Polychlorinated Biphenyls (PCB’s) Analysis using Miniaturized High-resolution Time-of-Flight Mass Spectrometer “MULTUM-S II”

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Overview

Block diagram of timing control

Introduction

In our laboratory, a miniature multi-turn TOFMS was constructed and named “MULTUM-S II (INFITOF)”. This instrument basically consists of four electric sectors and two additional electric sectors for the purpose of ion injection/acceleration. Accelerated ions traverse the figure of eight flight orbit many times. As a result of infinite flight length, higher mass resolution is available in the miniaturized MS. The size and weight of the system is 234 mm x 456 mm x 640 mm and 36 kg (including vacuum pump and electric circuits).

High-resolution selected ion monitoring (HRSIM) provides sensitivity and selective detection for compounds of environmental interest such as PCB’s. The analysis as traditionally carried out by using magnetic sector mass spectrometers is highly effective. However, setup and method development can be complicated, requiring careful programming of SIM target masses, lock masses, and retention time groups. Magnetic sector mass spectrometers with a resolving power of 10,000 or greater tend to be large and expensive.

TOFMS is an attractive alternative because there is little or no tradeoff between high resolution and high sensitivity. However, previously commercially available GC/TOFMS systems are not offered with a resolving power of 10,000 or greater. The MULTUM-S II is well suited for PCB analysis. The system is compact, portable, and capable of achieving a resolving power of >30,000 [1]. By acquiring high-resolution mass spectra in segments, method development is made easier.

Experimental section

Fig. 2 Photograph of GC-MULTUM system.

Results and Discussion

Performance evaluation

Fig. 4 (A) Variation of peak intensity by changing ionization voltage. (B) Signal response curve from 0.01 ppm and 1 ppm. Comparison of mass spectra of PCB-180-TP. (C) Zycles (low mass resolution < 400) and (D) 20 cycles (high mass resolution ~11,000). (E) TIC and mass chromatogram of m/z 293.8 ± 1 ppb.

Conclusion

1. MULTUM-S II can provide HSIMS data. 2. In 20 cycles, mass resolution was 10,000 and LOD was 1 ppb. 3. High-resolution mass spectra were beneficial for mixture analysis with brief preparation.

Reference