



Xensor Integration
Designing, prototyping, manufacturing

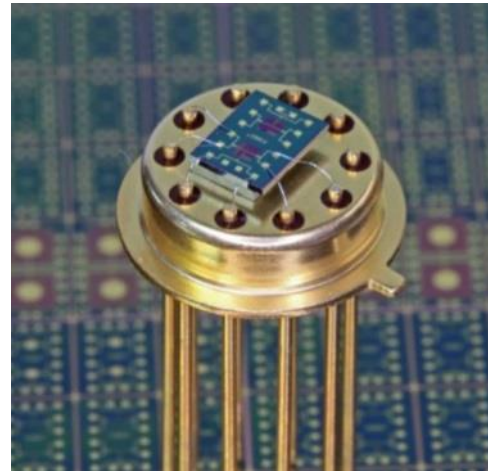
Distributieweg 28
2643 EJ Delfgauw
The Netherlands

XEN-394 Gold Series

Fast Scanning Calorimetry Chips

The XEN-394 is a series of micro-machined thin-film calorimeter sensors designed for measurements on small samples with high temperature scanning rates. The XEN-394 Gold series are made with gold interconnections, enabling them to go higher in temperature than the XEN-393 series, which has aluminium interconnections.

The sensors have dual ultra-thin silicon-nitride membranes, which are characterized by a high thermal resistance to the ambient and a very small time constant. This makes these sensors particularly suited for measurements in gaseous environments and for fast measurements, such as Fast Scanning Calorimetry.



Features

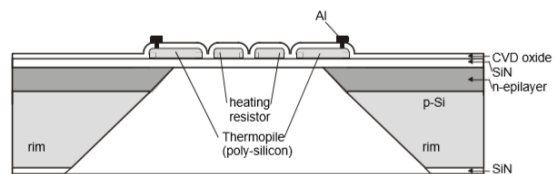
- Ultra-high heating and cooling rates up to 100 MK/s
- Wide sample temperature range from -273 °C up to 1000 °C

Applications

Study of thermally induced physical transitions and chemical processes like crystallization and reorganization of polymers, aluminium alloys, metallic glasses and other materials.

Principle of operation

The calorimeter chip consists of a thin membrane, suspended in a thick frame of silicon. Integrated heaters heat-up the middle of the membrane: the sample area of the chip, and a thermopile measures the sample area temperature. In this way the sample can be subjected to a predetermined temperature profile so that the behaviour of the sample with temperature changes can be observed.



Example of calorimeter chip fabrication; SiN membrane with poly-Si heater and thermopile

Design Considerations & Differences

XEN-39469	These are two chips designed with large, circular sample area on the membranes. Both chips have dual membranes. Each membrane has two, concentric heaters and two thermocouples of n-type vs p-type poly-silicon. In the XEN-39469, the center within the heaters is covered by gold to obtain a uniform temperature, but the heaters are not covered by gold. This enables the XEN-39469 to operate at higher temperatures (1000 °C) than the XEN-39470 (700 °C), in which the heaters are also coated with gold. Sample temperatures up to the silver point (962 °C) can be achieved.
XEN-39470	
XEN-39471	Small-sized sample area chip with a single heater and thermocouple and dual membranes.
XEN-39472	These two devices, which have dual membranes, have very small sample area with a single heater and single thermocouple. The small size of the sample area is designed to make the devices very fast. In the XEN-39473, an extra gold heat sink is created at 5 μm distance from the sample area, so that cooling is even faster than in the XEN-39472. The transfer of the XEN-39473 is half as high as of the XEN-39472, as a result of this heat sink. For the XEN-39473 cooling scan rates in excess of 100 MK/s have been attained.
XEN-39473	

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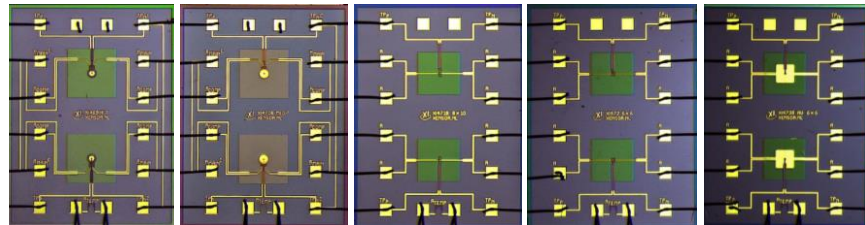
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Typical Specifications

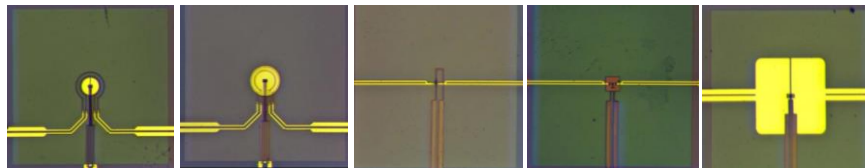
Ambient temperature 22 °C, air, 1013 mbar

	XEN-39469	XEN-39470	XEN-39471	XEN-39472	XEN-39473
General parameters					
output (V/W)	16	16	22	25	12
time constant (μs)	400	1000	17	6	3
noise-equivalent power (nW) @	18	11	29	44	133
heating and cooling rate (MK/s)	2.5	1.0	60	180	370
membrane + gas (kK/W)	22	22	63	71	34
addenda (nJ / K)	17	43	0.3	0.1	0.1
Dimensions					
chip dimensions (mm ²)	3.75x2.85	3.75x2.85	3.75x2.85	3.75x2.85	3.75x2.85
membrane size (mm ²)	0.8 x 0.8	0.8 x 0.8	0.7 x 0.7	0.7 x 0.7	0.7 x 0.7
membrane thickness (μm)	1.5	1.5	1.5	1.5	1.5
sample area (μm x μm)	90 ∅ (gold)	150 ∅ (gold)	8 x 11	6 x 6	6 x 6

Design Overview

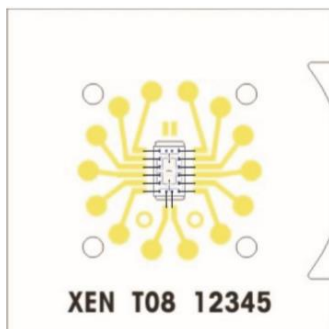


Close up of sample area

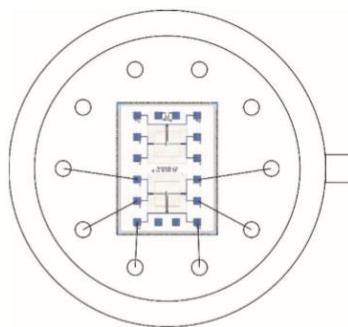


Housing

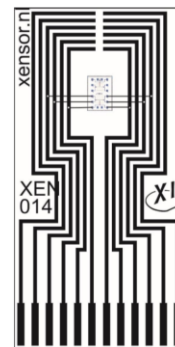
The XEN-394 series are available on various housings. The XEN-39469 in combination with the XEN-40016 housing can only be ordered exclusively via Mettler-Toledo because of the compatibility with the Flash DSC 2+.



XEN-40016



TO-5



XEN-40014