Applications note
Gas analysis solutions

Solutions for Innovation

Gas analysis

Gas Analysis Solutions with JEOL Mass Spectrometers

GC-QMS, High performance GC-TOFMS,
TG/DTA-MS System,
Pyrolyzer-GC-MS System

JEOL Ltd.

Gas Chromatograph-Quadrupole Mass Spectrometer

JMS-Q1600GC UltraQuad™ SQ-Zeta is the 6th generation of the JEOL GC-QMS system. It is equipped with a high-capacity vacuum pumping system and the largest hyperbolic quadrupole in its class, enabling highly sensitive analysis even with large gas inflows. For example, it is suitable for GC-MS analysis using packed GC columns and direct connection with thermogravimetry (TG).
Furthermore, it is possible to analyze molecular ion of hydrogen gas (*m/z* 2) for quantitative analysis with high sensitivity and accuracy.
It can also be used for long-term continuous monitoring analysis over 24 hours.

GC-QMS JMS-Q1600GC UltraQuad™ SQ-Zeta

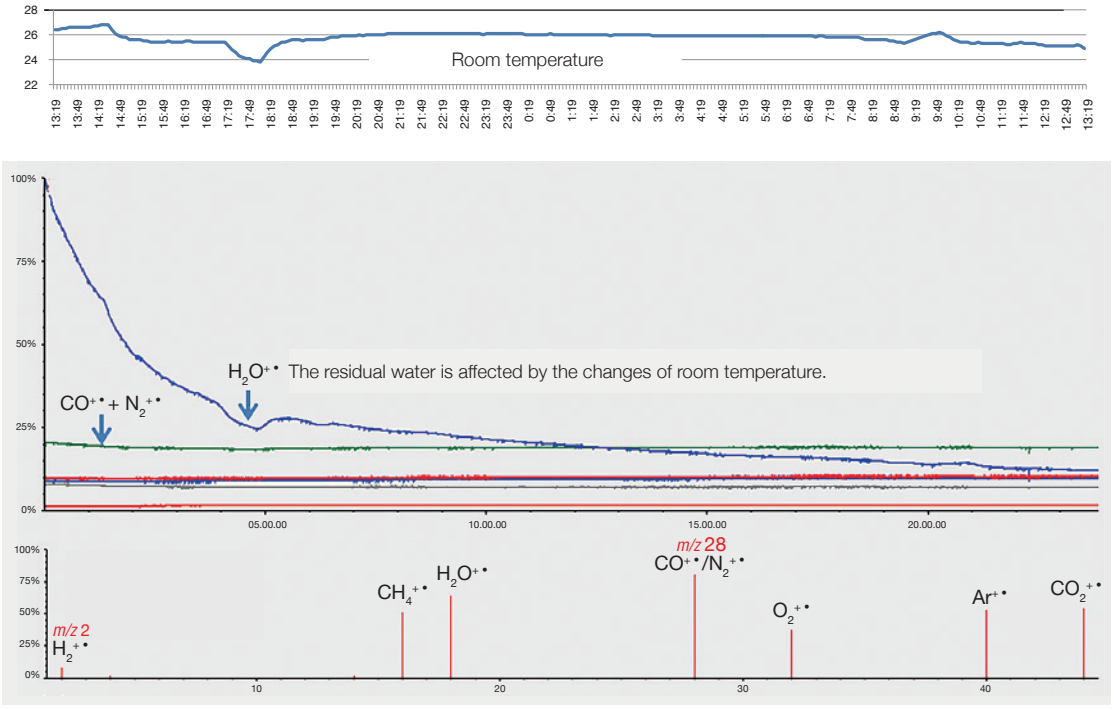
Analysis example

Long-term monitoring of a standard gas

Sample: 10 ppm each of H_2, O_2, N_2, CH_4, CO, Ar, and CO_2 in helium gas

m/z 28: $CO^{+\cdot}/N_2^{+\cdot}$ ⇒ Both species contribute to the peak height because they are not separated at the mass resolution of a quadrupole mass spectrometer.

m/z 18: $H_2O^{+\cdot}$ ⇒ The water in the vacuum chamber and tubing has been detected.

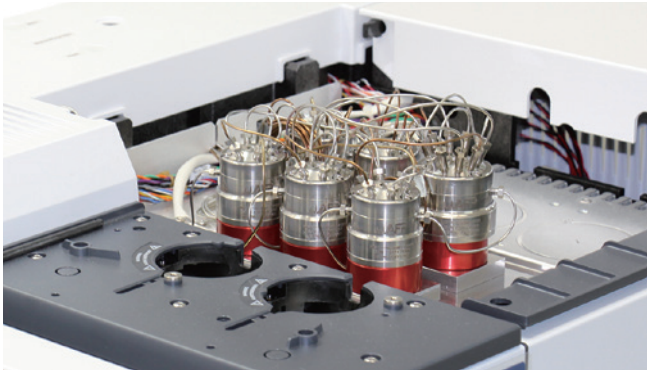


The maximum time per measurement is 24 hours. Automatic repetitive measurements can be made for continuous monitoring over 24 hours.

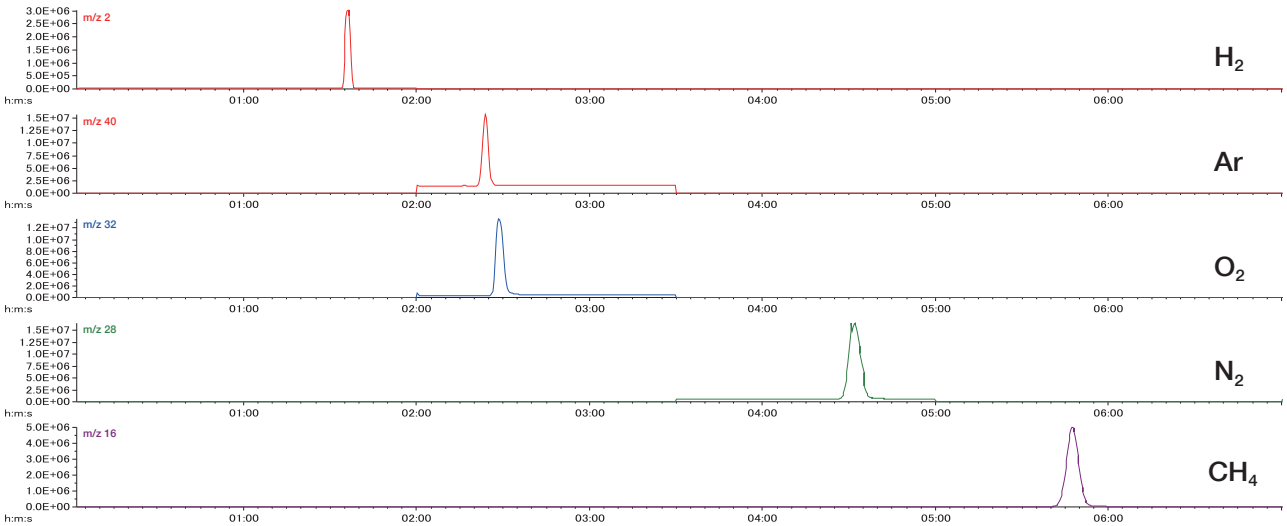
Analysis example

Analysis of trace hydrogen in a gas mixture using gas valve system and a megabore GC column

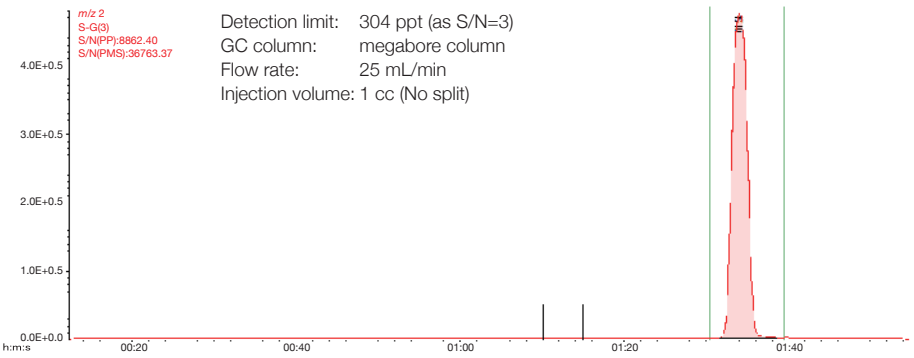
JEOL can offer various proposals to suit your needs, such as "ultra-trace gas analysis system" that enables analysis of trace components at ppb to sub-ppb levels by combining a gas valve system and capillary GC column or packed GC column, and "mixed gas analysis system" to measure high concentration gases.
The UltraQuad™ SQ-Zeta can also detect a ion at *m/z* 2 with high sensitivity, making it suitable for quantitative analysis of hydrogen.



Gas valve system produced by Labosoltech LLC



SIM chromatograms of gas mixture (1 ppm each component in helium gas)



SIM chromatogram of molecular ion of hydrogen (*m/z* 2)

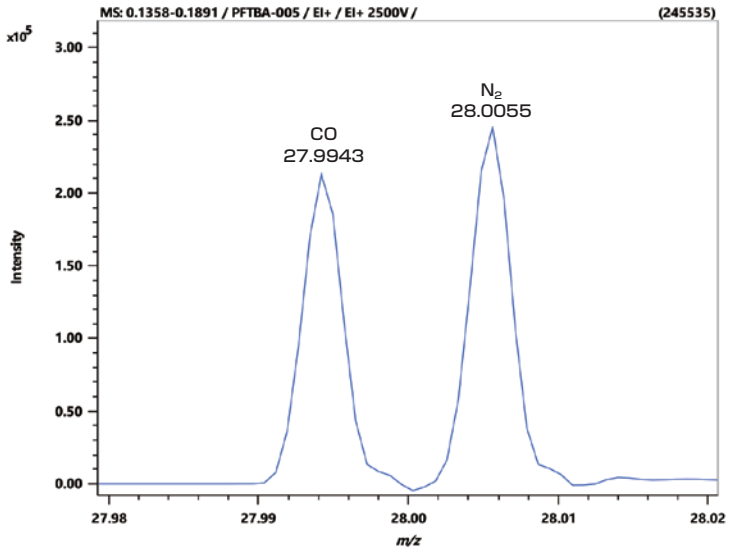
High Performance Gas Chromatograph – Time-of-Flight Mas Spectrometer

The JMS-T2000GC AccuTOF™ GC-Alpha is the 6th generation of JEOL's AccuTOF™ GC series gas chromatograph – time-of-flight mass spectrometer.
The AccuTOF™ GC-Alpha is a time-of-flight mass spectrometer that achieves ultra-high resolution and high mass accuracy compared to conventional instruments by employing an extended flight length and new ion optics, in addition to a conventional high-transmission ion transport system that does not use a radio-frequency ion guide. Coupled with the fast-response ion detector, it provides high mass resolution and good ion peak shape even in the low *m/z* region.
In addition to the standard Electron Ionization (EI), it can be equipped with ionization methods such as Field Ionization (FI), Photoionization (PI), and Chemical Ionization (CI), which enable a wide range of applications for volatile compounds.

JMS-T2000GC AccuTOF™ GC-Alpha

Separation of ions at *m/z* 28

Sufficient mass resolution and good peak shape are obtained to separate $CO^{+\cdot}$ and $N_2^{+\cdot}$ at *m/z* 28.



Analysis example

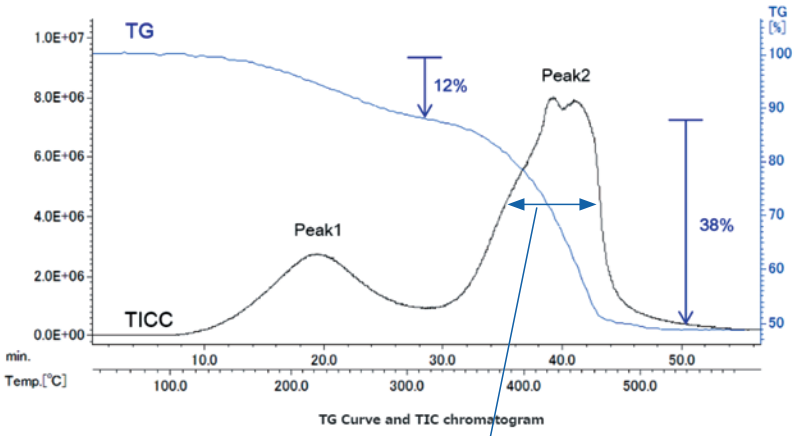
Evolved gas analysis of styrene-butadiene rubber using TG – high-resolution TOFMS

Many polymeric materials are used in a variety of products, and information on the gases evolved from them by heating is very important for evaluating the characteristics, quality, and safety of the products. Thermogravimetry – Mass Spectrometry (TG-MS) is a useful method for analyzing evolved gases from polymeric materials because it can correlate weight loss due to heating with qualitative information on evolved gases.

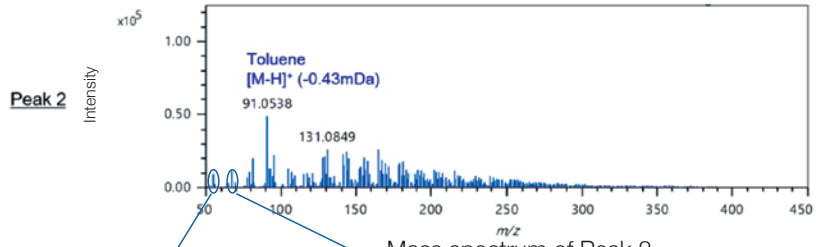
Here is an example of evolved gas analysis of styrene-butadiene rubber (SBR) containing a vulcanization accelerator by TG-MS method using AccuTOF™ GC-Alpha. The accurate mass of the detected ions confirmed the generation of hydrogen sulfide (H_2S) and sulfur dioxide (SO_2).

■ Measurement conditions

Sample	Styrene-Butadiene Rubber (SBR) 1 mg
TG	STA 2500 Regulus (NETZSCH)
Furnace temp.	45 °C → 10 °C/min → 600 °C
Transfer-line temp.	300 °C
Transfer-line column	Blank capillary tube, 3 m, 0.32 mm I.D.
Atmosphere	He, 100 mL / min
Split ratio	50 : 1
MS	JMS-T2000GC (JEOL)
Ionization	EI, Ionization Energy 70 eV
Mass range	*m/z* 10 to 800
Ion source temp.	300 °C
GC-ITF temp.	300 °C

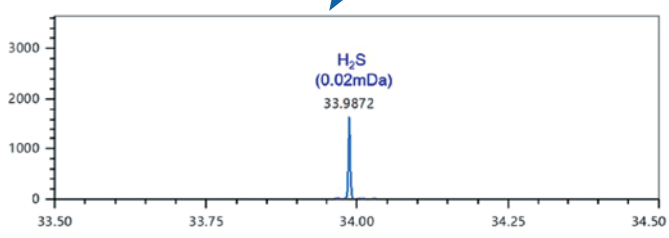


TG Curve and TIC chromatogram

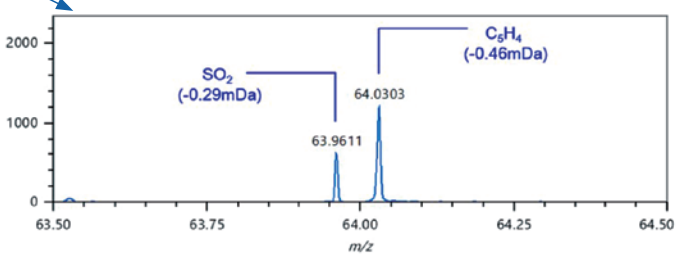


Mass spectrum of Peak 2

expanded



Expanded mass spectrum around *m/z* 34



Expanded mass spectrum around *m/z* 64

TG/DTA-MS System

The Thermogravimetry (TG) / Differential Thermal Analysis (DTA) system can observe weight loss and endothermic and exothermic reactions caused by the heating of samples. Direct connection of the TG/TDA system to a mass spectrometer allows detection and identification of components evolved from the sample.

Combination of a QMS and a TG/DTA(NETZSCH)

Combination of a TOFMS and a TG/DTA(NETZSCH)

Pyrolyzer-GC-MS System

A Pyrolyzer-GC-MS System, which combines a pyrolyzer and GC-MS, is a powerful tool for the qualitative analysis of organic compounds produced by thermal extraction or pyrolysis.

Combination of a QMS and a Multi-Functional Pyrolysis System coupled with Auto-Shot Sampler (Frontier Laboratories)

Combination of a TOFMS and a Multi-Functional Pyrolysis System (Frontier Laboratories)

Gas Analysis Solutions from JEOL

Analysis of low molecular weight gases, including those evolved from secondary batteries, biomass, ammonia combustion, polymer materials, and nuclear reactors, as well as trace impurities in high-purity gases, is becoming increasingly important.
JEOL offers a wide variety of gas analysis solutions using mass spectrometers to match your research and analysis objectives.

GC-QMS
JMS-Q1600GC
UltraQuad™ SQ-Zeda

GC-TOFMS
JMS-T2000GC
AccuTOF™ GC-Alpha

	GC-QMS JMS-Q1600GC UltraQuad™ SQ-Zeda	Applications	GC-TOFMS JMS-T2000GC AccuTOF™ GC-Alpha	Applications
Mass resolution	△ (Nominal mass : R2,000)	·Isotope ratio measurement ·Gas analysis generated by electrochemical reaction	○ (Accurate mass: R30,000)	·Simultaneous individual detection of the same nominal mass component Ex. Separation of nitrogen, carbon monoxide, ethylene @ *m/z* 28 Separation of carbon dioxide and nitrous oxide @ *m/z* 44, etc.
Observation of hydrogen	○	·Quantitative analysis of hydrogen in sample gas ·Observation of thermal desorption of hydrogen from metals	×	
Portability	○	·In-situ analysis at location of gas source	×	
Large flow introduction	○	·Tracking of quick reactions · Combustion test	△	
Long-term monitoring	○	·QA/QC for high purity gases · Reaction process monitoring	△	
EGA-MS analysis TG/DTA-MS analysis	○	· Analysis of evolved gases in organic and inorganic materials	○	· Analysis of evolved gases in organic and inorganic materials
GC-MS with packed column	○	·Analysis of impurities in high purity gases	×	
GC-MS with capillary column	○		○	· Analysis of impurities in high purity gases

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