Design and Analysis of Micro-Heaters for Temperature Optimisation Using COMSOL Multiphysics for MEMS Based Gas Sensor

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Abstract

Micro-Heaters are the key components in sub-miniature micro-sensors, especially in gas sensors. The metal oxide gas sensors utilize the properties of surface adsorption to detect changes in resistance as a function of varying concentration of different gases [5]. To detect the resistive changes, the heater temperature must be in the requisite temperature range over the heater area. Hence the sensitivity and response time of the sensor are dependent on the operating temperature of the micro-heater. So their proper design is of critical importance. In this paper, we report on the design and simulation of micro-heaters used in gas sensors with the aim of improving their temperature uniformity [3]. The design has been supported using Electro-thermal Simulations using the COMSOL Multiphysics. Micro-Heaters have been the subject of great interest owing to their extensive applications in gas sensors, humidity sensors and other micro-systems. A micro-heater should have low power consumption, low thermal mass and better temperature uniformity. In this paper, we have looked for geometric optimization of the heater structure to achieve optimizing temperature uniformity by performing analysis using COMSOL Multiphysics, a Finite Element Analysis (FEA) Package. We have presented four different patterns of micro-heater, namely Single Meander, double meander, fan shape and Grill shape of 100×100μm with their Electro-thermal simulated temperature profile. The Maximum Temperature of 483.86K was obtained. For the same supply voltage applied, it was found that the Square shape structure gave the best result with 99.51% of the heater area having a temperature greater than 80% of the maximum temperature attained with an average temperature of 387.054 K.

Reference

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Figures used in the abstract

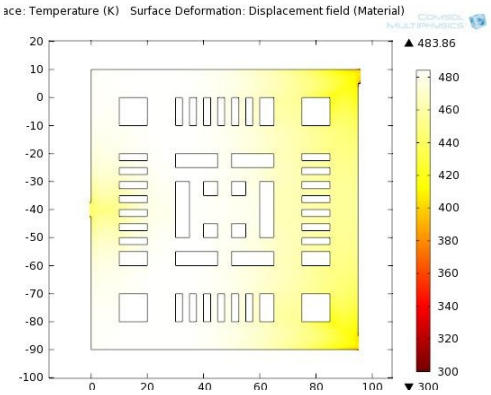

Figure 1: Temperature ditribution of grill type heater.

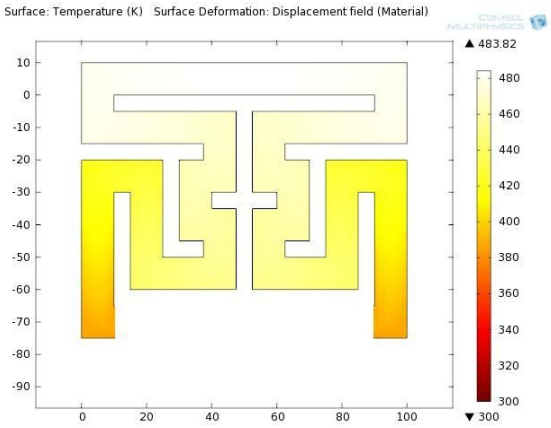

Figure 2: Temperature ditribution of doubl meader type heater.