Abstract

Metal oxide and thermal conductivity sensors are investigated in this work. Micromachining techniques are exploited and applied to improve the sensor performance. In focus are two applications, the air quality control for passenger cabins and the hydrogen detection in fuel cell applications. The former application requires a detection of carbon monoxide (CO) and nitrogen oxides (NO_x) in a range from 5 ppm to 50 ppm CO, respectively, 0.5 ppm to 5 ppm NO. The latter application requires a detection of hydrogen in air in the range from 0.1 % to 4 % H_2.

A strong reduction of power consumption and thermal response times could be achieved compared to conventional fabrication techniques. The power consumption could be limited to 20-50 mW, and the thermal response time was given in the millisecond range, τ = 10–20 ms. Beyond that, the sensors were characterized by a high mechanical stability. The fabricated dielectric membranes withstood a pressure difference across the membrane of 7 bar.

The gas-sensing performance of the fabricated metal oxide gas sensors was tested under varying operating temperature and CO and NO exposure. The results are very promising, a distinction between clean and polluted air could be achieved. Only in case of gas mixtures of both, CO and NO, a correct NO detection was not possible. The fabricated thermal conductivity sensors were tested under exposure to helium. Helium instead of hydrogen was used for security reasons. The achieved transduction efficiency, i.e. the part of the thermal energy that is transduced into the electrical output signal, was close to one. Therefore, a measurement accuracy of about 330 ppm helium in air could be achieved.