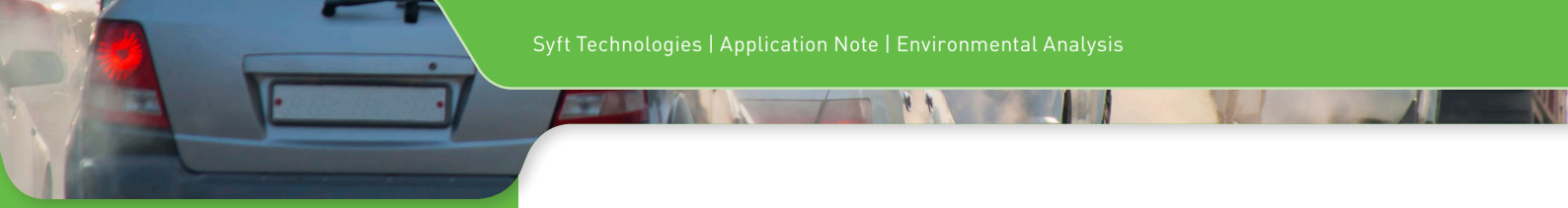


Real-Time Analysis of Automobile Exhaust Emissions, Using Syft SIFT-MS

Key Benefits

- Direct analysis of auto exhaust (no drying required)
- Real-time quantitative analysis
- Wide linear range
- Wide dynamic range
- Robust
- Easy to use

SIFT-MS provides real-time, humidity-independent analysis of diverse combustion products over wide linearity and dynamic ranges, making it eminently suitable for direct analysis of motor vehicle tail-pipe emissions.

Despite improvements in fuels, engines and catalytic converters, emissions of volatile organic compounds (VOCs) from motor vehicles remain a significant source of pollution in urban areas, and under appropriate conditions result in formation of photochemical smog. Selected Ion Flow Tube Mass Spectrometry (SIFT-MS) offers a unique ability to study motor vehicle emissions, because it can analyze individual VOCs and certain inorganic gases (such as NO and NO_2) in real-time, even at high humidity.

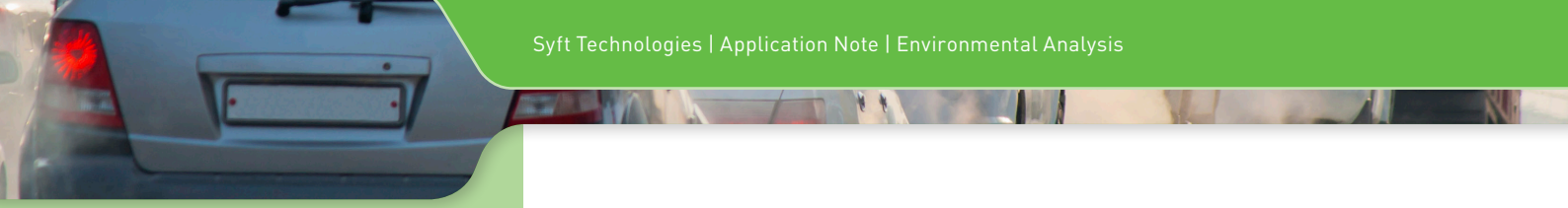
In this study most compounds were quantified using multiple reagent ions, which allowed the best reagent ion — product ion combinations to be selected. By minimizing interferences, SIFT-MS maximizes selectivity and accuracy.

Table 1 provides a brief overview of two gasoline-powered vehicles that had emissions analyzed using a Syft Technologies Voice200 SIFT-MS instrument. Exhaust gases were diluted 50% with ambient air and drawn continuously through PVC tubing using a small battery-powered pump. The SIFT-MS instrument extracted only a fraction of this gas for analysis.

Blanks were analyzed by pumping outdoor ambient air through the same length of tubing and were subtracted from the data presented here.

Figures 1 and 2 show the results of real-time analysis of the exhaust gases of the two vehicles. For clarity, the figures show different classes of compounds. These data were obtained for cars from a near-cold start, the engines at low revolutions and without load for the duration of the analysis. The engine of each car was maintained at consistent revolutions. The data reveal very different VOC profiles — both in terms of relative and absolute abundances, and in terms of temporal changes in the data.

The real-time, broad-spectrum, humidity-independent analysis provided by SIFT-MS makes it ideally suited to direct analysis of VOCs in motor vehicle tail-pipe emissions. The Syft Voice200 SIFT-MS solution provides a robust, easy to operate package for sensitive, quantitative analysis over a wide dynamic range.



Experimental Method

Sample	Auto exhaust gas[1]
Accessories	Glass T piece at exhaust; sampling pump drawing sample at 3 L min-1; 3 meters of ¼" i.d. PVC tubing[2]

1. Diluted 50% with ambient air through the T-piece
2. Residence time of <2 seconds.

SIFT-MS Analysis

Instrument	Voice200
Inlet type	High performance
Sample flow	45 sccm
Software	Voice200 & LabSyft
Analysis type	Selected Ion Mode
Reagent ions	H_3O^+, NO^+, O_2^+
Compounds[1]	29 in total, including aromatic and aliphatic hydrocarbons, aldehydes, ketones, alcohols, nitrogen oxides and hydrogen cyanide
Dwell time per mass	100 ms per measurement cycle
Data time resolution	10 seconds
Typical LOD[2]	0.5 pptv

Further Reading

Syft Whitepaper *SIFT-MS: A Significant New Tool for Real-Time Air Quality Monitoring*

Syft Brochure *LabSyft: Laboratory Software for SIFT-MS Applications*

Syft Brochure *Real Solutions*

Syft Brochure *Mobile Analysis of VOCs Made Simple*

B.J. Prince, D.B. Milligan, M.J. McEwan (2010), *Application of [SIFT-MS] to real-time atmospheric monitoring* Rapid Commun. Mass Spectrom. 24, 1763.

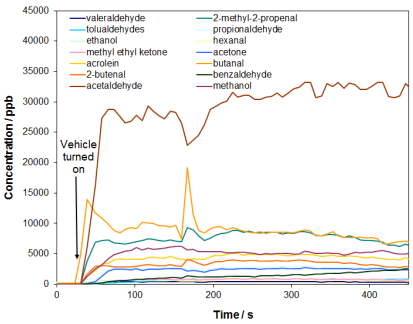
D. Smith, P. Spanel (2005). *[SIFT-MS] for on-line trace gas analysis*, Mass Spec. Rev, 24, 661-700.

Table 1: Details of the motor vehicles tested in this study.

Manufacturer and Model	Subaru Legacy	Nissan Murano
Identification in this report	Car A	Car B
Year of manufacture	2000	2005
Displacement (cubic centimeters)	2500	3500
Odometer reading in kilometers (miles)	131000 (82000)	22000 (14000)
Catalytic converter fitted	No	Yes
Time elapsed since previous use*	2 hrs	2 hrs
Engine RPM (at start and end of experiment)	1500	1500 – 1250

* Apart from shifting the vehicle into the testing park space

Figure 1: Real-time concentrations of various oxygenated compounds in the exhaust gases emitted by (a) car A and (b) car B (see Table 2), determined using SIFT-MS.



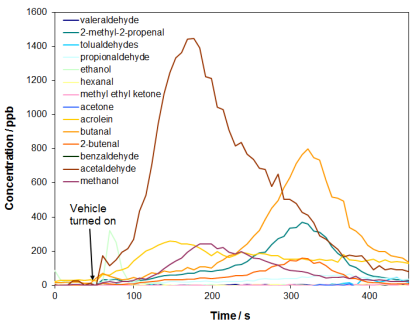
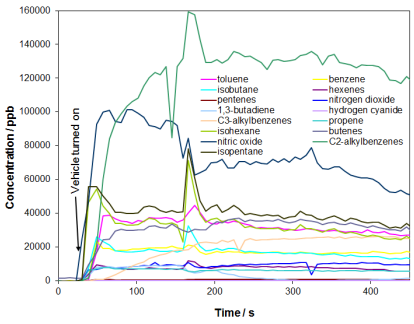
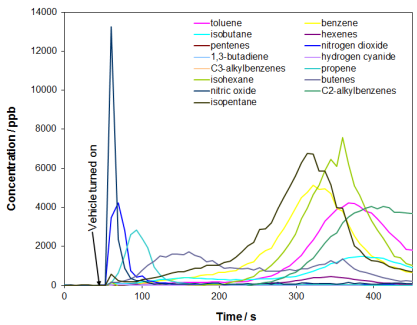


Figure 2: Real-time concentrations of selected hydrocarbons and nitrogen-containing compounds in the exhaust gases emitted by (a) car A and (b) car B (see Table 2), determined using SIFT-MS.

CAR A



CAR B



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