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GC-MS GCMS-QP™2050

Application News

High-Sensitivity Gas Analysis Using the GCMS-QP2050 and GI-30 Auto Gas Injector

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User Benefits

- Analyzing gas samples with the GCMS-QP2050 enables high-sensitivity measurements of trace inorganic gases and light hydrocarbons.
- Gas analysis using GC-MS supports quantitative determinations and qualitative identification of unknown components in gas samples through mass spectral library searches, without the need for standard substances.
- Using the GI-30 Auto Gas Injector enables automated, continuous gas analysis, reducing operator workload while achieving reproducibility comparable to liquid sample injection.

■ Introduction

Gas analysis is conducted across a wide range of fields, including resources, energy, and the environment. Typical targets include inorganic gases such as H_2, CO, and CO_2, and light hydrocarbon gases starting with CH_4, with analyses primarily performed using GC. In Application News No. 01-00858, examples of gas sample analysis using TCD and BID installed on the Brevis™ GC-2050 were presented.

However, qualitative analysis by GC requires standard substances, making the identification of unknown impurities in gas samples difficult. Furthermore, in inorganic gas analysis, complete chromatographic separation of peaks can be challenging, and when GC fails to fully separate them, both qualitative and quantitative analysis become difficult.

In contrast, gas analysis using GC-MS enables qualitative identification of unknown components without standard substances through mass spectral library searches. Quantitation in GC-MS is performed using mass chromatograms, allowing accurate measurements even when peaks overlap.

In this Application News, high-sensitivity analysis of inorganic gases and light hydrocarbon gases was performed using the compact yet high-performance GCMS-QP2050. Gas samples were introduced using the GI-30 Auto Gas Injector, enabling automated, continuous analysis and delivering higher reproducibility than manual sample injection.

■ Instrument Configuration and Analytical Conditions

A 10 ppm standard mixed gas sample in a cylinder was analyzed using the GCMS-QP2050. Gas sample injection into the GC-MS was performed with the GI-30 Auto Gas Injector (P/N: S221-89755-41). The instrument configuration is shown in Fig. 1.

The analytical conditions used are summarized in Table 1. Under typical ionization settings (ionization voltage 70 V and emission current 60 µA), ionization of the helium carrier gas generates a significant signal at *m/z* 2, making detection of H_2 (monitor ion: *m/z* 2) difficult. Therefore, for analysis in SIM mode, the ionization voltage was set to 20 V and the emission current to 20 µA to suppress He ionization.

Fig. 1 Appearance of GCMS-QP™2050 + GI-30 System

Table 1 Analysis Conditions

Model:	GCMS-QP2050 (Injection port: SPI) + GI-30 (Note: For the GCMS-QP2050 Entry, these analysis conditions are not applicable due to differences in pumping speed.)		
[GI-30]		[MS]	
Loop Volume:	1 mL	Ion Source Temp.:	200 °C
Purge Gas:	He (20 kPa)	Interface Temp.:	250 °C
[GC]		Pumping Speed:	255 L/s
Inj. Temp.:	150 °C	Acquisition Mode:	SIM
Carrier Gas:	He	Event Time:	0.3 s
Inj. Mode:	Split 4	Ionization Voltage:	20 V
Flow Mode:	Column Flow (7.0 mL/min)	Emission Current:	20 µA
Purge Gas:	3.0 mL/min	Monitoring *m/z*:	Refer to Fig. 2
Column:	MICROPACKED-ST (2.0 m × 1.0 mm I.D.) (Input as 250 m × 0.50 mm I.D., df = 15 µm for flowrate calc.)		
Oven Temp.:	35 °C (2.50 min) – 20 °C/min – 250 °C – 15 °C/min – 270 °C (5.42 min)		

■ Analysis in SIM Mode

A 10 ppm standard mixed gas was analyzed in SIM mode. The resulting SIM chromatograms are shown in Fig. 2, along with the monitored ions (*m/z*).

By setting the ionization voltage to 20 V and the emission current to 20 µA in SIM mode, ionization of the helium carrier gas was suppressed, enabling high-sensitivity detection of H_2. While the TIC chromatogram obtained in Scan mode showed overlapping peaks for O_2 and N_2, acquiring mass chromatograms in SIM mode allowed these peaks to be separated.

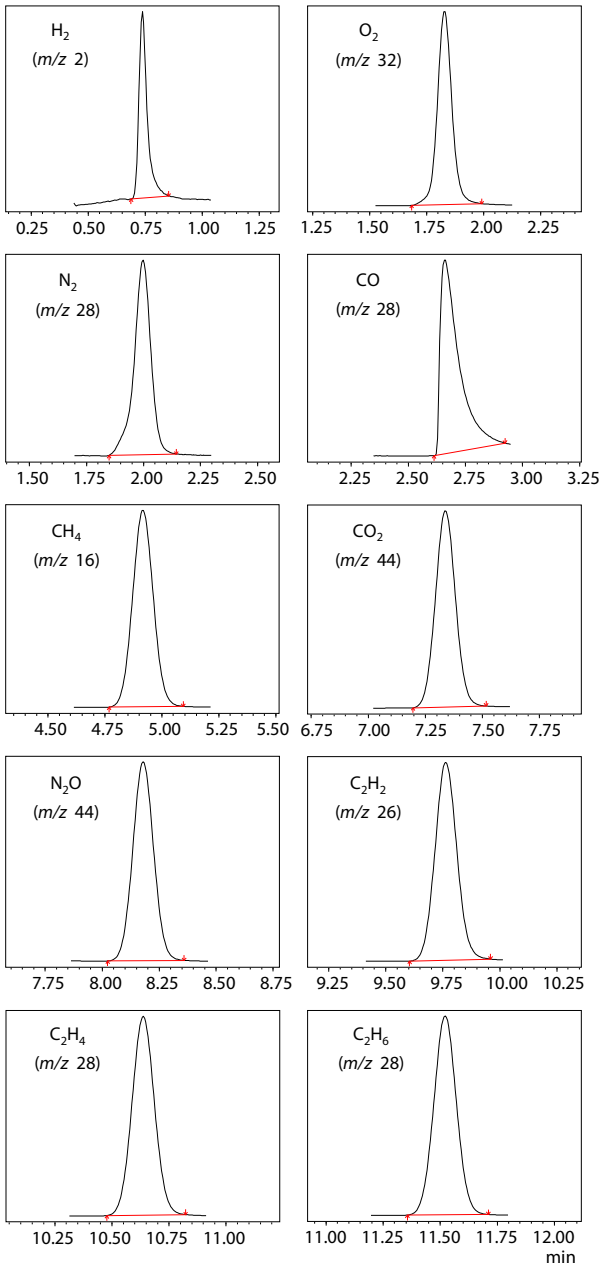

Fig. 2 SIM Chromatograms of a 10 ppm Standard Gas Mixture

■ Automated Continuous Analysis Using the GI-30

The GI-30 Auto Gas Injector is a sample pretreatment device that automatically introduces a fixed volume of gas into the GC. It is used by connecting either a gas cylinder or a sample bag. When the GI-30 is connected to a gas cylinder, automated, continuous analysis of gas samples becomes possible.

The GI-30 is equipped with an optional valve purge mechanism. Purging the internal valve with gas reduces the ingress of ambient air. This is effective for analyzing components in ambient air, such as N_2 and O_2, as well as for measuring trace-level components.

Table 2 shows the peak-area repeatability (%RSD) obtained when a 10 ppm standard mixed gas was analyzed automatically and continuously in SIM mode. As an example, an overlay of the CH_4 SIM chromatograms is shown in Fig. 3. Because the GI-30 meters a fixed volume of gas into the GC via a sample loop, excellent reproducibility was achieved for all compounds.

Table 2 Area Value Reproducibility for Each Component with n = 10

	Area Value Reproducibility (%RSD)
H_2	5.85
O_2	1.56
N_2	2.68
CO	2.71
CH_4	0.574
CO_2	0.725
N_2O	0.708
C_2H_2	1.27
C_2H_4	1.11
C_2H_6	1.05

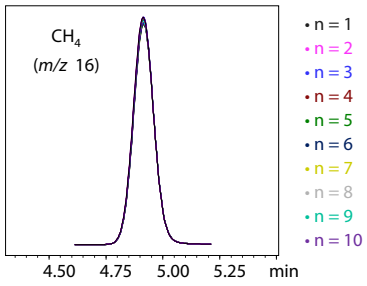

Fig. 3 Overlaid SIM Chromatograms of CH_4 (n = 10)

■ Conclusion

Using the GCMS-QP2050, high-sensitivity analysis of inorganic gases, such as H_2, and light hydrocarbons was achieved. Gas sample injection was performed with the GI-30 Auto Gas Injector, enabling automated, continuous analysis and delivering higher reproducibility compared with manual sample injection.

The compact, high-performance GCMS-QP2050, together with the GI-30, enables automation and high-precision gas analysis, and supports greater efficiency in GC-MS-based gas analysis.

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