



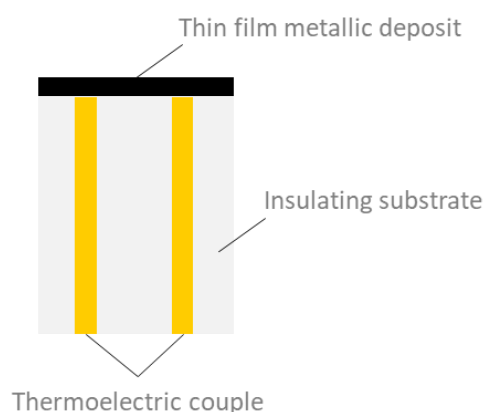
## Dynamic Heat Fluxmeters: the DHF series

Sensors of the DHF (*Dynamic Heat Fluxmeters*) series are intended for very fast thermal phenomena detection and measurement. DHF devices are based on a thin conductive film deposited on the front face of the sensor, coupled with a type K thermocouple. DHF sensor can be used as surface thermocouples, but also as heat flux sensors.

### STRUCTURE

DHF probes are surface thermocouples: a thin electrically conductive film is deposited on a highly insulating substrate:

- ▶ The substrate must withstand high surface temperature, while having a very low thermal conductivity. Materials used for the substrate are high performance, machinable ceramics, such as alumina ( $\text{Al}_2\text{O}_3$ ), zirconia ( $\text{ZrO}_2$ ) or hafnia ( $\text{HfO}_2$ );
- ▶ Thin conductive film is generally made of a high melting point metal or alloy, preferentially having a high emissivity in order to increase incident radiation absorption, such as porous tungsten (W) or porous platinum (Pt);
- ▶ Thermocouple hot junction is distributed on the thin film by connecting thermoelectric wires to the surface metal (and not directly one on the other). Doing so, the sensor measures the mean (radial) surface temperature.



*Illustration of the basic structure of a DHF sensor (scale not representative)*

Compared to a classical wire thermocouple (even of some microns thickness), DHF sensors will demonstrate better reactivity (in terms of signal amplitude and response time) due to a large surface exposed to the incoming heat flux. Another fact contributing to this better reactivity is the presence of an insulating substrate, which generate a fast temperature increase of the exposed surface.

Other benefits compared to classical thin thermocouples are:

- ▶ An easier way to handle and to fix on your experiment ;
- ▶ A better robustness of the hot junction towards bad handling ;
- ▶ A perfect fixity in front of a gas flow

### TYPICAL USE

DHF probes are ideal for fast thermal event characterization, such as:

- ▶ Detonation, pyrotechnics
- ▶ Fire balls
- ▶ Rocket engine ignition

and more generally for any application dealing with fast thermal events detection (qualitative) and measurement (quantitative), with typical duration ranging from 1 microsecond to 1 millisecond.

NexTherm Sensing DHF sensors outperform classical competing products by their ability to estimate heat flux, in addition to temperature. This is of a great interest when thermal events must be characterized more precisely.

### STANDARD DHF SENSORS

DHF sensors are available in two standard versions, according to response time.



Standard model	Thermocouple type	Temperature range	Thin film thickness	Rise time ( $\tau_{63\%}$ )
DHF-10	Type K (Cr-Al)	0-1300°C	10 $\mu\text{m}$	<1ms
DHF-01	Type K (Cr-Al)	0-1300°C	1 $\mu\text{m}$	<1 $\mu\text{s}$

As baseline, DHF sensors are built as follows:

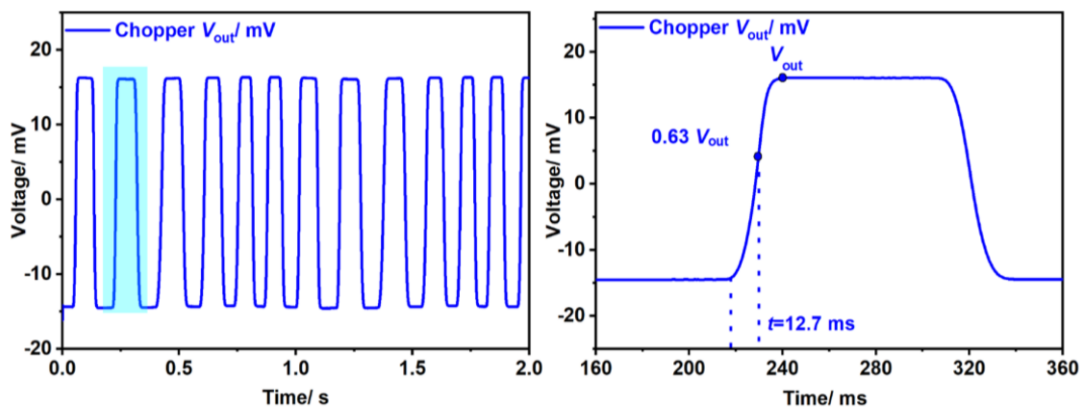
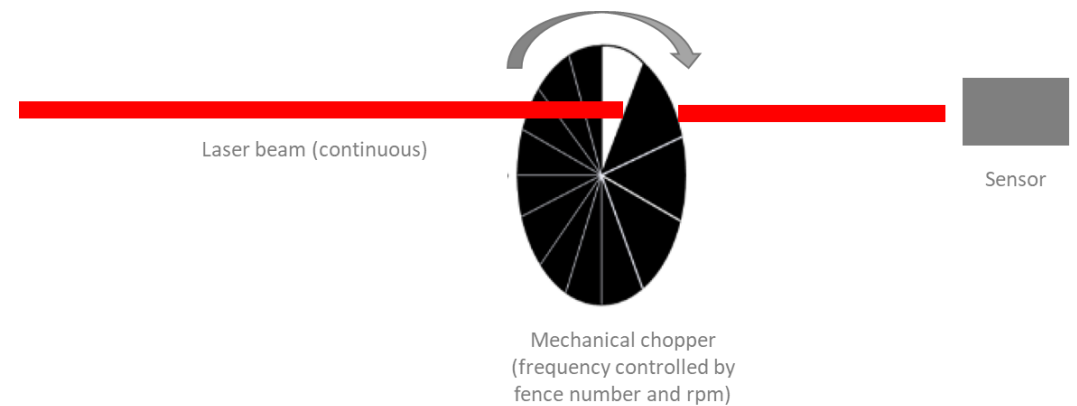
- ▶ Type K (chromel-alumel) hot junction, along with a tungsten (W) thin film. To comply with your application, other thermoelectrical couples and surface metals are available on demand ;
- ▶ Macor® as insulating substrate. In case of incompatibility with your application (temperature level, chemical aggression, etc.), please contact us for special substrate ;
- ▶ Nude probe (*i.e.* no mechanical support). If needed, please contact us for specific thread or flange mounting ;
- ▶ Standard wire with length is 1 meter. Miniature type K connector with flat plug completes the baseline version.

## CALIBRATION

Each DHF sensor is calibrated in two steps:

-  Temperature calibration, using thermostatic bath ;
-  Dynamic calibration, using CO<sub>2</sub> infrared laser

Response time (63%) of each unit is established by the means of a chopper wheel placed in front of the laser beam:




## ORDERING

For standard model ordering, please use the following referencing:

DHF-RT-MF-TC-MS

with the corresponding coding:

-  RT : response time (10 for 10 microns film ⇔ 1 millisecond, 01 for 1 micron film ⇔ 1 microsecond)
-  MF : material of the film (baseline : tungsten (W))
-  TC : thermocouple type (baseline : type K (K))
-  MS : material of the substrate (baseline Macor® (M1))

*Example: for a DHF sensor with 1 millisecond response time, using tungsten finish, type-K thermocouple and Macor® substrate: DHF-10-W-K-M1*

For other configurations, please contact us.

SALES CONTACT



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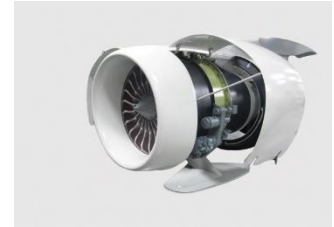
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