / s	Processing at 4“, 6“ and 8“ wafers
	Applicable to encapsulated volumes of approx. 5 mm³	Design for a wide pressure range 0,001 mbar … 1000 mbar
		Applicable to volumes < 5 mm³
Drawback: min. measurable leakage rate 8×10^{-10} mbar · l / s	Requirement: Transparency for IR light with wavelength 3 µm … 5 µm	Field of application: Characterization of housing elements (QFN, TO, etc.)

Figures:
page 1: SEM image of resonating microstructure after deep reactive etching of silicon; page 2: Schematic of the spectroscopic testing routine (left), Optical components of the spectrometer (right)

Photo acknowledgments:
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