LOW POWER THERMOCATALYTIC SENSORS WITH NANOSTRUCTURED GAS SENSITIVE MATERIALS

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Micro-catalytic gas sensors are essential devices for detection of combustive gases up to lower explosion limit (LEL). As the power dissipation of Pt coil based sensors are 120 - 150 mW [1] intensive research is devoted to reduce it to the order range while preserving sensitivity and stability. The reported micro-hotplate structures can operate up to 600 ^{o}C at a cost of 20-50 mW power consumption [2]. Nowadays the research activity is focused on development and processing of stable, nano-structured catalyst layer in MEMS compatible thick film form.

Difference in approach of fabrication gas sensitive material for coil based and silicon MEMS sensors is great. In first type sensors catalytic material must to be bulk form bead or cylinder with diameter 400-500µ. In second type sensor catalytic material deposited on planar microhotplate with diameter 100-250µ de facto forming 2D surface. The desire to increase the amount of applied catalytic material leads to form non homogenous thermal profile in bulk of catalytic material (the farther the catalyst particles from the heater, the lower their operating temperature) which in turn entails lead effect of catalytic reforming of organic molecules and blurring of peak signals characteristic of various gases. Similar effects are less common for bulk wire catalytic sensors. But in bulk catalytic material, another problem arises – porosity. The rapid and effective transfer of chemical reactants to solid surfaces through porous structures is essential for enhancing the performance of nanomaterials for gas sensing applications.

The regulation of the porous structure in bulk material has already been solved for wire catalytic sensors using particles of different sizes, usually varying 8-10 times. The use of catalytic carrier particles with a size of the order of ten microns is possible for bulk structures and does not seem realistic for planar structures. In the bulk structure, large particles form a matrix for smaller particle, in the planar they lie on the heater in only a few quantities interfering with adhesion of small particles to MEMS microhotplate. In our work, we tried to reduce this inconsistency by using two classical materials of carriers for Pt-Pd catalytic material. First one is Al_2O_3 and second one is CeO_2/ZrO_2 which were deposited to silicon MEMS microhotplate by inkjet printing, carefully selecting the thickness and viscosity of the layers and dimension of catalytic carrier particles for forming regular porosity of the gas sensitive material for a high sensory response signal.

Acknowledgement

This work was funded by the Ministry of Science and Higher Education of the Russian Federation (Grant No. 14.587.21.0053 from 21.02.2018, unique identifier RFMEFI58718X0053) in frame of joint Russian-Hungarian project.

Keywords: *combustible gases, MEMS, catalytic sensor*

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