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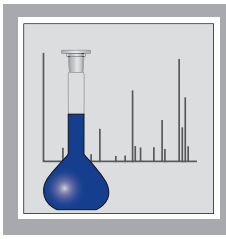

Highlights of Analytical Chemistry in Switzerland

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Non-invasive Medical Diagnostic by Breath Analysis: Acetone Detection

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Keywords: Acetone · Breath analysis · Diabetes · Nanoparticle gas sensors · Non-invasive medical diagnostic

The rising costs of medical care are pushing toward an optimization of resources and rapid integration of novel approaches. Breath analysis is a non-invasive diagnostic method offering for some applications even better performance than labor-intensive approaches such as blood analysis while drastically decreasing personnel and material costs. Breath is a mixture of nitrogen, oxygen, carbon dioxide, water, and a small fraction of other gases. The latter consists of simple gases (NO_x, NH_3) and more than 1000 trace and volatile organic compounds (VOCs) that are either generated in the body (endogenous) or are absorbed as contaminants from the environment (exogenous). These endogenous compounds can be utilized as breath markers for specific diseases.

Acetone is related to type-1 diabetes and its concentration increases from 300–900 ppb for healthy humans to more than 1800 ppb for diabetic patients. Methods for breath analysis have progressed considerably over recent years. However, to achieve their use in clinical practice, the test techniques and devices need to be highly sensitive, selective, and require a fast response to the analyte; low cross sensitivity to humidity; small size and low production and maintenance costs.

Recently, we have demonstrated that Si:WO_3 nanoparticle films made by flame spray pyrolysis are able to rapidly detect down to 20 ppb of acetone in realistic breath conditions (*e.g.* 90% relative humidity). More specifically, the electrical resistance of such films drops remarkably (up to several orders of magnitude) by reaction with the analyte and thus allows a direct measurement of its concentration (chemo-resistive gas sensor). If a diabetic were to exhale on such a sensor, its resistance would suddenly drop much more (40%) than if a healthy person would do it. As a result, it would be possible to perform fast screening of potential diabetics during routine medical visits or even in pharmacies. Furthermore, this sensor prototype can be easily miniaturized to decrease power consumption and thus to improve its portability. This has potential for the monitoring of breath acetone concentration and in the future could facilitate the determination of blood glucose level. **These results demonstrate that breath analysis by chemo-resistive nanoparticle gas sensors has high potential as a rapid, non-invasive medical diagnostic. Furthermore, these portable devices can be produced at low cost while offering extremely high performance and thus could help reducing the cost of medical care while improving the quality of life of diabetic patients (no finger prick).**

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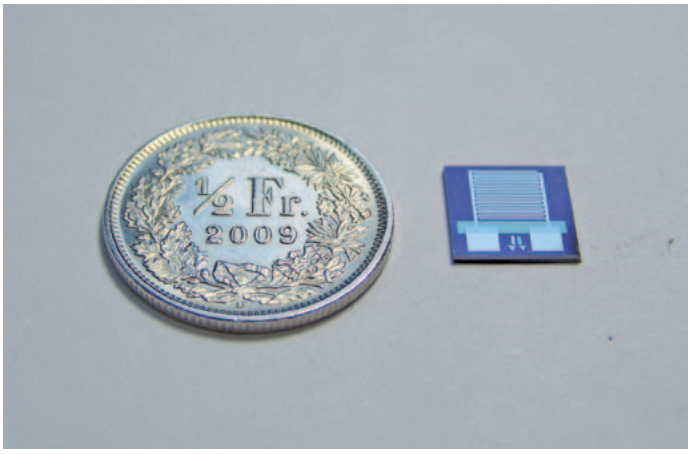
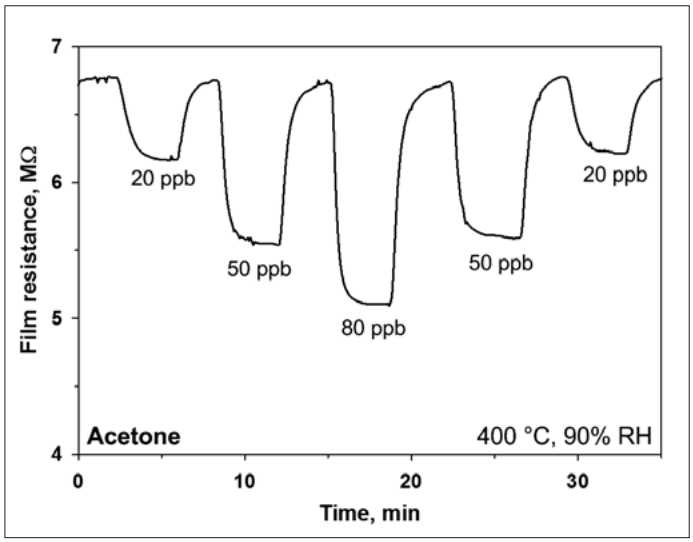


A prototype of the diabetes sensor. Thanks to its small size, it could be easily incorporated into an affordable, portable device for self-diagnosis.



WO_3 sensor resistance at realistic conditions (90% relative humidity) upon exposure of different ultra-low acetone concentrations (20, 50 and 80 ppb) at 400 °C.

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