

Application Data Sheet

No. /

GC

Gas Chromatograph Simultaneous Analysis of Evolved Gas Produced by the Degradation of a Lithium-Ion Battery

LAAN-J-GC-E007

In evaluating the degradation of lithium-ion rechargeable batteries, it is necessary to analyze the gases produced inside the battery. The composition of the sampled internal gases can be investigated by conveying them to a gas chromatograph. The Shimadzu Tracera High-Sensitivity Gas Chromatograph uses a revolutionary plasma technology to detect all compounds except He and Ne. The system is capable of the simultaneous analysis of C1 to C3 hydrocarbons and inorganic gases including hydrogen, so it eliminates the conventional need for carrier gas switching or combined use of multiple systems. In addition, the Tracera's high sensitivity makes it possible to analyze small quantity gas samples.

This Data Sheet introduces the simultaneous analysis of internal gases from a lithium-ion rechargeable battery utilizing the Tracera system.

Instruments Used	
Software	GCsolution
Gas chromatograph	Tracera (GC-2010 Plus A + BID-2010 Plus)
Analysis Conditions	
Column	Micropacked ST
Column temperature	35°C(2.5min) - 20°C/min - 250°C(0min) - 15°C/min - 270°C(5.42min) Total.20mi
Carrier gas controller	Pressure
Pressure program	250kPa(2.5min) – 15kPa/min – 400kPa(7.5min) (He)
Injection mode	Split (1:10)
Injection port temperatu	re 150°C
Detector temperature	280°C
Discharge gas volume	70mL/min
Injection volume	50µL

Analysis of Internal Gases from a Lithium-Ion Rechargeable Battery

Fig. 1 shows the chromatogram for the internal gases from a lithium-ion rechargeable battery. It is evident that the system is capable of the simultaneous analysis of C1 to C3 hydrocarbons and inorganic gases including hydrogen. The concentration ratios (%) for each component excluding oxygen and nitrogen are shown.



Linearity for each component of the standard gas was confirmed. The concentration values for each component are shown in Table 1, and the chromatograms and calibration curves for each component are shown in Fig. 2.

Component name	Concentration (%)				
Hydrogen	0.962	1.92	2.89	4.81	
Carbon monoxide	0.404	0.808	1.21	2.02	
Methane	2.08	4.16	6.24	10.4	
Carbon dioxide	0.412	0.824	1.24	2.06	
Ethylene	0.204	0.408	0.612	1.02	
Ethane	0.204	0.408	0.612	1.02	
Propylene	0.102	0.205	0.307	0.512	
Propane	0.101	0.202	0.303	0.505	

Table 1: Concentrations for Each Component















Fig. 2: Linearity for Each Component

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