Trace Analysis of Rare Gases in Air with smartGC-infiTOF

Keywords：gas analysis, trace impurity analysis, noble gases

Overview

- Using our GC-MS "smartGC-infiTOF," we measured trace amounts of rare gases in the air.
- Ne, Kr, and Xe were all measured with good S/N and isotopic ratio profiles.
- Data shows our "smartGC-infiTOF" could be useful for measuring trace impurities in gaseous samples.

Introduction

In general, GC and GC-MS are used for trace impurity analysis of gaseous samples. However, using standard GC to measure trace levels of Ne impurities in gaseous samples is difficult. In this application note, we report on the use of our smartGC-infiTOF for measuring trace amounts of Ne (18.18 ppm), Kr (1.14 ppm), and Xe (0.087 ppm) in the air.

(Reference: "By volume, dry air contains 78.09% nitrogen, 20.95% oxygen, 0.93% argon, 0.04% carbon dioxide, and small amounts of other gases." Excerpt from Wikipedia)

Experimental

We installed a packed column into our smartGC and connected to our infiTOF inlet. One mL samples were introduced into and separated using the packed column and then introduced into the infiTOF ion source The air sample was measured in both low-resolution (1 lap) and high-resolution (20 laps) modes. (Details are listed in Table 1.)

Table. 1 Measurement conditions for trace gas analysis.

Method Parameters	
Instrument	smartGC（MS-SG-02） infiTOF（MS-UHV-Pro）
Column	1/8inch -SUS tube “ShincarbonST” packing Size: 1.6 mm i.d. X 1.5 m
Column Temp.	150 °C
Carrier Gas	He
Flow Rate	20 cc/min
Ionization Energy	23 eV
infiTOF # of Laps	Ne, Kr, Xe: 1 lap, Ne: 20 laps

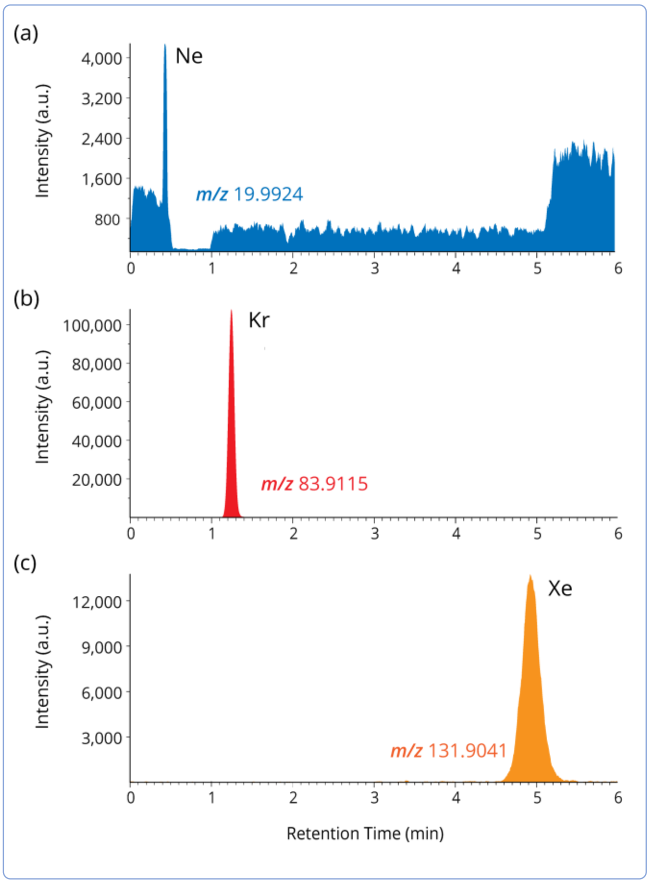

Fig. 1 Low-resolution mass chromatograms for (a) Ne, (b) Kr, and (c) Xe

Results and Discussion

・High Resolution

Low-resolutions mass chromatograms for Ne, Kr, and Xe are shown in Figure 1. The approximate retention times were 0.5 min for Ne, 1.0 min for Kr, and 5.0 min for Xe. The baseline was stable for Kr and Xe and S/N was sufficient for qualitative analysis, but Ne had neither a stable baseline nor sufficient S/N. It was thought that HF and $H_2{}^{18}O$ peaks were overlapping with Ne at nominal *m/z* 20.

After measuring in high-resolution mode, it was observed that HF and $H_2{}^{18}O$ were indeed close to Ne around m/z 20, as shown in Fig. 2(a), and that they are likely overlapping in low-resolution mode (Fig.1(a)). A mass chromatogram of Ne was generated using the high-resolution data, which showed increased S/N and baseline stability compared to low-resolution measurements.

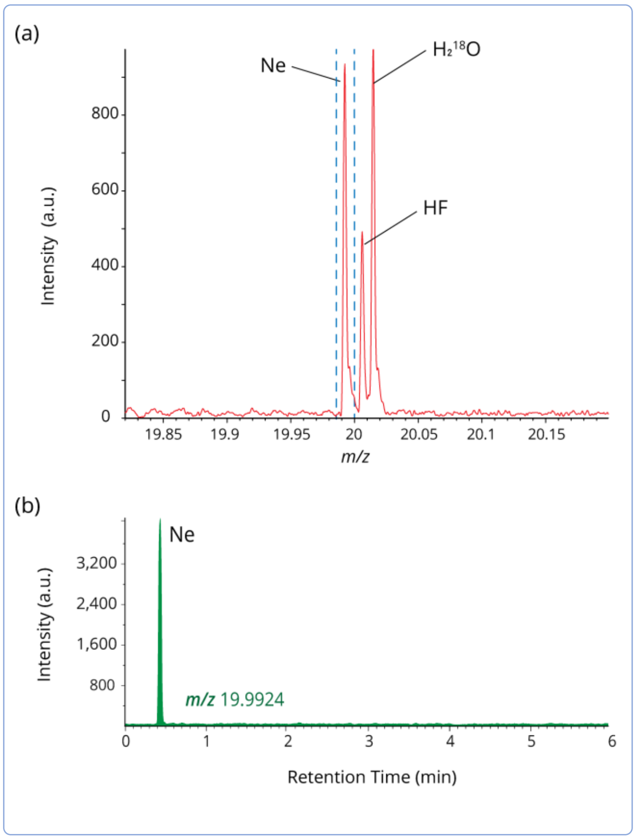

Fig. 2 (a) High-resolution mass spectrum around m/z 20
(b) Mass chromatogram of Ne using high-resolution data

With high-resolution measurements, the infiTOF is an effective device for measuring trace gas impurities by excluding interfering peaks.

• Isotope Ratio Measurement

Krypton and Xenon have well-known isotopic ratio profiles, so we measured and compared them to their natural abundances.

Obtained mass spectra for Kr and Xe are shown in Figures 3(a) and 3(b), respectively, and Figures 3(c) and 3(d) show the natural abundance ratios. Each measured isotope ratio matches its natural abundance ratio well.

Conclusion

We analyzed trace amounts noble gasses in the air using our smartGC+infiTOF system. With this system, Kr and Xe were observed with sufficient analytical S/N. Neon was observed with sufficient S/N after separating interfering peaks with high-resolution mode. Additionally, an excellent agreement was observed between the measured isotopic ratios and the natural abundances of Kr and Xe.

These results indicate that the low- and high-resolution modes of smartGC+infiTOF can be useful for measuring trace impurities in gaseous samples.

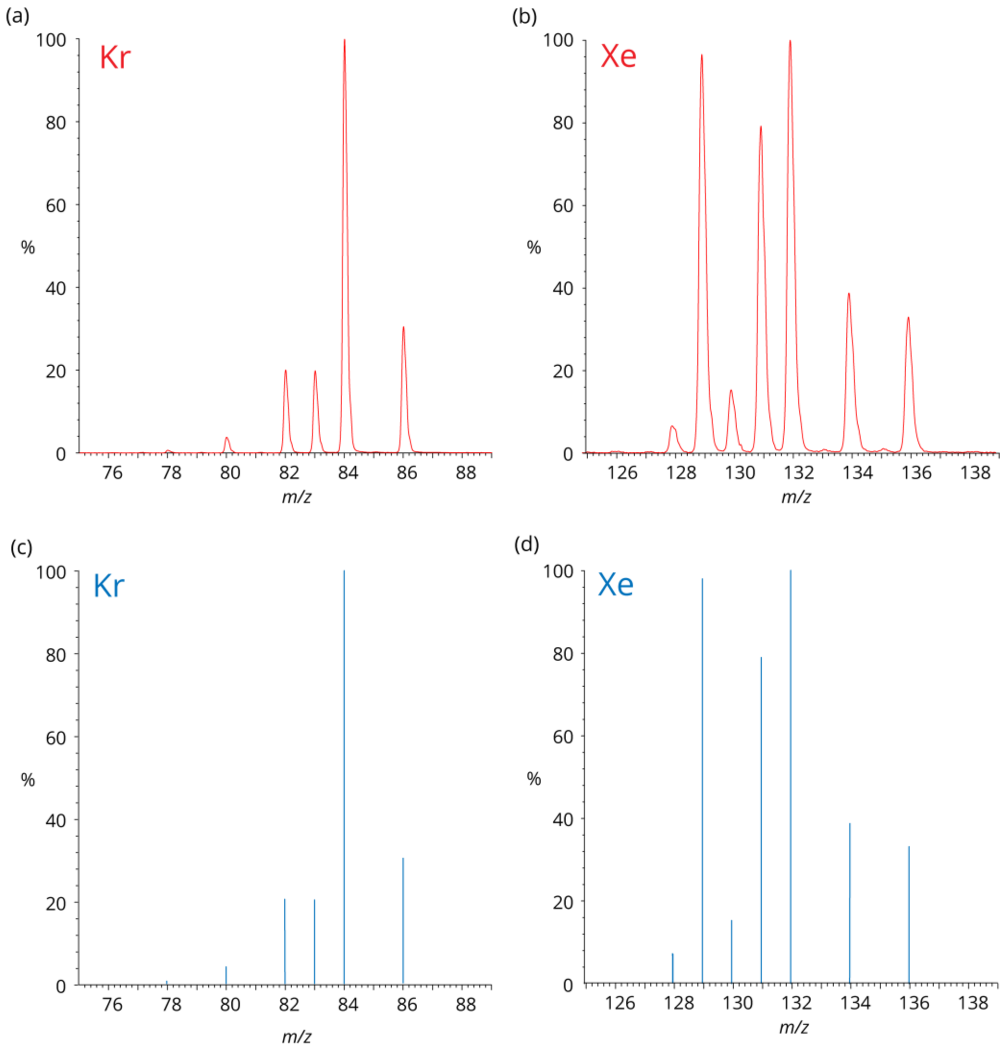

Fig.3 Measured mass spectra for Kr (a) and Xe (b), and natural abundance ratios for Kr (c)and Xe (d)

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