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Application Data Sheet

No. 123

GC–MS
Gas Chromatograph Mass Spectrometer

Py-GC/MS Analysis of Electronic Circuit Board Parts Using Nitrogen Carrier Gas

Helium, which is used as a carrier gas for GC-MS, has in recent years been subject to dramatic price increases and delivery delays. This can, in some cases, make it difficult to obtain Helium. Equipped with a newly developed turbomolecular pump, the GCMS-QP2020 can be operated using replacement carrier gases, such as hydrogen and nitrogen. The measurement range guidelines for each carrier gas is shown in Fig. 1. Although nitrogen provides less sensitivity than helium, its price is ten times lower and it is easily available.

This application data sheet introduces an analysis of the instantaneous pyrolysis of an electronic circuit board using Py-GC/MS, while comparing the usage of nitrogen versus helium as the carrier gas.

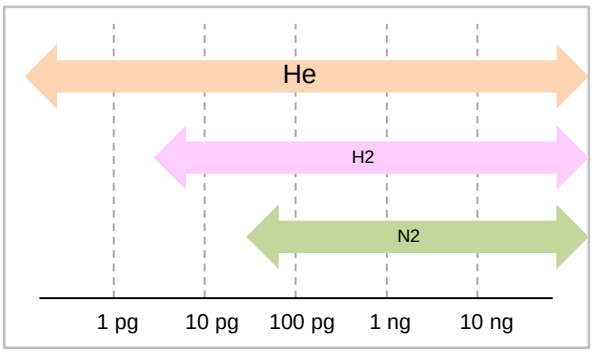

Fig. 1: Measurement Range Guidelines for Each Carrier Gas* (On-Column Amount)

* These measurement ranges are at best only guidelines, and may be unsuitable depending on the target compound's sensitivities and characteristics.

Conversion of Analysis Methods

In changing the carrier gas from helium to nitrogen, the length of the column was changed from 30 m to 20 m and the inner diameter was changed from 0.25 mm to 0.18 mm. The analysis conditions were converted using the web-based "EZGC™ Method Translator*1" provided by Restek Corporation (http://www.restek.com/ezgc-mtfc). For more information regarding the "EZGC™ Method Translator," refer to Application Data Sheet No. 120. The analysis conditions for analyses using helium and nitrogen as the carrier gas are shown in Table 1.

Table 1: Analytical Conditions

Pyrolyzer	: Multi-Shot Pyrolyzer EDA/PY-3030D
GC-MS	: GCMS-QP2020
Glass insert	: Deactivated split glass insert with wool (P/N: 225-20803-01)
[PY]	
Analysis mode	: Single shot
Furnace temp.	: 600 ˚C (1 min)
Interface temp.	: 300 ˚C

- Helium carrier gas -

Purity	: 99.99 %
Gas purification filter	: Click-ON triple trap (Helium Specific) SGT P/N: SGT-CO1051
[GC]	
Column	: SH-Rxi™-5Sil MS (length 30 m, 0.25 mm I.D., df=0.25 μm)
Injection temp.	: 300 ˚C
Column oven temp.	: 40 ˚C (2 min)→(15 ˚C/min)→320 ˚C (10 min)
Injection mode	: Split
Split ratio	: 50
Flow control mode	: Linear velocity (39.5 cm/sec)
Initial column flow	: 1.2 mL/min
[MS]	
Ionization mode	: EI
Interface temp.	: 300 ˚C
Ion source temp.	: 230 ˚C
Acquisition mode	: Scan
Scan event time	: 0.3 sec
Scan range	: *m/z* 60 to 600

- Nitrogen Carrier Gas -

Purity	: 99.99 %
Gas purification filter	: Click-ON triple trap SGT P/N: SGT-CO1005
[GC]	
Column	: SH-Rxi™-5Sil MS (length 20 m, 0.18 mm I.D., df=0.18 μm)
Injection temp.	: 300 ˚C
Column oven temp.	: 40 ˚C (2 min)→(14.8 ˚C/min)→320 ˚C (10.15 min)
Injection mode	: Split
Split ratio	: 50
Flow control mode	: Linear velocity (26.2 cm/sec)
Initial column temp.	: 0.32 mL/min
[MS]	
Ionization mode	: EI
Interface temp.	: 300 ˚C
Ion source temp.	: 230 ˚C
Acquisition mode	: Scan
Scan event time	: 0.3 sec
Scan range	: *m/z* 60 to 600

*1: EZGC™ Method Translator is a trademark of Restek Corporation.

Analysis Results

The total ion current chromatograms (TICC) measured for the instantaneous pyrolysis of electronic circuit boards using helium and nitrogen as the carrier gases are shown in Fig. 2. By using the EZGC™ Method Translator, a nearly identical chromatogram pattern could be obtained. Table 2 shows the results of a library search of typical detected peaks using the NIST 14 mass spectral library, and Fig. 3 shows the mass spectrum for the Bisphenol A detected. Even when nitrogen is used as the carrier gas, the mass spectrum is virtually the same as that when helium is used as the carrier gas. This means that existing mass spectral libraries can be used as is. For qualitative applications or quantitative analysis at a μg/mL (ppm) level, it is possible that a transition to nitrogen carrier gas can be made.

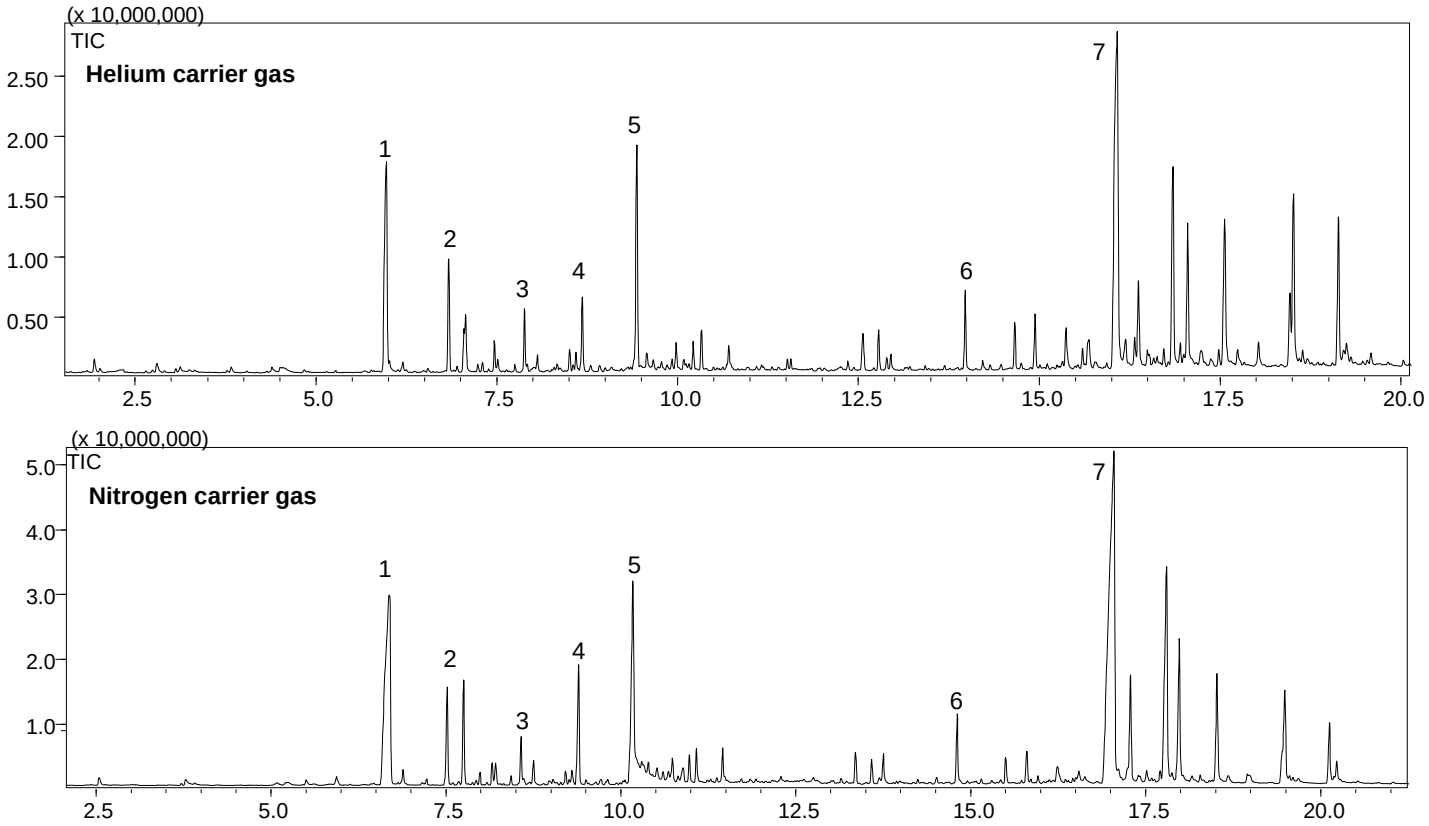

Fig. 2: Total Ion Current Chromatogram (TICC) Measured for the Instantaneous Pyrolysis of Electronic Circuit Board
Top: Helium Carrier Gas, Bottom: Nitrogen Carrier Gas

Table 2: Results of Library Search for Typical Compounds Detected

No.	Identified Compound	Similarity (SI)	
		He Carrier Gas	N2 Carrier Gas
1	Phenol	99	98
2	Methylphenol	98	98
3	Xylenol	97	98
4	Isopropylphenol	96	97
5	Isopropenylphenol	94	92
6	Cumylphenol	94	93
7	Bisphenol A	95	98

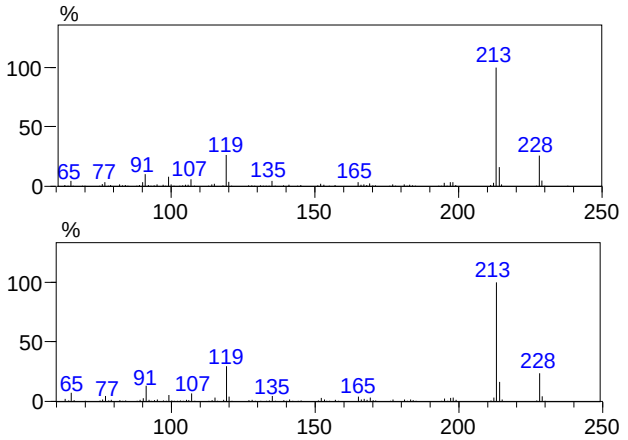

Fig. 3: Mass Spectrum for Bisphenol A Detected
Top: Helium Carrier Gas, Bottom: Nitrogen Carrier Gas

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