

Optical design, development and manufacturing strategies

for MEMS based pyroelectric infrared sensors

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Abstract

Non-Dispersive Infrared (NDIR) gas sensors have emerged as pivotal tools across diverse domains, from environmental monitoring and industrial safety to medical gas analysis. Offering high sensitivity, specificity, and long-term reliability, these sensors excel in precise gas detection. Their high sensitivity and specificity, wide range of applicable gases, and compact design further enhance their utility. A key component of a NDIR gas sensor is the photodetector. State-of-the-art gas sensors either use thermopile or pyroelectric sensors. The latter is preferred in applications where a rapid response to changes is a key requirement. A pyroelectric detector operates by utilizing a pyroelectric material that generates electric charge when exposed to temperature changes. Incident infrared radiation cause a voltage signal proportional to the rate of temperature change.

Micro-Hybrid Electronics GmbH manufactures pyroelectric detectors (see Fig. 1) using a MEMS process instead of the more conventional precision mechanical manufacturing. In addition to the widely known benefits of parallel manufacturing and process control, the MEMS process bakes certain key elements such as the thermal decoupling and polarization of the pyroelectric material into the design. With the traditional manufacturing method, these would have been separate steps during detector assembly. Furthermore, reducing the critical dimension of the pyroelectric material into the realm of IR wavelengths enables the designer to specifically tune the IR absorption spectrum to the desired application.

In our conference contribution, the entire process chain is presented, starting with the design phase, through testing and characterization, to transfer to series production. In doing so, we address the key points both in the design process and in manufacturing.

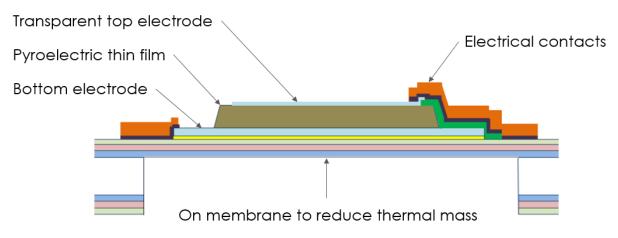


Figure 1: Schematic structure of pyroelectric sensor