LTCC-Hot-Plates for Gas Sensors: Improved Sensor Design and Applicability of Commercial LTCC-Materials

Gas sensors manufactured in low temperature cofiring ceramics (LTCC)-technology show a high potential concerning high temperature stability, possibility of integration and inexpensive manufacturing. Also, the thermal coefficient of expansion (TCE) of LTCC-materials fit much better to the TCE of the oxidic gas sensitive layers than the TCE of silicon.

First gas sensors manufactured in LTCC-technology consumed 1.4W at 400°C [1]. An improved design should take the low thermal conductivity of the LTCC-material into account. To achieve better performance, the sensor device should be produced as small as possible, since the heat convection and the radiation is proportional to the surface.

The improved design of the presented LTCC-gas sensor is similar the commonly used micro machined silicon hot-plates [2]. The heated area (1.8mm x 1.8mm) is suspended by four beams. The beams are connected to a frame which provides mechanical stability and the possibility to connect the sensor electrically. The sensor shows a reduced power consumption of 630mW at 400°C or 480mW at 330°C , although the technological limit for miniaturization is not reached. Compared to commercially available thick film sensors on ceramic alumina substrates (1W at 330°C) [3] the performance is improved.

As a second result, the electrical resistivity of several commercially available LTCC-materials at high temperatures is presented. Typical LTCC-materials are designed for maximum temperatures lower than 200°C. To verify the usability of the materials above 200°C, the electrical properties were measured by impedance spectroscopy in the temperature range from 300°C to 700°C between 100mHz and 1MHz. The results were surprising. Some LTCC-materials showed a higher resistivity than 96% alumina which is commonly used for gas sensors.

Literature

[1] H. Teterycz et al.: *Sensors and Actuators B73* (1998) 100 –103.
[2] I. Simon et. al.: *Sensors and Actuators B*73 (2001) 1- 26.
[3] I. Denk et al.: Proceedings Sensor 1999, Nürnberg, p. 339-344