

Healthcare industry BW

AppliedSensor GmbH – Chemical gas sensors to detect contaminants

Sensors and sensor systems are the speciality of Reutlingen-based AppliedSensor GmbH. The company develops gas detectors for the detection of harmful inorganic and volatile organic compounds. The application of the detectors is as broad as the presence of such gases, and they can be used anywhere from small family houses to offices, from cattle sheds to cars.

Back in the 1980s, the universities of Tübingen (Germany) and Linköping (Sweden) combined their expertise in sensor technology with the aim of pooling their strengths to speed up the development of such technology. The university spin-off companies MoTech GmbH (Reutlingen) and NST AB (Nordic Sensor Technologies, Linköping) later carried on the work started by the two universities. The two companies, which were both established at the end of the 1990s and worked in similar fields, decided to join forces in 2000. This led to the creation of AppliedSensor GmbH, a company that now has branches in Linköping and in Reutlingen, as well as a sales office in New Jersey, USA.

“The creation of AppliedSensor GmbH resembles in many ways the success story of HP, with the only difference that we did not really begin our business in a garage. We were a team of five colleagues from the University of Tübingen, who contributed some of our own money to set up MoTech GmbH entirely on our own and without the financial support of external investors,” recalls Dr. Heiko Ulmer, one of the co-founders who is now managing director of the Reutlingen branch of AppliedSensor GmbH. The market situation at the time quickly obliged the companies to streamline with the two original companies becoming one, followed by a diversification of product developments.

Growing expertise in air quality

With more and more awareness and knowledge of the risks that even slightly contaminated air poses for human health, the need for precise and reliable sensor systems for all kinds of closed spaces, be they vehicles or buildings, has been steadily increasing over the last few years. The problems start with bad air: Due to energy-saving requirements, many builders are now building much tighter houses in order to reduce the overall size of air leaks in the building envelope. However, the more airtight a building is the less possibility there is for the air to exchange naturally. Normal breathing gases, the emissions from building materials, furniture and other objects accumulate, affecting human well-being and health, and causing irritations and headaches after just a short



A clever idea: The mobile gas sensor shaped like a USB memory stick. Attached to a PCR, it sounds an alarm when the air quality decreases.

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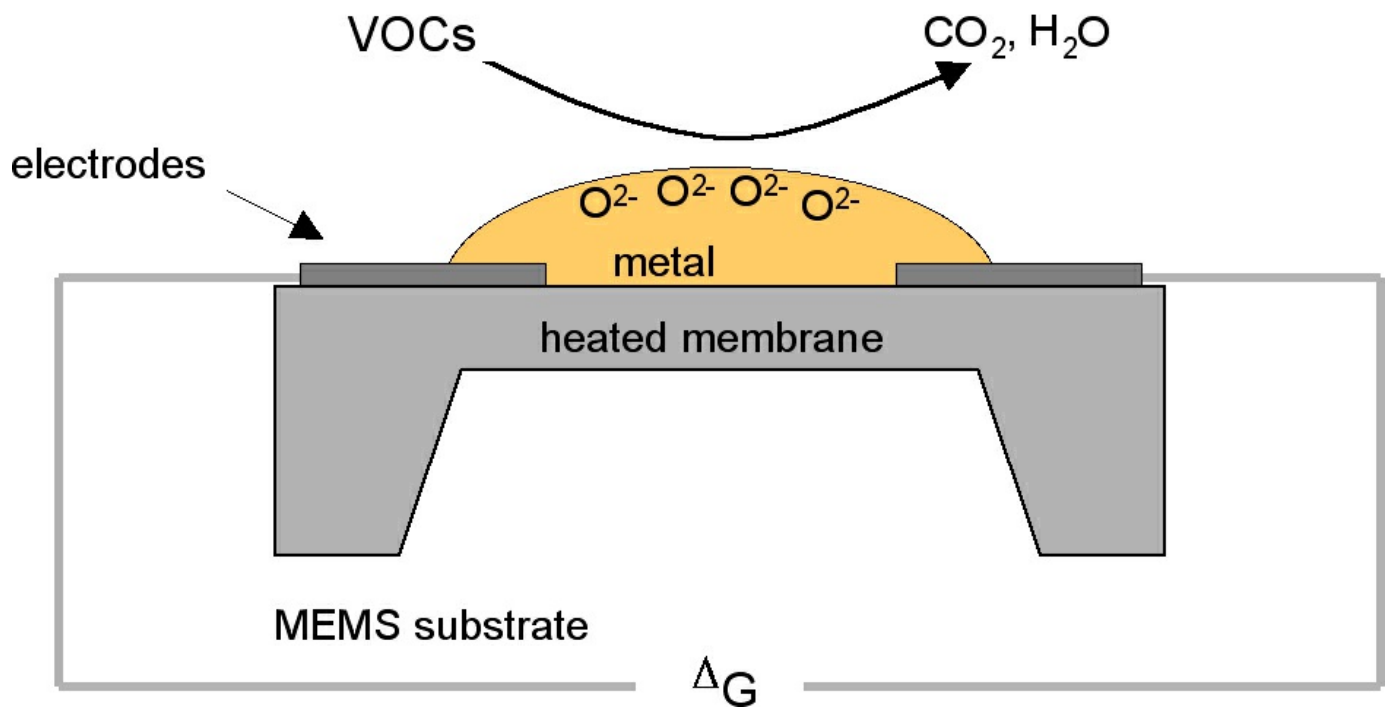
period of exposure to bad air. According to a publication by AppliedSensor, the EPA (United States Environmental Protection Agency) goes even further, suggesting that respiratory and cardiac diseases, and even cancer, may be some of the long-term risks of exposure to bad air.

In crowded rooms such as schoolrooms, meeting rooms and waiting rooms, problems can accumulate unnoticed since many harmful gases such as carbon monoxide are odourless. Although this is not true for many organic compounds, it is nevertheless the case that VOCs (volatile organic compounds) are usually only perceived at a higher concentration that is good for human health. Technology can help, for example in the form of sensitive detectors that can be integrated into ventilation systems, or wall thermostats (decentralised) to regulate the exchange of air as required. "The majority of our products are complete modules, including microprocessors; but if our clients wish we will also deliver individual components," said Ulmer.

Metal oxide technology from the company's think tank

AppliedSensor is a specialist in the combination of the required sensor properties – small, versatile, as maintenance-free as possible, durable and in particular, affordable – in a broad range of applications. Metal oxide semiconductors are the core of the company's technology; they are used to detect carbon monoxide, nitrogen dioxide, VOCs and many other compounds. "These semiconductors help us achieve major breakthroughs. The micromechanical substrate is applied to a silicon chip, which only heats up in the centre of the chip (normally to about 300 degrees) and,

in contrast to ceramic carriers, only requires about 20 Milliwatts of power," said Ulmer.



The functional principle of metal oxide sensors: VOCs (volatile organic compounds) in the environmental air react with oxygen atoms of the metal oxide. The released electrons lead to an increase in the resistance of the semiconductor, which then creates a signal.

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The functional principle is based on a catalytically induced reaction (oxidation or reduction). For example, carbon monoxide is oxidised to carbon dioxide. During this reaction, an electron is transferred and the sensor resistance decreases. Precious metals such as platinum and palladium are frequently used as catalysers. Only small quantities of catalysers are required; a few nanogrammes per sensor are sufficient," said Ulmer. "It initially took us a long time to find the optimal operation parameters that would enable us to detect harmful substances in a few seconds," said Ulmer. The Ulm-based company has long since succeeded in solving this initial challenge and is now working to find new applications and markets for its technologies.

In terms of quantity, the majority of sensors are currently used in the automotive industry, especially in convenience applications. The sensors are integrated into the ventilation system of cars, which immediately adapts to changes signalled by the sensors. "The first product used to regulate the ventilation system in cars was launched in 2006. It was developed in cooperation with Texas Instruments, now known as Sensata Technologies," said Ulmer who also envisages that hydrogen-driven cars might constitute an interesting future market for his technology: "In this field, our detectors will be mainly used for safety applications. We can detect leakage in the fuel cells or the hydrogen tanks from small amounts of escaping hydrogen."

Addressing mass and niche markets

The company's second largest business area is building services engineering; the company sells several thousand modules per year, with a growing tendency. In order to be able to continue supplying the growing market with innovative products in the long run, AppliedSensor also invests in research. At present, AppliedSensor is involved in a four-year EU cluster project focusing on

research into innovative technologies relating to building efficiency and air-conditioning technology.

“Infrared gas sensors that measure carbon dioxide are the current state-of-the-art technology in buildings. However, these sensors are relatively expensive, which limits their application. Our sensors are about two to three times cheaper. In terms of costs, therefore, our technology has the potential to enable the installation of a separate sensor in every room,” said Ulmer summarising the future perspectives.

It must be pointed out that the sensors are not always used to measure all the ambient air. Ulmer mentions a special application from the company’s development department: “We have plans to integrate our gas sensors in extractor hoods. However, such special applications require time-consuming and costly testing, from feasibility and design studies to cost analyses.” The company’s product portfolio also includes small moderately priced mobile devices suitable for just about everybody. “These devices are designed in the shape of a USB memory stick and are aimed at monitoring air quality: When the USB stick detects “bad air”, it sounds an alarm, the PC starts to blink, alerting the user to open the window. “These devices are totally new and we are still looking for additional sales partners, for example from the promotional items industry,” said Ulmer.

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