AUTOMOTIVE INDUSTRY SOLUTIONS

SYFT TECHNOLOGIES

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Technologies

AUTOMOTIVE APPLICATIONS OF SIFT-MS

Volatile organic compounds (VOCs) and inorganic gases are emitted from diverse automotive components, assembled motor vehicle cabins, and as combustion by-products from motor vehicles. Some emissions are highly toxic (including the carcinogens benzene and formaldehyde), some have nuisance value (e.g. causing sensitization), but most are contributors to smog. Recognizing the public health and environmental issues, regulatory bodies and industry increasingly seek to reduce public and environmental exposure to these emissions. Historically, however, no technology has been able to provide simple, rapid, and comprehensive analysis for these diverse chemicals.

Selected ion flow tube mass spectrometry (SIFT-MS) addresses the shortcomings of traditional analytical techniques with a unique combination of benefits that enable it to quantify diverse gases in real time with very high selectivity over wide linear and dynamic ranges, while providing long-term stability, ease of use and ease of integration.

SIFT-MS represents a breakthrough in the detection, quantification, and tracing of gaseous emissions for the automotive industry. This brochure outlines several SIFT-MS-based vehicle and component testing solutions provided by Syft Technologies.

VEHICLE INTERIOR AIR QUALITY (VIAQ) ANALYSIS

The high-speed, comprehensive, and sensitive analysis provided by SIFT-MS makes it ideally suited to testing of chemically diverse VOCs in car interiors.

Traditional testing uses laboratory-based analytical techniques (gas chromatography mass spectrometry (GC/MS) and high performance liquid chromatography (HPLC)) that are expensive, have slow sample turnaround, require technical personnel, and are incompatible with rapid testing on the production line or in the parking lot.

SIFT-MS analyzes all aldehydes and other VOCs in one rapid, simple front-line test, making wide-scale screening economic. Instant feedback on the acceptability of every vehicle coming off the production line is a reality! This ensures that any deviations from the standard production specification can be identified immediately, allowing corrective actions to be taken.
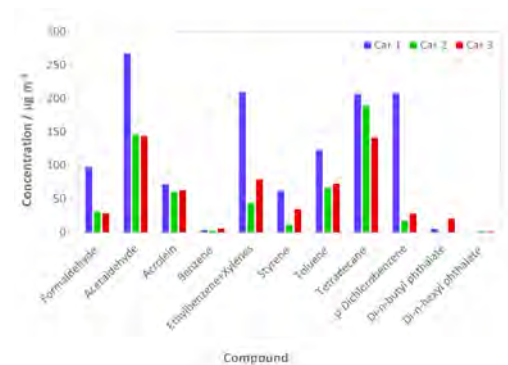
SIFT-MS test results for three new vehicles from the same manufacturer.

RAW MATERIAL AND COMPONENT EMISSIONS

Increased regulation of emissions in motor vehicle passenger cabins has led to original equipment manufacturers (OEMs) imposing emission standards on raw material and component suppliers to prevent inclusion of sub-standard products in finished vehicles. Analogous to the VIAQ application, conventional analytical technologies for testing components are expensive, complex, and slow.

The comprehensive analysis provided by SIFT-MS – coupled with its high throughput and very low cost of ownership – provides an ideal tool for certifying conformance of every batch of product across diverse compound classes, including aldehydes, phthalates, aromatics, chlorinated organics, and organotin compounds.

Both the OEM and supplier benefit from the rapid turnaround, since batches with higher emissions can be identified before shipping, eliminating costly rejections by the OEM. Wide-scale product screening also enables the supplier to identify product issues earlier, optimizing production processes and reducing product losses or re-work.
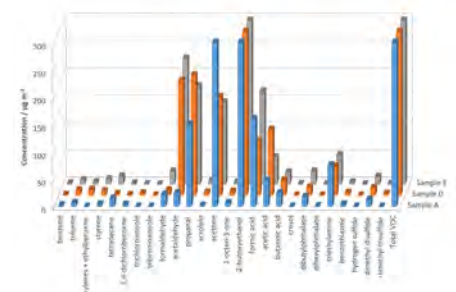
Emissions of diverse volatile compounds from three leather samples.

ENGINE EXHAUST ANALYSIS AND CATALYST R&D

Despite improvements in fuel quality (including changes to additives), internal combustion engines, and catalytic converters, emissions of VOCs and inorganic gases from motor vehicles remain a significant source of pollution in urban areas due to their numbers.

SIFT-MS provides unique opportunities to study and reduce motor vehicle emissions, because it can:

- Analyze individual VOCs and most inorganic gases (such as NOx and SOx) in real-time, even

at high humidity, providing a more comprehensive picture of emissions.

- Monitor transient effects such as a sudden burst in emissions on acceleration, which conventional techniques completely miss.

These capabilities enable deeper insights to be obtained compared to results from conventional analytical methods. Rapid analysis provided by SIFT-MS also enables faster feedback of the findings into R&D and production decisions.

Tailpipe emissions of oxygenated sompounds from a three-year-old Nissan Murano fitted with a catalytic converter.
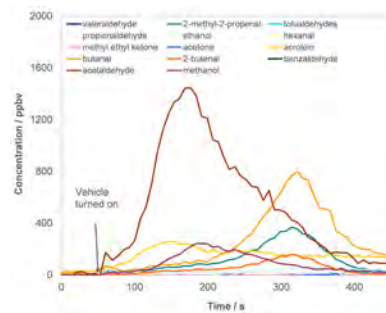
BATTERY AND FUEL CELL APPLICATIONS

The comprehensive, simple gas analysis capabilities of SIFT-MS make it ideally suited to detection of gases used in batteries, or that are produced when batteries fail or are abused:
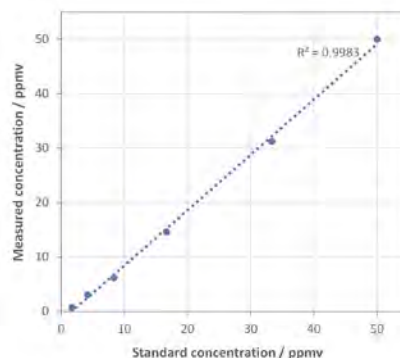
- Acid gases, such as hydrogen chloride, hydrogen fluoride, nitric acid, and sulfur dioxide

- Organic electrolytes used in lithium ion batteries, including dimethyl carbonate and diethyl carbonate.

SIFT-MS is also ideally suited to both fuel cell research and ongoing

quality assurance of fuels. R&D applications include evaluation of fuel cell conversion efficiencies and evaluation of the effects of reactive impurities on the fuel cell catalyst (for example, ammonia and hydrogen sulfide). SIFT-MS also provides an economic solution for ongoing quality assurance of fuel gas supplies to ensure that they do not contain compounds at concentrations that will poison commercially deployed fuel cells.

Linear detection of HCl using the NO_2^- reagent ion of SIFT-MS.

SUMMARY

Syft Technologies' SIFT-MS instruments provide highly sensitive, selective and non-discriminatory analysis that offer unparalleled opportunities for the process-line, QA laboratory and R&D laboratory:

- Detection and quantitation of regulated VOCs and aldehydes in vehicle cabin air;

- Comprehensive, high-throughput screening for emissions from raw materials and automotive components;

- Real-time motor vehicle exhaust analysis in support of pollutant reduction;

- Battery and fuel cell applications.

Syft Technologies is committed to its customers' success, delivering simplicity of operation, fully integrated solutions, user-friendly software, product reliability, and extensive after-sales support.

SELECTED ION FLOW TUBE MASS SPECTROMETRY (SIFT-MS)

SIFT-MS is the leading real-time analytical technique for comprehensive gas analysis to ultra-trace levels.
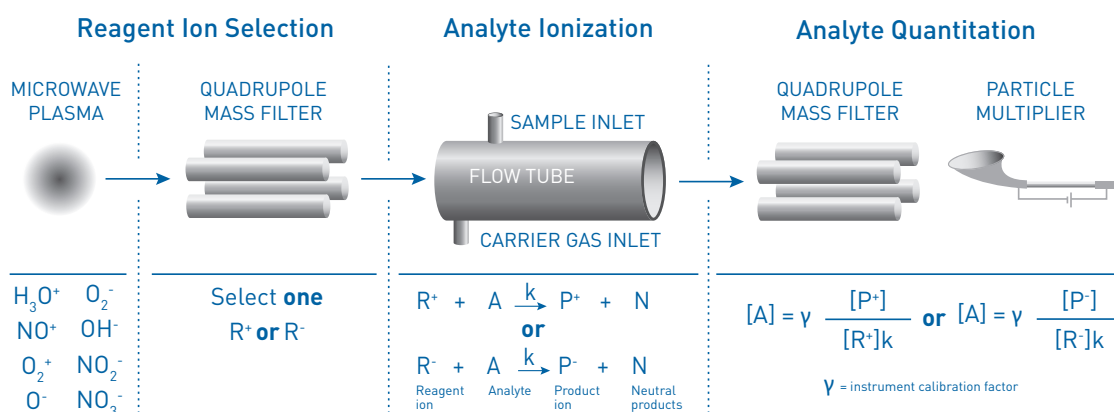
SIFT-MS uses ultra-soft, precisely controlled chemical ionization coupled with mass spectrometric detection to rapidly quantify VOCs and permanent gases to low part-per-trillion concentrations by volume (pptv). Eight chemical ionization agents (reagent ions) are applied in Syft instruments: H_3O^+, NO^+, O_2^+, O^-, O_2^-, OH^-, NO_2^-, and NO_3^-.

These eight reagent ions react with VOCs and inorganic gases in very well controlled ion-molecule reactions but they do not react with the major components of air (N_2, O_2, and Ar). This enables SIFT-MS to analyze air at trace and ultra-trace levels without preconcentration.

Rapid switching of eight reagent ions provides unsurpassed selectivity among direct MS techniques.

Reagent Ion Selection

MICROWAVE PLASMA

QUADRUPOLE MASS FILTER

H_3O^+ O_2^-
NO^+ OH^-
O_2^+ NO_2^-
O^- NO_3^-

Select **one** R^+ **or** R^-

Analyte Ionization

SAMPLE INLET

FLOW TUBE

CARRIER GAS INLET

$$R^+ + A \xrightarrow{k} P^+ + N$$
or
$$R^- + A \xrightarrow{k} P^- + N$$

Reagent ion   Analyte   Product ion   Neutral products

Analyte Quantitation

QUADRUPOLE MASS FILTER

PARTICLE MULTIPLIER

$$[A] = \gamma \frac{[P^+]}{[R^+]k} \quad \text{or} \quad [A] = \gamma \frac{[P^-]}{[R^-]k}$$

γ = instrument calibration factor

BENEFITS OF SYFT SIFT-MS INSTRUMENTS

- Instantaneous identification and quantitation of VOCs and inorganic gases using a fully integrated, extensive chemical ionization library

- Real-time gas analysis to low part-per-trillion by volume (pptv) concentrations with class-leading selectivity, no preconcentration, and high robustness to humidity

- Analysis of diverse compounds in a single analysis (e.g. acid gases, amines and organosulfur compounds)

- Ease of operation with push-button simplicity, no sample preparation, and comprehensive LabSyft data analysis software

- Designed and engineered for use in demanding environments, with easy integration into sample delivery systems (including autosamplers) and IT infrastructure

- Reliable, low maintenance instruments and accessories, with market-leading aftersales support.

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