PIRANI VACUUM GAUGES WITH ACTIVE HEAT-LOSS COMPENSATION

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ABSTRACT

Pirani sensors measure the thermal conductivity of a residual gas in a vacuum in order to determine the pressure by generating a temperature gradient between the sensing element and a heatsink. Usually, the measuring range of Pirani sensors is limited from approx. 10^{-4} mbar up to several hundred Millibars or even atmospheric pressure. Therefore, Pirani sensors are often combined with other technologies like ionization vacuum gauges to cover lower pressures [1]. Thus, there is an interest in extending the measuring range of Pirani sensors to avoid additional technologies and to cover the high vacuum regime down to 10^{-6} mbar.
Langer has derived in [2] a theoretical model that states increasing the ratio between the active area of the sensing element and its parasitic losses also increases the sensitivity in high vacuum and extends the measuring range at the same time towards lower pressures. Since there are limits in increasing the active area of a sensing element, investigations have been made to minimize the parasitic losses through active counter heating [3].
This effect has already been confirmed using a MEMS chip. The chip consists of an under-etched sensing element with the shape of a miniaturised hotplate. Additional heating elements are placed on the suspensions to limit their parasitic heat loss [4]. Since MEMS technology only pays off in high quantities, additionally a conventional micro-wire Pirani with standard Pt100 elements was built. The sensing element of the sensor is a helix-shaped micro wire, which is suspended between two pins. On these pins, the Pt100 elements are attached with a conductive epoxy glue and act as additional heating elements (Fig. 1). During operation, they are used to generate heat on the pins to limit the parasitic heat flow over them. It can be shown that active counter-heating using additional heating elements on the suspensions of the sensing element increases the sensitivity in low pressure regimes. Furthermore, this extends the measuring range by up to one order of magnitude.

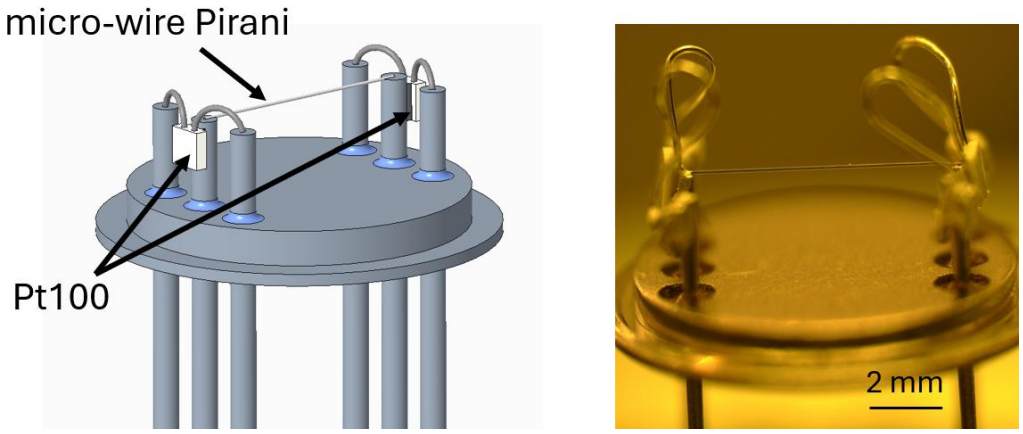

Fig. 1: Sketch and microscope image of a conventional micro-wire Pirani sensor with additional Pt100 heating elements to limit the parasitic heat losses over the pins.

References

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