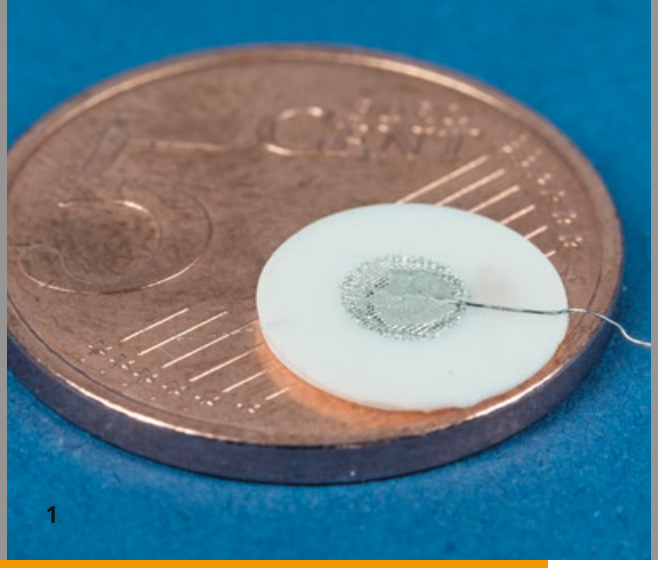
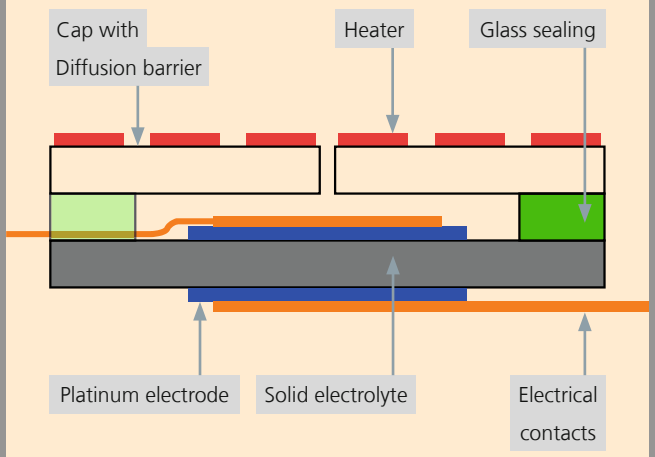


1




2



# LIMITING CURRENT TYPE OXYGEN SENSOR FOR INDUSTRIAL APPLICATIONS

Dipl.-Phys. Stefan Dietrich, Christian Eckart, Dr. Mihails Kusnezoff

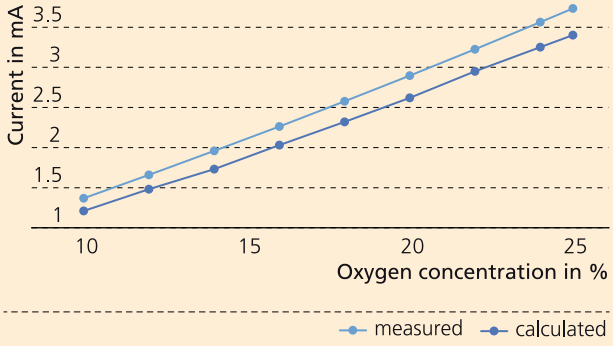
Sensors for the measurement of the oxygen content in gas mixtures are not only essential components of fuel drives, but also of medical systems for respiratory gas monitoring and various industrial processes. By choosing the appropriate measurement principle, sensor design and operating parameters the oxygen sensors can be adapted to various applications. Fraunhofer IKTS has now developed a limiting current type oxygen sensor based on a ceramic solid electrolyte (3YSZ).

The sensor principle takes advantage of the high oxygen ion conductivity of 3YSZ at temperatures above 600 °C: a DC voltage applied between two electrodes deposited on the electrolyte will cause oxygen ions to flow and a resulting electronic current in the external circuit. To maintain the ion current, oxygen is extracted from the measuring gas at one electrode and released at the other – an electrochemical oxygen pump. By controlling gas access to the oxygen-deficient electrode using a diffusion barrier, the ionic current is limited and a corresponding limiting current can be measured in the electronic circuit. If suitable geometrical and operating parameters are selected, the limiting current is proportional to the oxygen concentration in the measuring gas.

Limiting current oxygen sensors offer several advantages over other oxygen sensor types. First of all, sensor operation does not require a reference gas. Theoretical limiting current density data can easily be calculated, allowing for simple sensor calibration. In contrast to the logarithmic signal dependence of potentiometric oxygen sensors, the linear response of limiting current sensors permits the use of a larger measuring range.

The sensor developed at IKTS features a disc of 10 mm in diameter and a power consumption of 6 W at 600 °C operating temperature. The chart below illustrates the linear sensor response of a prototype in the concentration range relevant for breath analysis. The data correlates well with theoretically calculated values. However, the measurement range can be adjusted between 0–100 vol % by modifying sensor parameters, so the sensor can easily be used for other applications as well. The sensors operate at temperatures of up to 700 °C and the robust materials used make them suitable for the use in harsh environment applications. A miniaturized version of the sensor is currently being developed to reduce power consumption.

Current-oxygen concentration at
U = 0.95 V and T = 700 °C




Forschungsnetzwerk Mittelstand

1 *Sensor prototype.*
2 *Scheme of a sensor structure.*



Contact Stefan Dietrich • Phone +49 351 2553-7880 • stefan.dietrich@ikts.fraunhofer.de