Summary:
The detection of flammable gases is necessary to avoid explosive atmospheres. For this reason, low-cost pellistors are frequently used sensors, although they suffer from high operation temperatures and high power consumption. Within the scope of our work, we present a novel wireless low-power catalytic gas sensor system for flammable gases. The combination of a MEMS-based sensor and low power radio system provide the opportunity to monitor complex infrastructures without using the grid for power supply.

Keywords: flammable gas sensor, catalytic combustion, sensor node, low-power wireless

Background and Motivation
The early detection of flammable gases or explosive gas mixtures is extremely important in order to avoid endangerment of people and the damage of plants and facilities. Flammable gas sensors are sold in millions and are used for energy supply by gas, at filling stations, but also in the private sector for gas heaters and pipes. Due to their high-energy consumption, these sensors can only be operated by grid, whereby the installation of a sensor network becomes complex and expensive. Low energy consumption of the gas sensors offers the possibility to operate sensor nodes for the detection of flammable gases or explosive gas mixtures independently of the power grid. Here, we present a newly developed wireless sensor node for the detection of wireless sensors. The node connects the intelligence of a low power wireless transceiver with a MEMS-based hotplate with a very low thermal mass, the power consumption of the sensor module decreases to approximately 100mW. This enables the usage of the sensor for mobile applications as well.
Fig. 1: Overview of the measurement system. The radio module receives the data from the sensor module and could send it to different application depended destinations. The diameter of the sensor is about 300 µm.

Results

For the monitoring of flammable gases, a reliable detection of the lower explosion limit (LEL) is necessary. To report leakages or to evacuate people in harmful areas, 10% of the LEL should be detected. Here we present a gas-sensing device optimized for the methane detection. Figure 2 presents the measured data for three different gas concentrations below the LEL of methane of 4.6% [3]. At a low working temperature of 350°C, the sensor signal shows, after a burn-in step, a very stable baseline and due to the high signal to noise ratio (SNR) concentrations far below the LEL could be safely detected.

The sensor data could be transmitted to a gateway, which process the data and activates further steps, if necessary. A possible node to node range of over 250 m covers the majority of all industrial and consumer applications.

Conclusion

The use and the development of new materials as well as the optimization of the sensor design enable the reduction of the power consumption, whereby the lifetime of an autonomous sensor system increases significantly. Our investigations illustrate, for the first time, the possibility to develop a remote-query able and networkable low-power sensor system for the detection of flammable gases.

References

