MEMS BASED NATURAL GAS METER FOR HOME APPLICATIONS

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We propose a natural gas energy meter, based on MEMS TCD-like sensor structure and a new measurement method of the calorific value. This method will use the thermal conductivity (based on the thermal conductivity sensor) with the difference that the heating element is pulse supply and the measured signal have characteristics in the time domain.

The MEMS sensor structure is similar to well-known TCD sensors from gas chromatography applications. It consist of five platinum thin-film thermoresistors located across the microfluidic channel. One of the thermoresistor works as a heater; rest of them are connected to the Wheaston-bridge circuit (Fig. 1).

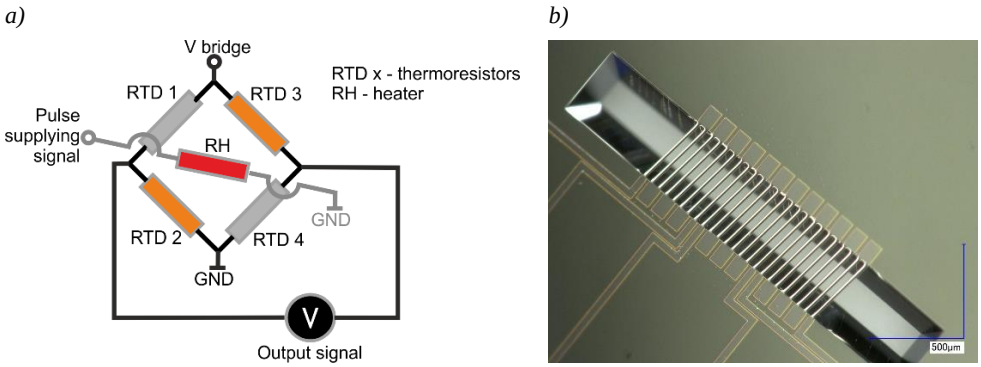

Fig 1. The MEMS TCD-like sensor, a) schematic representation of electrical connection, supplying and output signal conditioning method, b) part of the fabricated structure: platinum thin-film thermoresistors located across the microfluidical channel are visible.

The structure has been optimize to achieve the highest sensitivity by matching proper geometry and technology. The optimization was made taking into account the conditions of newly proposed measurement method. The heater is supplied by pulse signal forming a pulsating thermal wave. The wave is detected by temperature sensors. Pulse supplying signal forcing characteristic changes of the measured signal possible to analyse in time domain. The measured signal is fitted to mathematical model. After mathematical treatment the calorific value of natural gas is determined.

Sensor calibration has been performed. Three components reference gas mixture of methane, ethane and nitrogen have been used. These three components are dominant in the composition of natural gas distributed in Poland. In addition, methane and ethane have the greatest contribution to the caloric content of the mixture. The uncertainty for determining the gas calorific value was determined to be 3% (doubled standard deviation).

According to the author's best knowledge, this is the best result achieved as a result of indirect measurement without the use of gas chromatographs. The solution is a prototype including the MEMS TCD-like sensor, electronics and implemented software for automatic measurements.

In an extended form of presentation, more details about the sensor construction and technology will be described. The analysis regarding the measurement error will be deepened and it will be shown that the solution is a viable alternative to chromatographic measurements performed in main distribution points of natural gas.