Air Convection on a Micro Hotplate for Gas Sensor

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Abstract

Monitoring of indoor CO2 concentration is of particular interest to detect room occupancy in order to optimize power consumptions of building. One approach to monitor the indoor CO2 concentration is to use optical detection using specific absorption lines of CO2 molecules in the infrared domain close to 4.2 µm. Such optical sensors include a detector, typically a micro-bolometer, an IR source (the hotplate) and a filter to select the interesting band in the black body spectrum of the emitter. All these components are made in well known planar Si technology using the MEMS approach. To fabricate a free-standing micro-hotplate, we use Si3N4/SiO2 as supporting layer and TiN/Pt/TiN for and heater layer. In the past, we have optimized the filament geometry (conductive track width) using a COMSOL electro-thermal model [1] (Figure 1). Though, to describe conductive and convective thermal exchanges in air out of the micro-hotplate, we use the proposed law by [2]. Key feature for a wider use of the sensing technique involves the management of the power consumption that is related to the temperature uniformity of the micro hotplate. We improve our electro-thermal heater model, tacking in account the convective thermal effect that can be described using COMSOL's Heat Transfer Module. In such a way we can propose an explicit thermal flux law.

Reference

1. S. Gidon, and S. Nicoletti “Optimisation of Filament Geometry for Gas Sensor Application”, Comsol Conf 2010.
2. E. Cozzani, “Material properties measurement and numerical simulation for Characterization of ultra-low-power consumption hotplates”, Transducers & Eurosensors ’07, 14th International Conference on Solid-State Sensors, Actuators and Microsystems, Lyon, France, June 10-14, 2007.
3. Pierre Barritault, Mickael Brun, Serge Gidon, Sergio Nicoletti, “Mid-IR source based on a freestanding microhotplate for autonomous CO2 sensing in indoor applications”, Sensors and Actuators A 172, 379– 385, 2011.

Figures used in the abstract

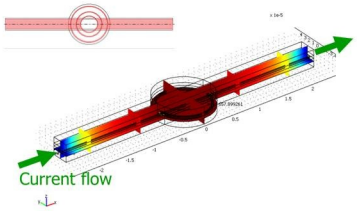

Fig. 1

Figure 1

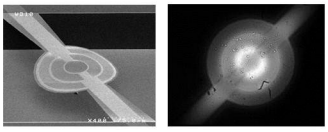

Fig. 2

Figure 2

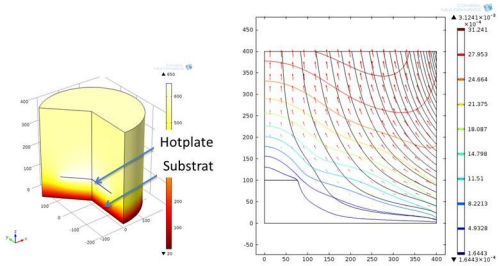

Fig. 3

Figure 3

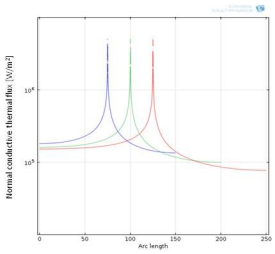

Fig. 4

Figure 4