Toxic methanol detection by handheld filter–sensor device

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Methanol is poisonous when ingested or inhaled, resulting in devastating consequences including organ failure, blindness and death. (Kraut 2008) This is a potential hazard in laboratories and chemical plants where methanol is commonly used as a solved. Also, alcoholic beverages adulterated with methanol are a threat, commonly leading to poisoning outbreaks in developing countries with hundreds of victims. While chemical sensors, such as nanostructured metal-oxides, are portable, inexpensive and can detect alcohols down to ppb concentrations (Pineau 2018), they cannot differentiate methanol from ethanol and other interferants. (Güntner 2019) To improve selectivity between ethanol and methanol, sensor can be combined with filters (van den Broek 2018).

Here, we present a handheld detector (Fig. 1a) capable to selectively detect methanol in the presence of high ethanol background. It consists of a filter placed upstream of a highly sensitive, but non-specific Pd-doped SnO_2 microsensor. The filter is a small packed bed (150 mg) of a commercial adsorbent (Tenax TA), which adsorbs and retains analytes based on their chemical interaction. After passing the filter, analytes are detected by the sensor. The sensor consists of a highly porous network of SnO_2 nanoparticles fabricated by flame spray pyrolysis (FSP) that are directly deposited onto microsensor substrates by thermophoresis. (Güntner 2016)

The resulting methanol detector can selectively detect methanol without interference of simultaneous ethanol and acetone (Fig. 1b). In specific, methanol is detected within 2 min in a large concentration range from 1–1000 ppm at ambient 50% RH. The detection of methanol is thereby independent of the interfering ethanol concentration up to 95% relative saturation (~60 000 ppm). As a proof-of-concept, the detector was also tested on methanol-spiked breath samples and rum where it could reliably detect and quantify toxic methanol concentrations. It shows thus great promise for detection of toxic methanol concentrations in indoor air or in the headspace of beverages, as well as for fast screening of methanol poisoning from breath.

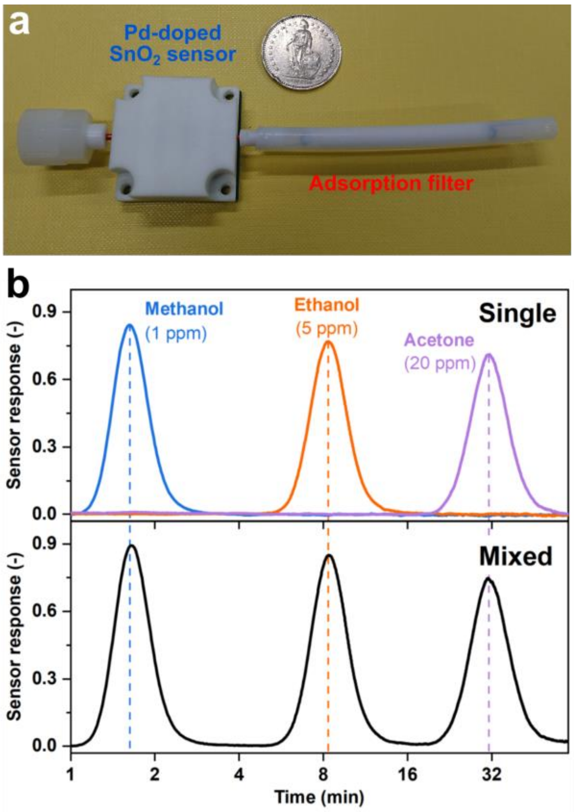

Figure 1. (a) Handheld methanol detector. (b) Response of the detector when sampling methanol (1 ppm), ethanol (5 ppm) and acetone (20 ppm).

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