G.A.S. Breath Analysis

Methanol: Trace- to Toxic-Level Detection in Human Breath

Methanol is commonly found in human breath at trace concentrations. Main sources are consumption of fruits, vegetables, fermented drinks, alcoholic beverages and the sweetener aspartam when metabolised. Furthermore mircobiota may also be a source.

Methanol itself is not toxic, yet its metabolites formaldehyde and formate are. The treatment threshold for methanol poisoning is reported to be 20mg/dL in blood.[1]

Methanol can be directly analysed in human breath as well as from saliva (via gas phase sampling in the mouth cavity) using G.A.S. GC-IMS systems. For direct breath analysis the BreathSpec® is equipped with a medical spirometer, triggering end tidal breath sampling by CO_2 concentration. Alternatively, a GC-IMS can be equipped with a luer port for the injection of gaseous samples from any standard luer tip syringe. This enables flexible sampling of breath exhaled from either the mouth or nose. Sampling in the mouth cavity may overcome sampling issues were patients are incapable or unwilling (e.g. forensic applications).

The GC-IMS separates gas mixtures by gas chromatographic retention times and specific ion mobility. This results in 2-dimensional separation enabling the analysis of individual compounds. Fig. 1 displays the GC-IMS chromatogram of i) human breath and ii) static gas phase of methanol (2.5mmol/l) in water (physiological salt solution). This concentration represents the treatment threshold for methanol poisoning. Monomer and dimer peaks are highlighted in Fig.1. The respective maxima are plotted by GC retention time in Fig. 2.

The methanol spiked water exhibits significant monomer and dimer signals. Even in human breath the monomer ion of methanol is distinct, enabling the monitoring of methanol in normal breath.

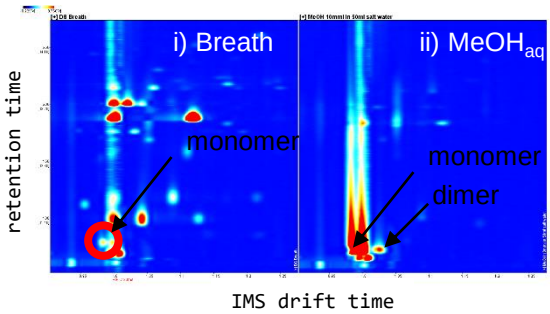

Fig.1: GC-IMS chromatogram of i) human breath and ii) static gas phase (20°C) over methanol (2.5mmol/l) in water (physiological salt solution)

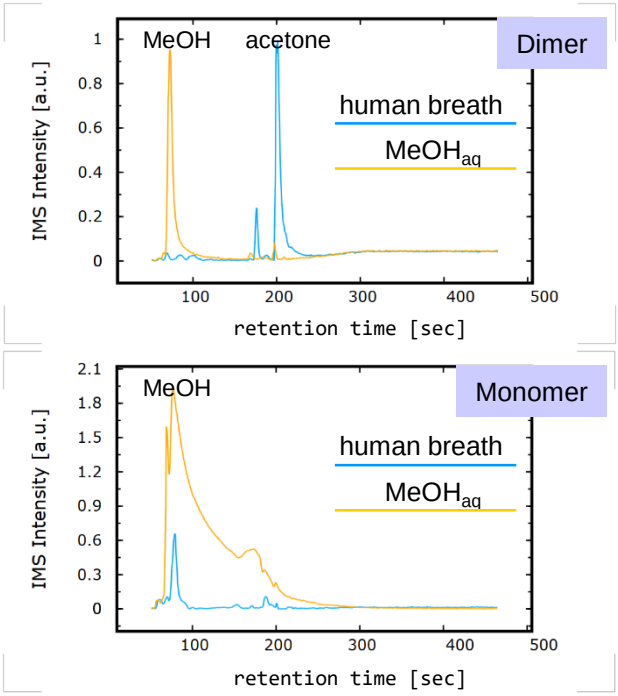

Fig.2: IMS signal at maximum intensity of methanol monomer and dimer peaks versus retention time

Device Setup:
Ion-Mobility-Spectrometer:
- GAS ^{3}H-IMS TOF-design (tube length: 9.98cm)
- Driftgas: N_2

GC:
- 30m OV-201 type phase 1µm, d: 0.53mm
- Carrier gas: N_2
- Carrier gas flow ramp (150sec@3SCCM > linear ramp to 300sec@75SCCM > 75SCCM)
- runtime: 11min

[1] Kostic MA, Dart RC, J Toxicol Clin Toxicol. 2003;41(6):793-800.