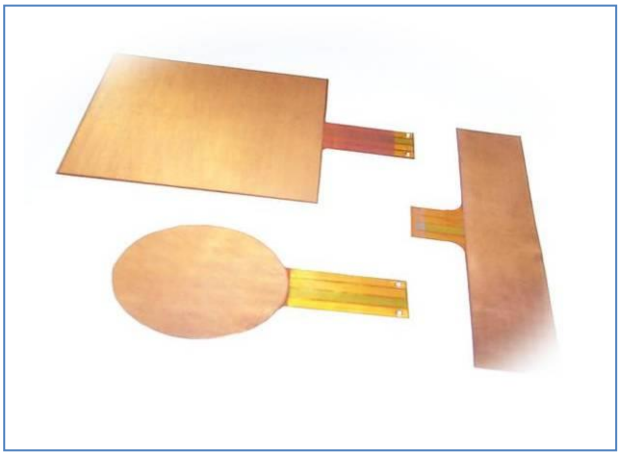
Captec Entreprise www.captec.fr

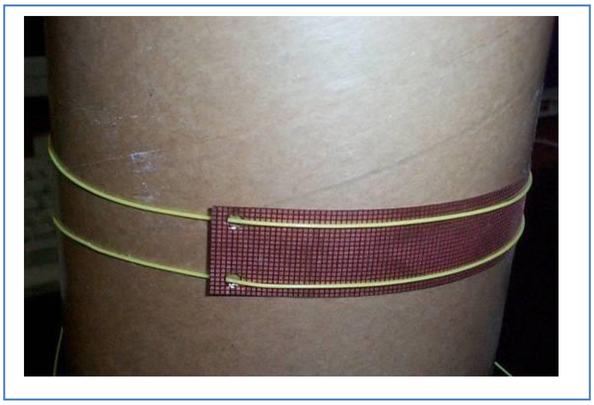
Heat flux sensors Series

Thin foil heat flux sensors

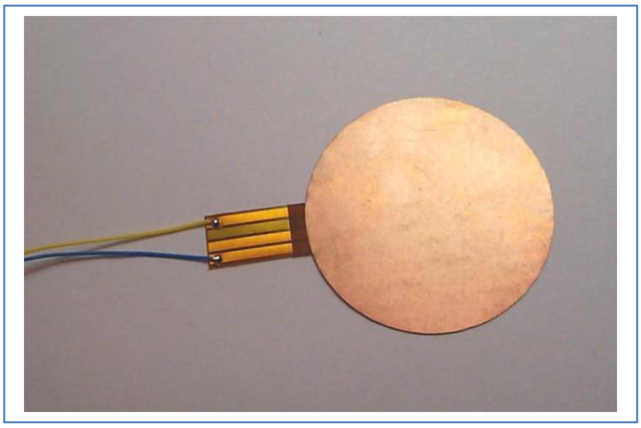


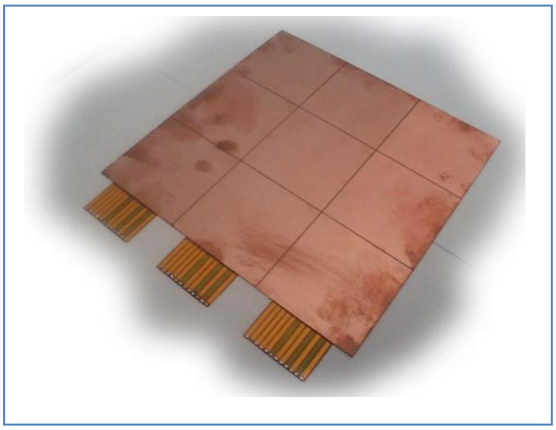
- **For measuring all three heat transfer modes in W/m^2**

- **With the sensitivity delivered with each sensor**



- **Rigid or Flexible**
- **Waterproof, insulated**
- **High pressure**
- **Cryogenic measurements**
- **No temperature drift of sensitivity**
- **Black models for measuring total heat flux**
- **Al reflecting models shielded from radiant flux**
- **Custom models**





CAPTEC heat flux sensors

- CAPTEC heat flux sensors are devices of low thickness (0,45mm) copper coated on their two sides. Their output meander comprises two connectors for the heat flux output and two connectors for the built in T thermocouple output.

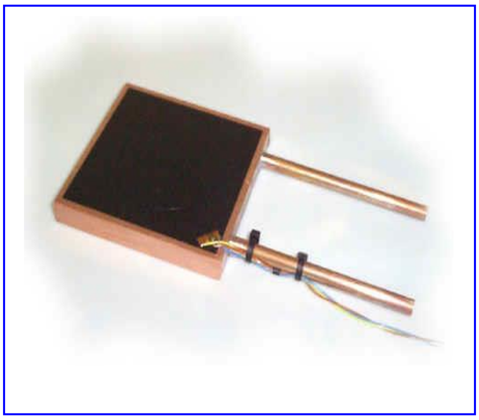
- Standard sensors of sizes ranging between 10x10mm and 300x300mm are available in stock, all sizes and shapes are available on request. The output voltage is delivered between two PTFE cables (blue and yellow) ready to be connected to a voltmeter or to a datalogger.

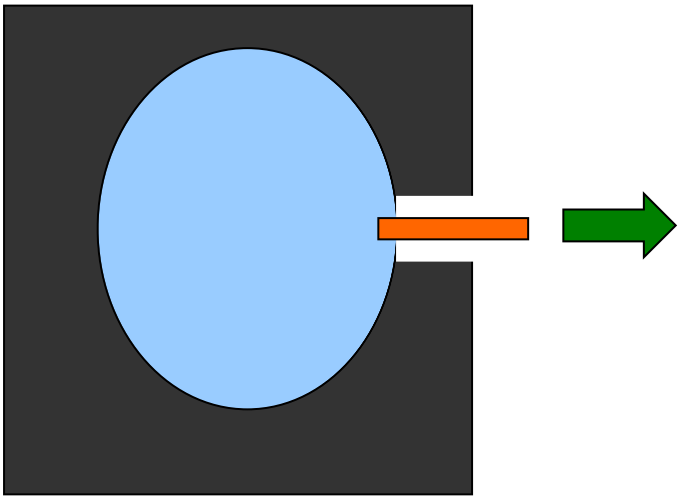
- Their output is proportional to the net heat flux into their sensing area whose temperature can be separately measured by a built in thermocouple. Since heat flux can be convective, radiant or conductive, the sensor output per unit heat flux (per W/m^2) is the same for all three heat transfer modes.

- The sensitivity is the mV response per unit heat flux (per kW/m^2) impressed across the sensing area kept at constant temperature (accurately measured +/- 3%).

- All sensors fabricated by CAPTEC are delivered with their sensitivity measured in $\mu V/W/m^2$. Since CAPTEC is not a 'certified lab', a COFRAC calibration by radiation can be delivered on request.

Heat flux sensors Series





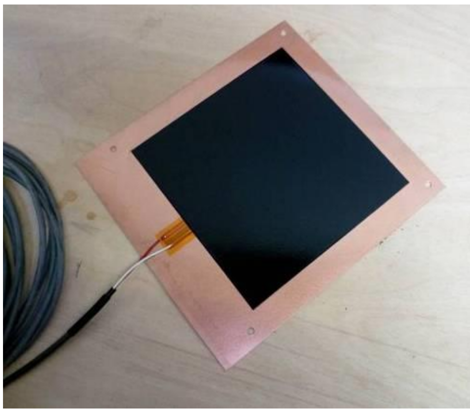
- Since the output voltage is proportional to heat flux, sensitivity is a constant within a large range of heat flux intensity extending from a fraction of W/m^2 to several hundreds of kW/m^2

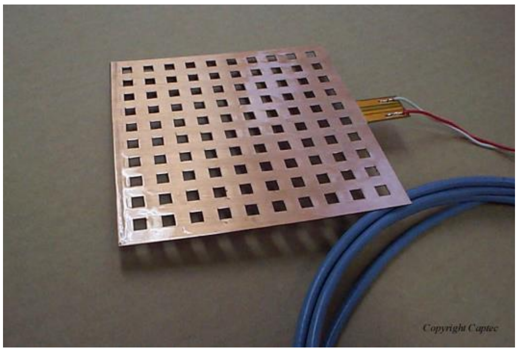
- The output voltage sensitivity is measured at the temperature of the sensing area so that there is no temperature drift of the sensitivity to heat flux is kept unchanged within a large range of temperature extending from cryogenic temperature up to 300°C; (120°C for standard devices).

- Larger the sensing area, larger the sensitivity (nearly 0, 5 $\mu V/W/m^2$ for each additional square cm^2 of sensing area). An important encountered problem in practice consists to determine how large must be the sensor area for accurately measuring an expected heat flux or a minimum detectable heat flux.

- In solid materials, the sensor output is proportional to heat flux of Fourier's law ($\varphi = -\lambda \nabla \theta$) ; the related temperature gradients inside the sensor and the environment are not measured. These gradients always cause some energy loss and thus lead to a reduction of heat flux into the sensing area.

- In a vacuum, the transfer of heat by convection is vanishing so that radiant flux of Stefan Boltzman law becomes predominant. This net heat flux is determined regardless the variations of temperature caused by radiation absorption on the sensing area





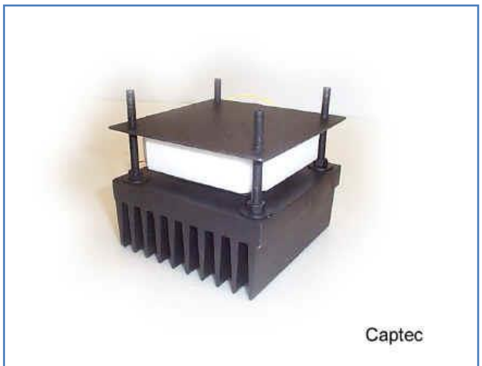
- If the sensor is coated black the sensor output depends on the total heat flux that is on all three heat transfer modes. If the sensing area is Al reflecting, radiant flux will become negligible so that the sensor output mainly depends on convective heat flux measured in W/m² with the device sensitivity.

- The differential association of sensors coated black and Al reflecting mounted on the same copper support leads to cancel the convective heat flux and to produce an output proportional to radiant flux impressed on the differential assembly.

- Since heat flux density is measured independently on the gradients of temperature in the sensor, the thermal noise that limits the sensor resolution is cancelled.

- In most applications, the sensor is surface mounted by using adequate glue, a thermal compound or a double sided adhesive tape. No power supply is required; the self-generated output is measured by a milli voltmeter and translated into W/m² by using the sensor calibration.

- Application: the quick thermal conductivity tester



Two calibrated heat flux sensors are mounted on the external sides of a sample in form of plate (whose thickness is about 1/10 of the lateral dimensions) for measuring the net heat flux produced by a temperature difference of the order of 10°C applied across the sample.

Thermal conductivity λ is determined with no reference sample as the net heat flux ($\varphi = - \lambda \nabla\theta$) per unit temperature gradient ($\nabla\theta = \Delta T/e$) .

- The heat radiation unit

- For sensing the heat emission from a flare in its environment (in the range (0-4 kW/m^2)) or for measuring asymmetric radiation between warm or cold panels, cold windows ….
- Independently from the sensor temperature which can be continuously changing.

- Linear
- Sensing area:150x150mm
- Sensitivity 100mV/kW/m2
- Without glass dome
- Readout on any mV indicator