

# Application Data Sheet

## No. 11

**GC**  
Gas Chromatograph

## Trace Analysis of Carbon Dioxide in High-Purity Hydrofluorocarbon

Fluorocarbon, a generic term for organic compounds with C-F bonding, is a chemical material used as a refrigerant in refrigerators and freezers, and in air conditioners in cars, buses, other vehicles, and buildings. It is also used as a cleaning agent for electronic components and precision parts. Hydrofluorocarbon (HFC) is classified as a non-ozone-depleting chlorofluorocarbons(CFC) substitute and is used as a gas for semiconductor etching and electronic component cleaning. High-purity HFC is utilized in the semiconductor and electronics industries; confirming its purity requires measuring the concentration of impurities. This data sheet introduces an example of analyzing trace quantities of CO<sub>2</sub> impurities in high-purity HFC using the Shimadzu "Tracera" High-Sensitivity Gas Chromatograph System.

### Instruments Used and Analysis Conditions

#### Instruments Used

Gas chromatograph: Tracera (GC-2010 Plus + BID-2010 Plus)  
Gas sampler: MGS-2010  
Software: LabSolutions

#### Analysis Conditions

Column: PoraPLOT Q (0.32 mm I.D. × 25 m, df = 10 μm)  
Column temp.: \*30 °C (5 min) - 40 °C/min - 100 °C (8.25 min), 15 min in total  
Carrier gas: He: 40 cm/sec, constant linear velocity mode  
Injection mode: Split (1:10)  
Injection port temp.: 150 °C  
Detector temp.: 200 °C  
Discharge gas: He: 50 mL/min  
Injection volume: 1 mL (gas sampler used)

\* The initial column temperature (30 °C) can be set at a room temperature of 25 °C or lower.

Note: It is not possible to separate air components (N<sub>2</sub>, O<sub>2</sub>, Ar) or CO under these analysis conditions.

### Results

Multiple high-purity HFCs were analyzed. Fig.1 shows the resulting chromatograms, and Table 1 shows the quantitative results for CO<sub>2</sub>. The CO<sub>2</sub> concentration in sample #3 was a very low, which was only 0.3 ppm. The S/N ratio was approximately 43. Conventional analysis of trace levels of CO<sub>2</sub> requires using an FID and a methanizer. This example demonstrates how a simply configured Tracera system can analyze trace amounts of CO<sub>2</sub> with high sensitivity.

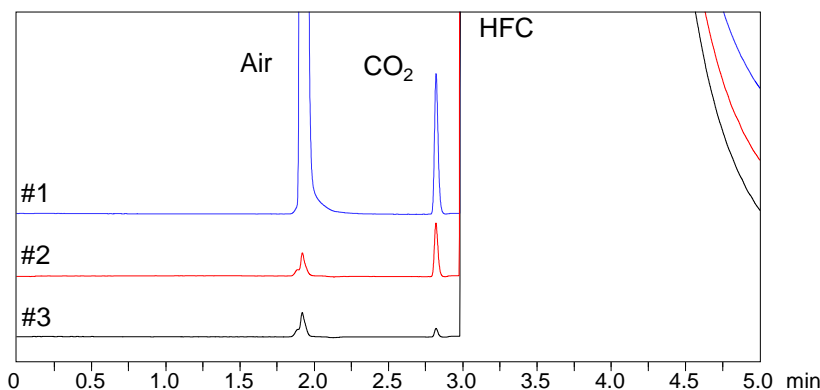


Fig. 1: Chromatograms for High-Purity HFCs

Table 1: CO<sub>2</sub> Quantitative Results

Sample	Quantitative Conc. (ppm)	S/N
#1	5.09	1043.5
#2	1.93	250.7
#3	0.31	43.14

First Edition: August 2013