ICP-MSを用いた気体試料の直接分析

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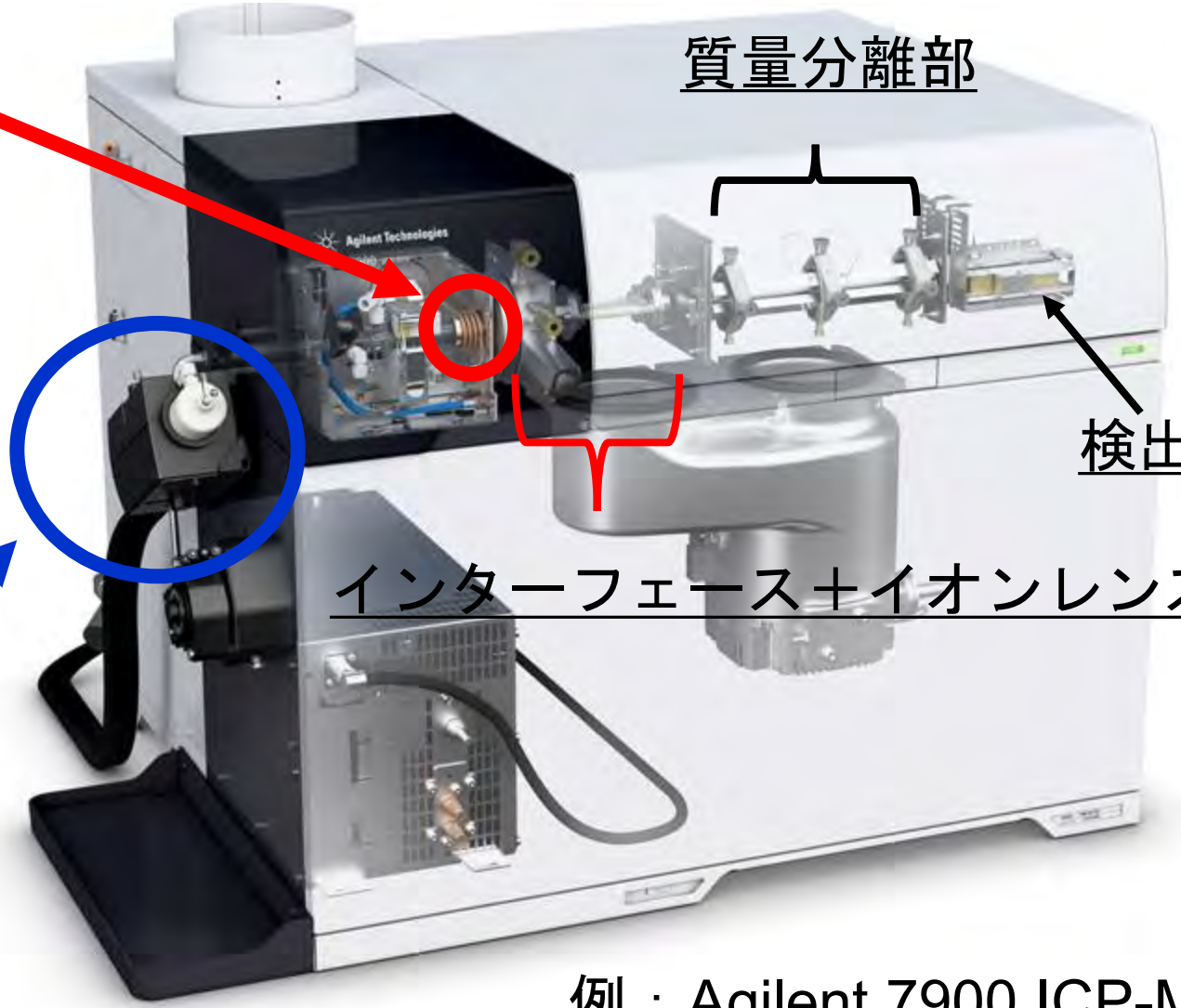
ICP-MS：誘導結合プラズマ質量分析法

ICP-MS

- 高感度元素分析法
- 溶液試料測定が主流



例：Agilent 7900 ICP-MS

Direct multi-element analysis of SPM by GED-ICPMS

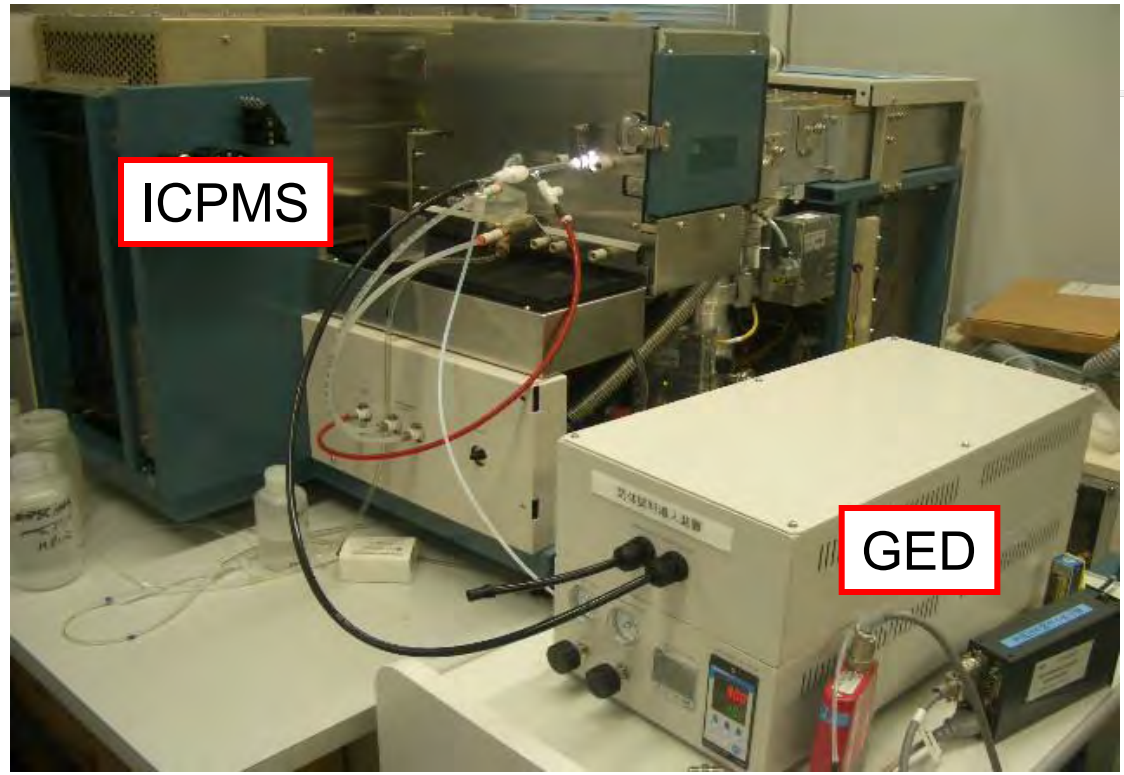
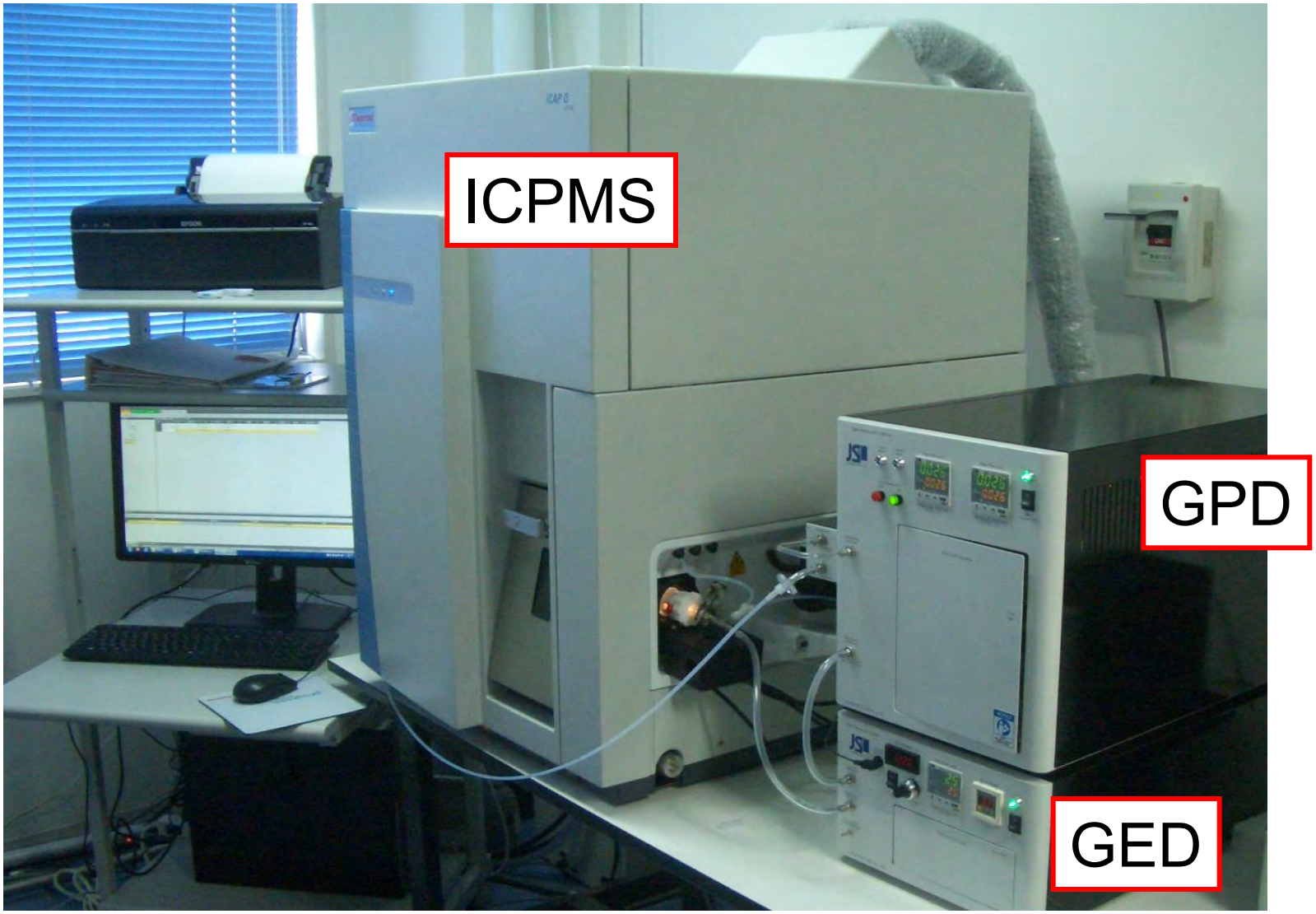


Photo of GPD-GED-ICPMS



気体試料の直接多元素分析

対象試料：

◎気体（希ガス、常温で気体状で存在する元素）

◎粒子（浮遊粒子状物質：SPM）

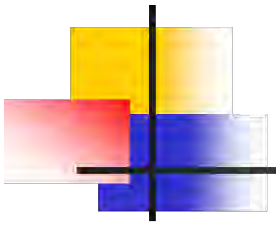
本分析手法の応用分野：

◎環境調査：大気環境モニタリング、局所環境（沿道など）調査、
作業環境（室内など）調査など

◎燃焼煙調査：自動車排ガス、たばこ煙（主流煙、副流煙など）、
排ガス（製造業、廃棄物処理施設など）、など

◎ガスおよびガスボンベ中の粒子分析（製品管理）、など

ICPMSを用いた気体試料の直接多元素分析



① ガス交換・ICPMS法

→ 空気中の浮遊粒子状物質の元素分析

② 微粒子化・ガス交換・ICPMS法

→ 空気中の反応性ガスの分析

GED-ICPMS

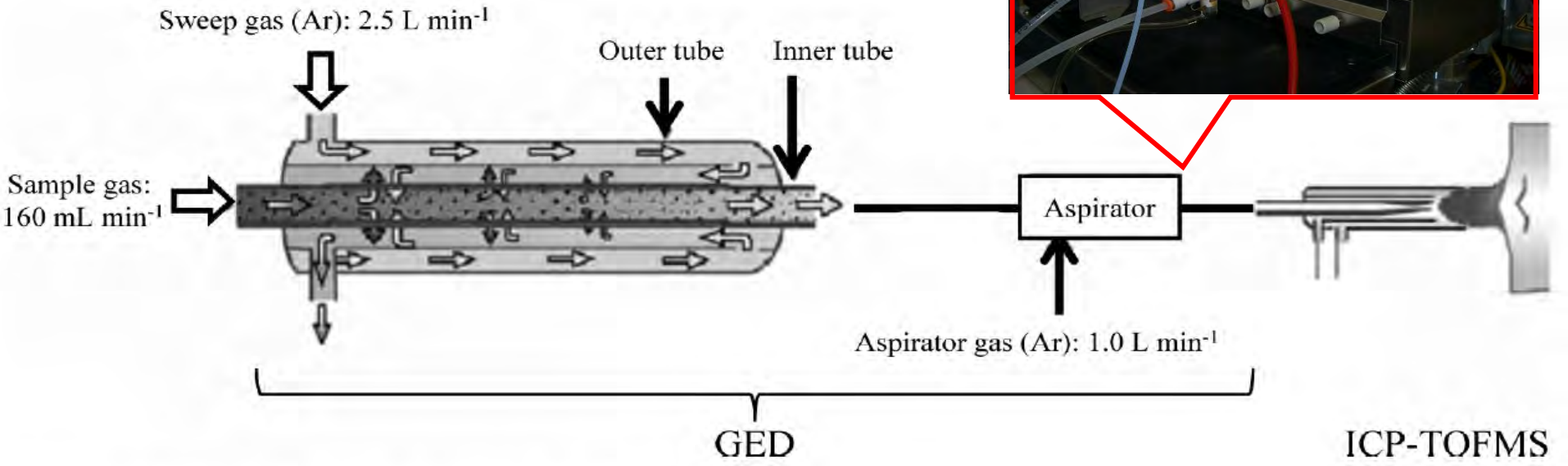


Fig. 1 Schmatic diagram of GED-ICP-TOFMS

Specifications on glass film tube (inner tube) in GED are as followings: Name, Shirasu porous glass; Material, Porous silicate film; Pore size, 100 nm; Film porosity, 65 %; Thickness, 0.7－0.8 mm; Length, 700 mm (350 mm × 2); Outer diameter, 10 mm.

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Evolution on GED-ICPMS

住友化学　2008-I, 41-49

プラズマイオン源質量分析装置を用いる気体試料直接分析法の開発

住友精化(株)　技術室
西口講平
宇谷啓介

Development of Direct Analytical Method for Gaseous Samples by Plasma Source Mass Spectrometer

Sumitomo Seika Chemicals Co., Ltd.
Technical Office
Kohei NISHIGUCHI
Keisuke UTANI

TECHNICAL NOTE www.rsc.org/jaas | Journal of Analytical Atomic Spectrometry

Real-time multielement monitoring of airborne particulate matter using ICP-MS instrument equipped with gas converter apparatus†‡

Kohei Nishiguchi,[a] Keisuke Utani[a] and Eiji Fujimori*[b]

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DOI: 10.1039/b802302f

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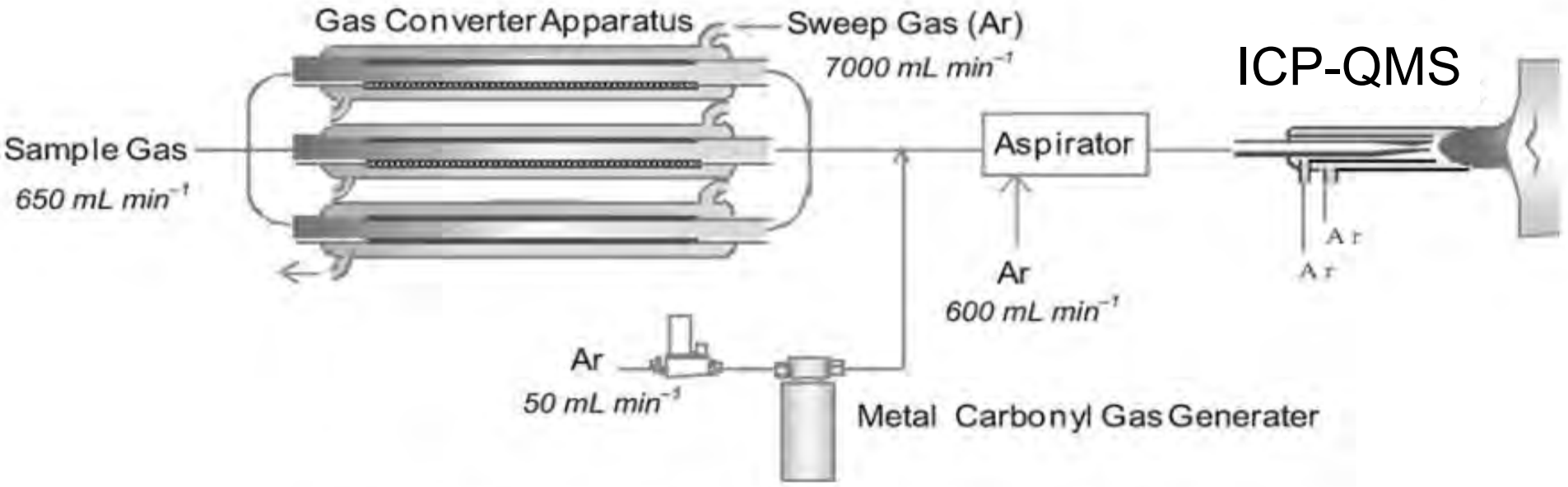

Fig. 2 Schematic diagram of gas converter/ICP-MS.

住友化学　2008-I, 41-49

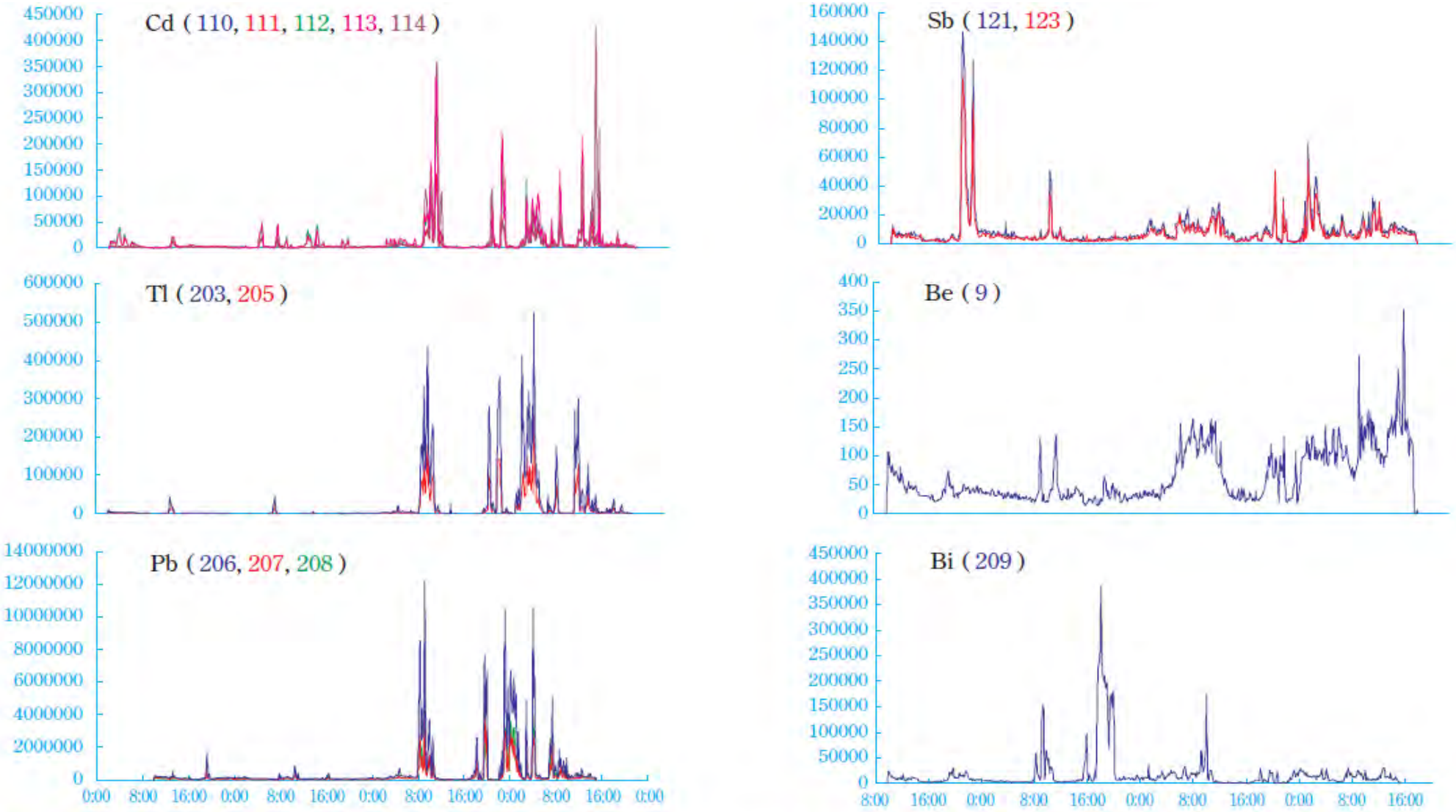

Fig. 15 Continuous Multielement Monitoring of Enviromental for 80 Hours

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年間特集「空」：報　　文

ガス交換/ICP-TOFMS によるたばこ煙の直接・多元素同時分析

大畑　昌輝®[1]，西口　講平[2]，宇谷　啓介[2]

<Title in English>
Direct Simultaneous Multi-element Analysis in Tobacco Smoke by ICP-TOFMS after Gas Exchange

GED-ICP-TOFMS

https://www.jstage.jst.go.jp/article/bunsekikagaku/62/9/62_785/_pdf

ICP-TOFMS Spectrum Obtained by GED-ICP-TOFMS

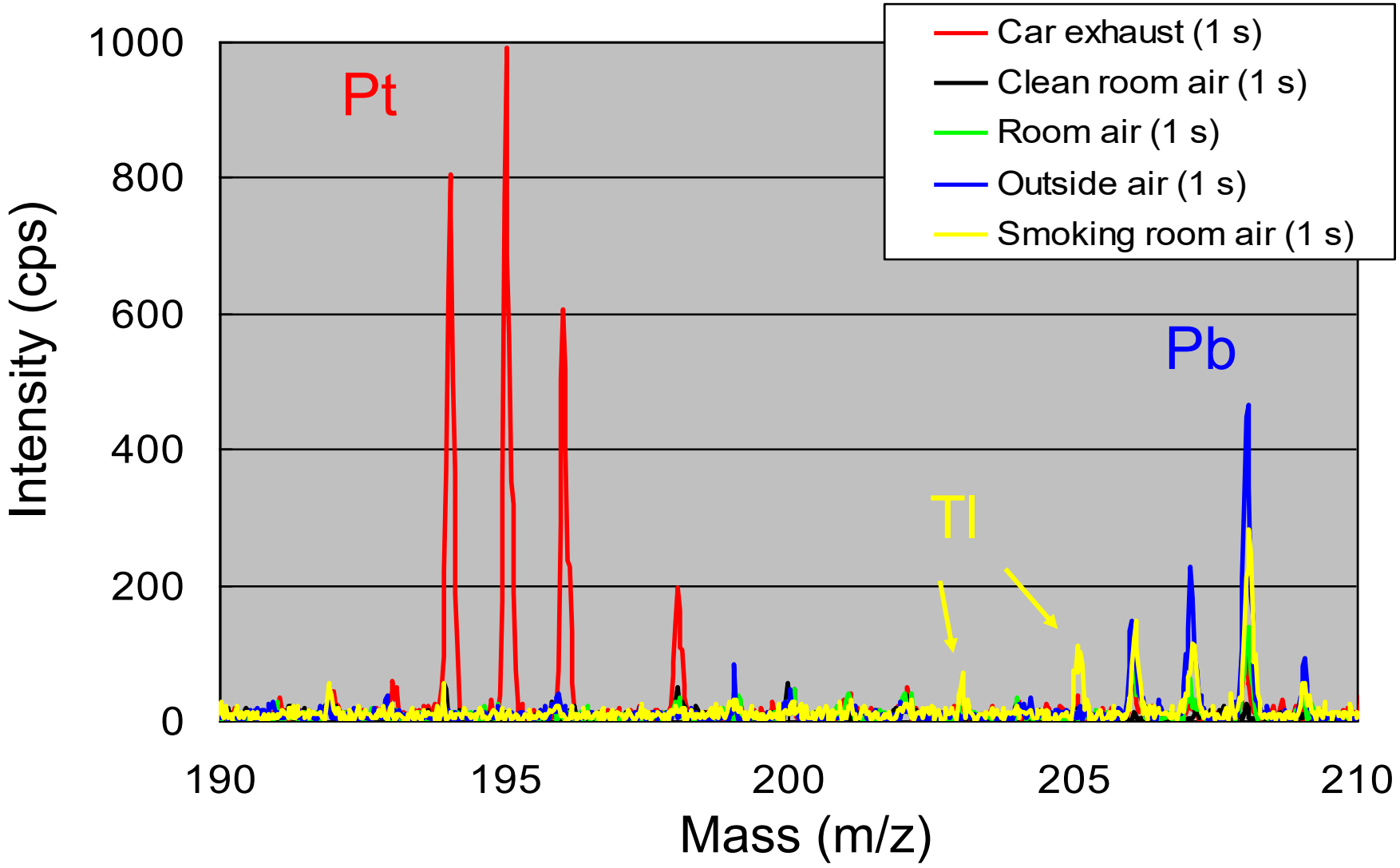
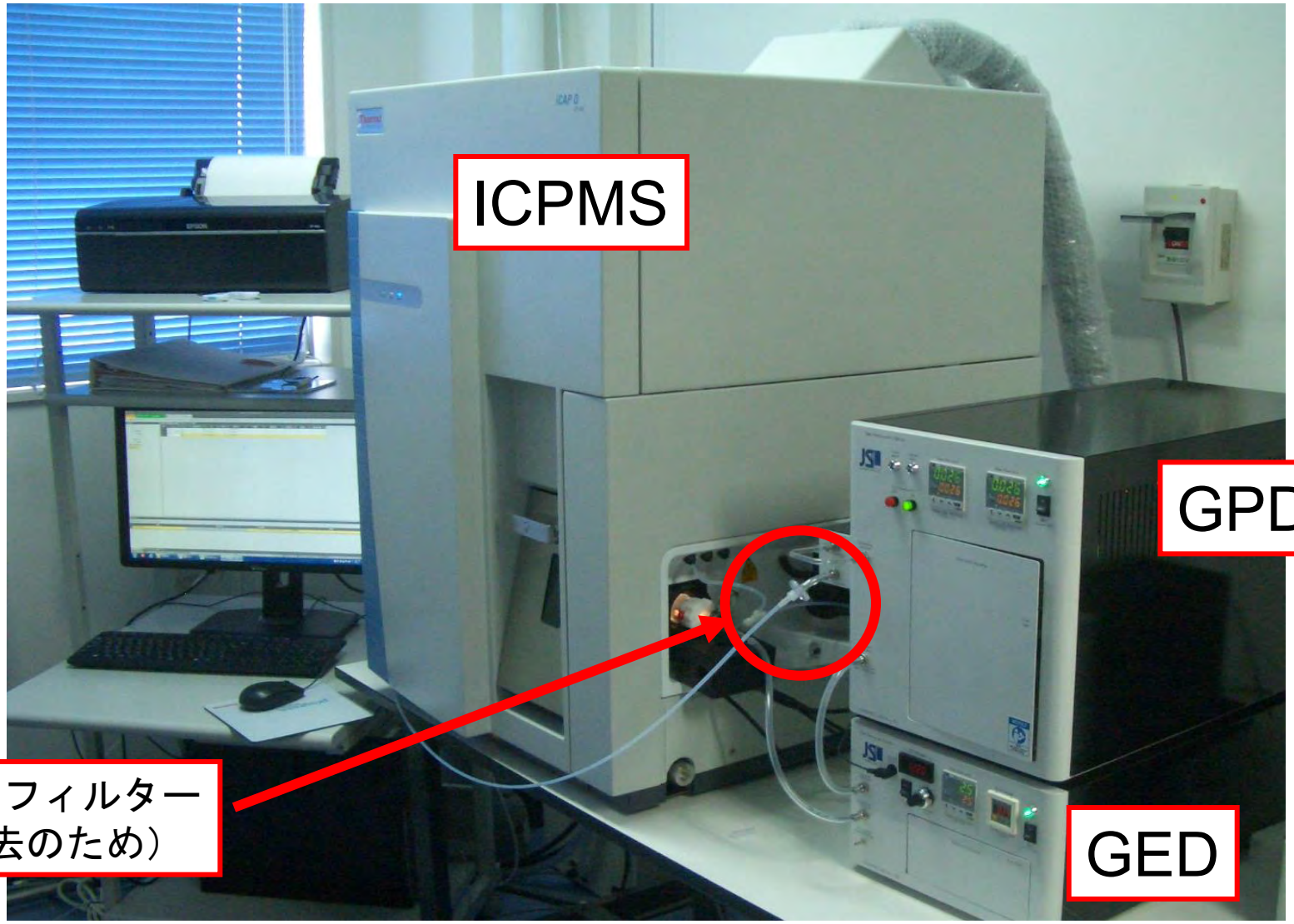
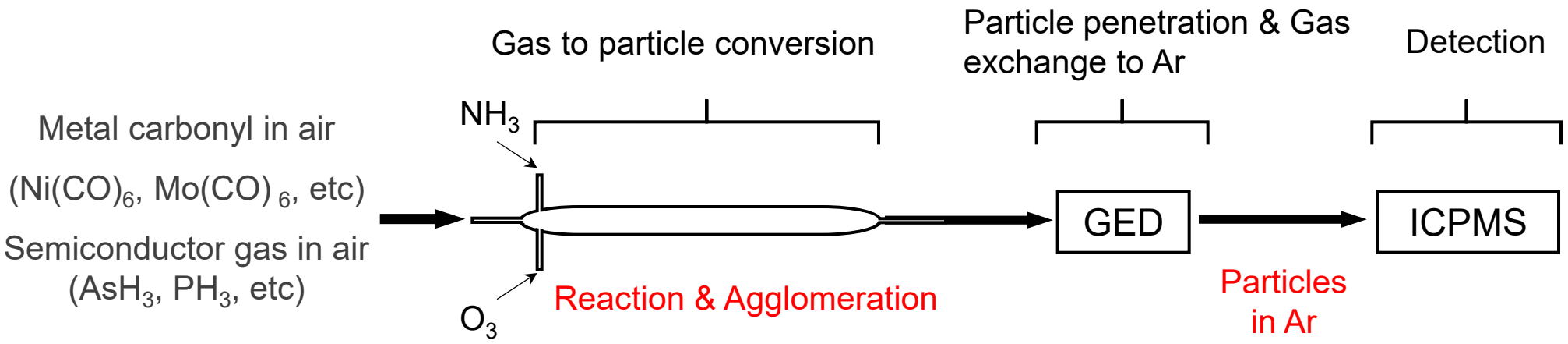
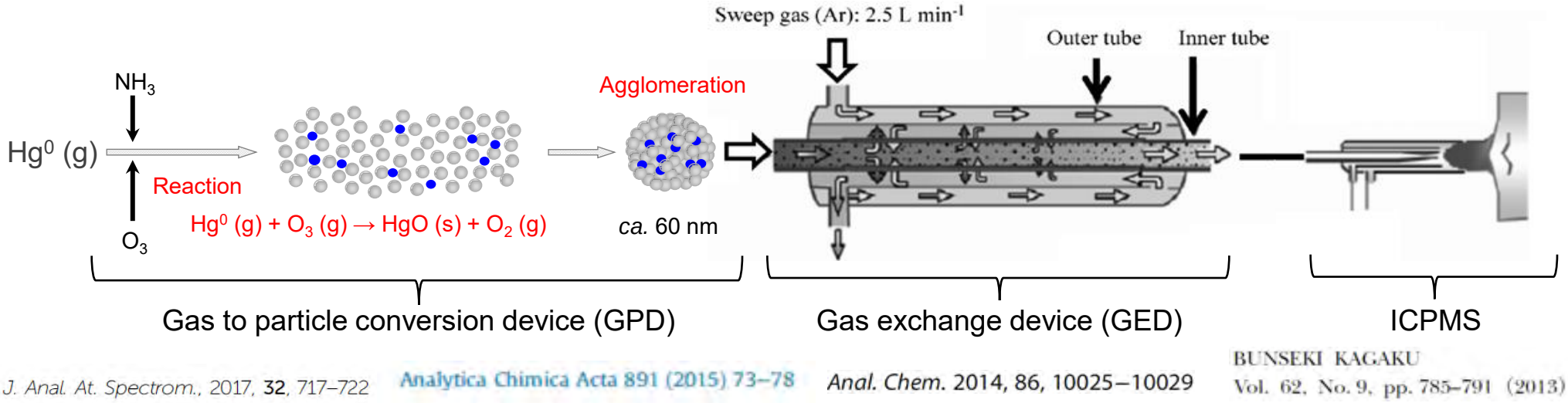


Photo of GPD-GED-ICPMS



GPD-GED-ICPMS





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Anal. Chem. 2014, 86, 10025−10029

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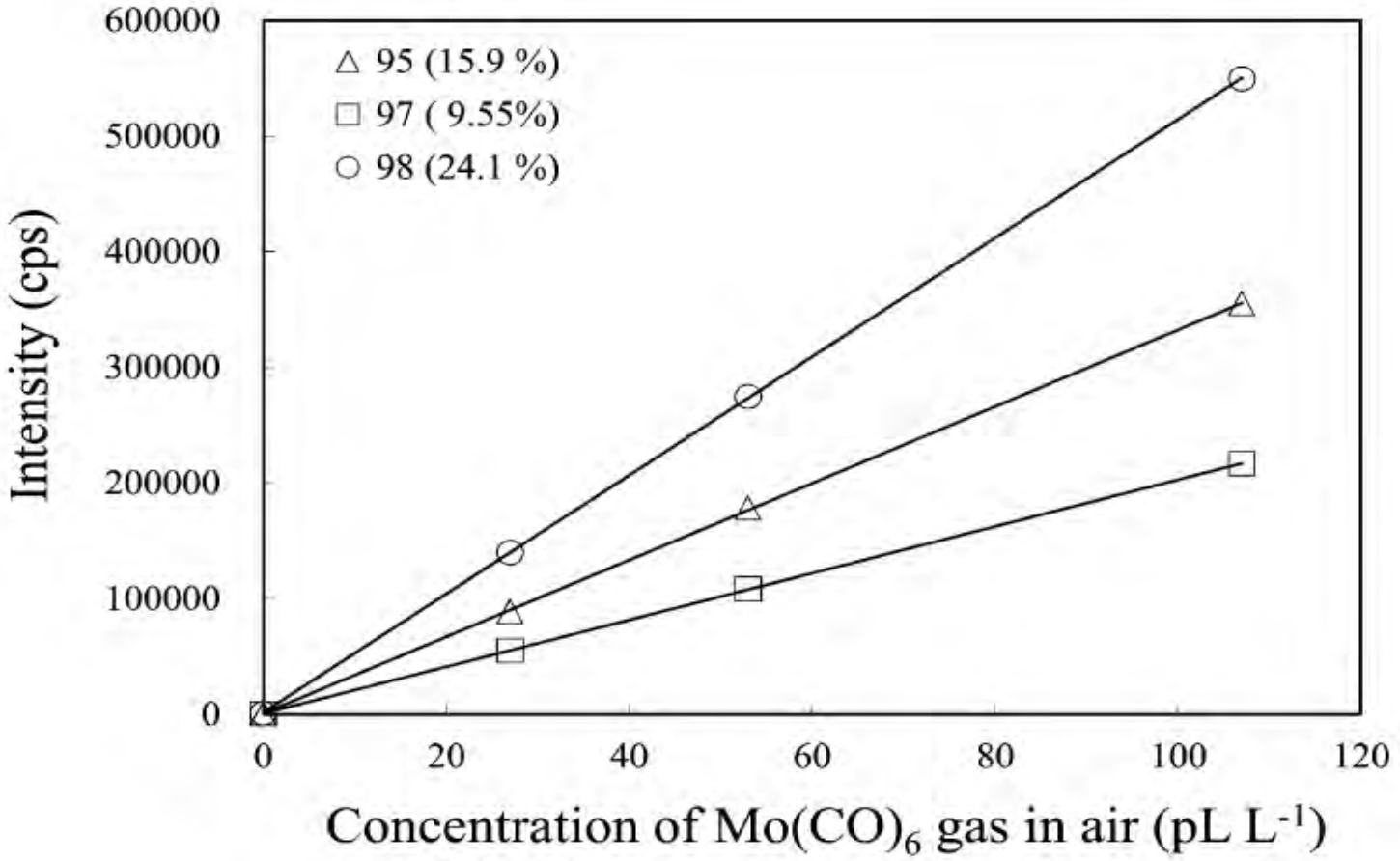
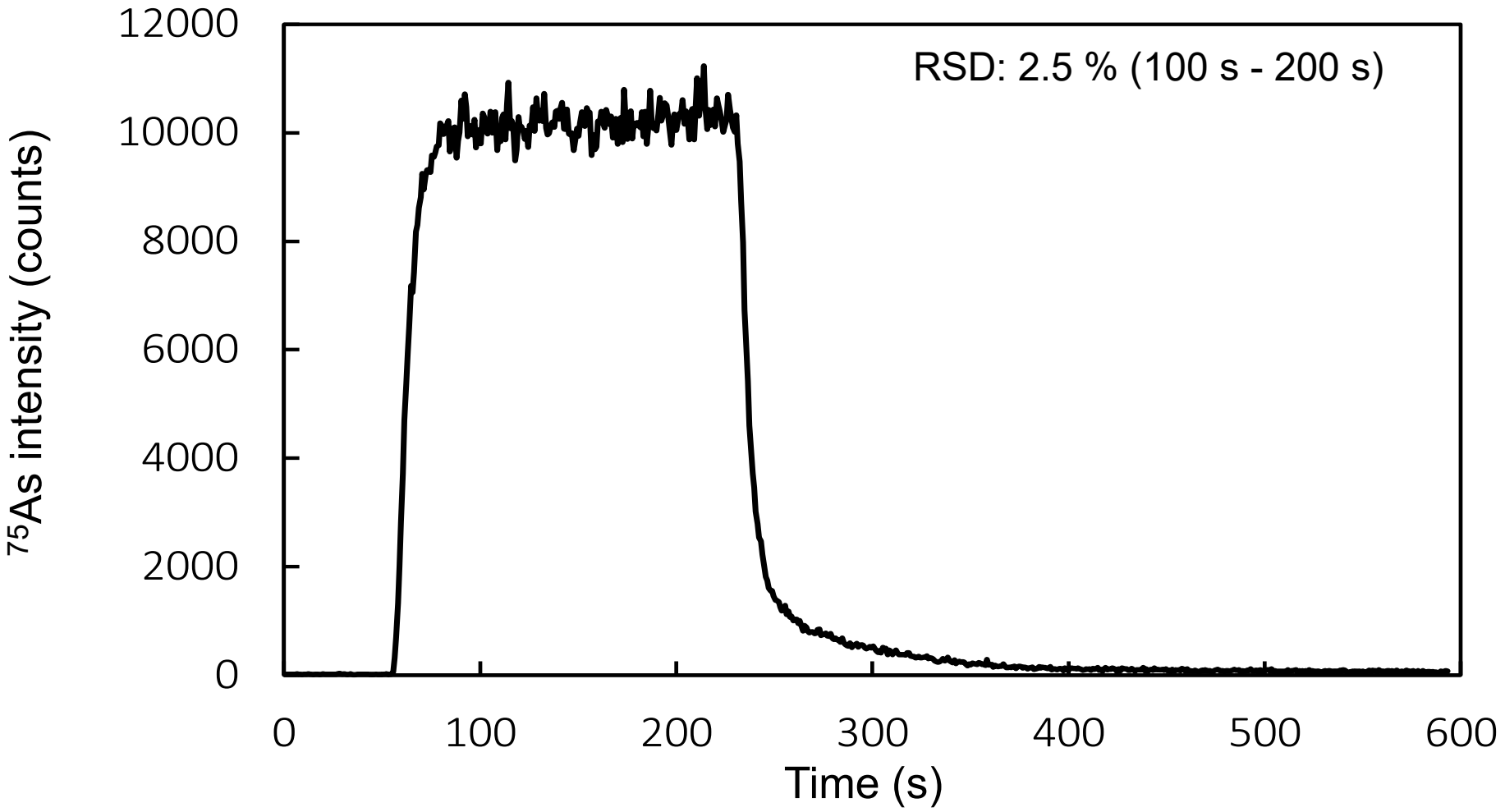


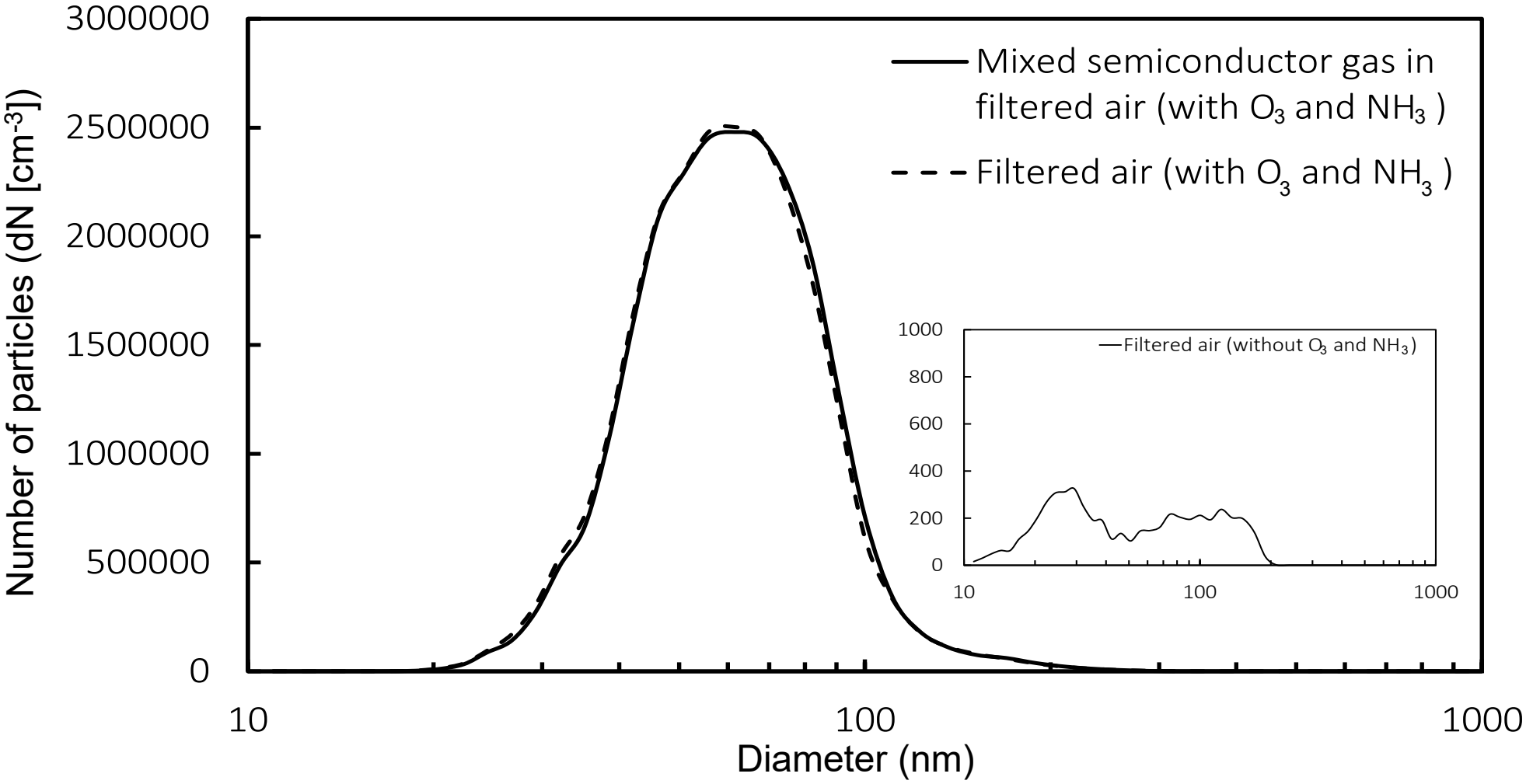
Figure 5. Calibration curves observed for different isotopes of $Mo(CO)_6$ by GPD-GEDICPMS. The flow rates of the sample gas introduction as well as 1% O_3 and NH_3 gases for GPD were 100 and 50 mL min^{-1}, respectively, and the concentration of the NH_3 solution was 4%.

Time-resolved signal of ^{75}As obtained by the introduction of 1 nL L^{-1} AsH_3 in air through GPD-GED-ICPMS

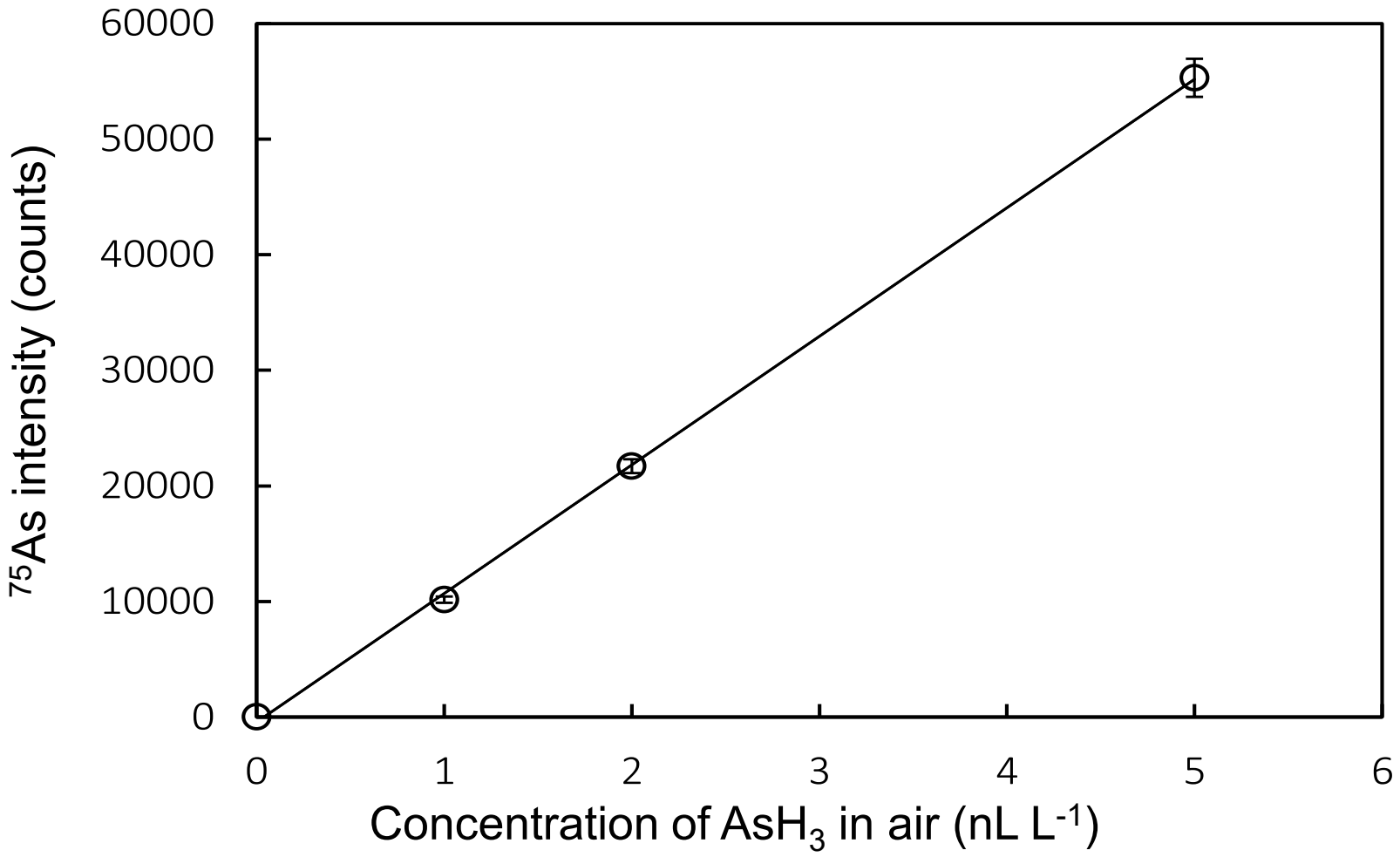


Size distribution of particles converted by gas to particle conversion device (GPD)

The mixed semiconductor gas: 1 nL L^{-1} AsH_3 and PH_3 in air



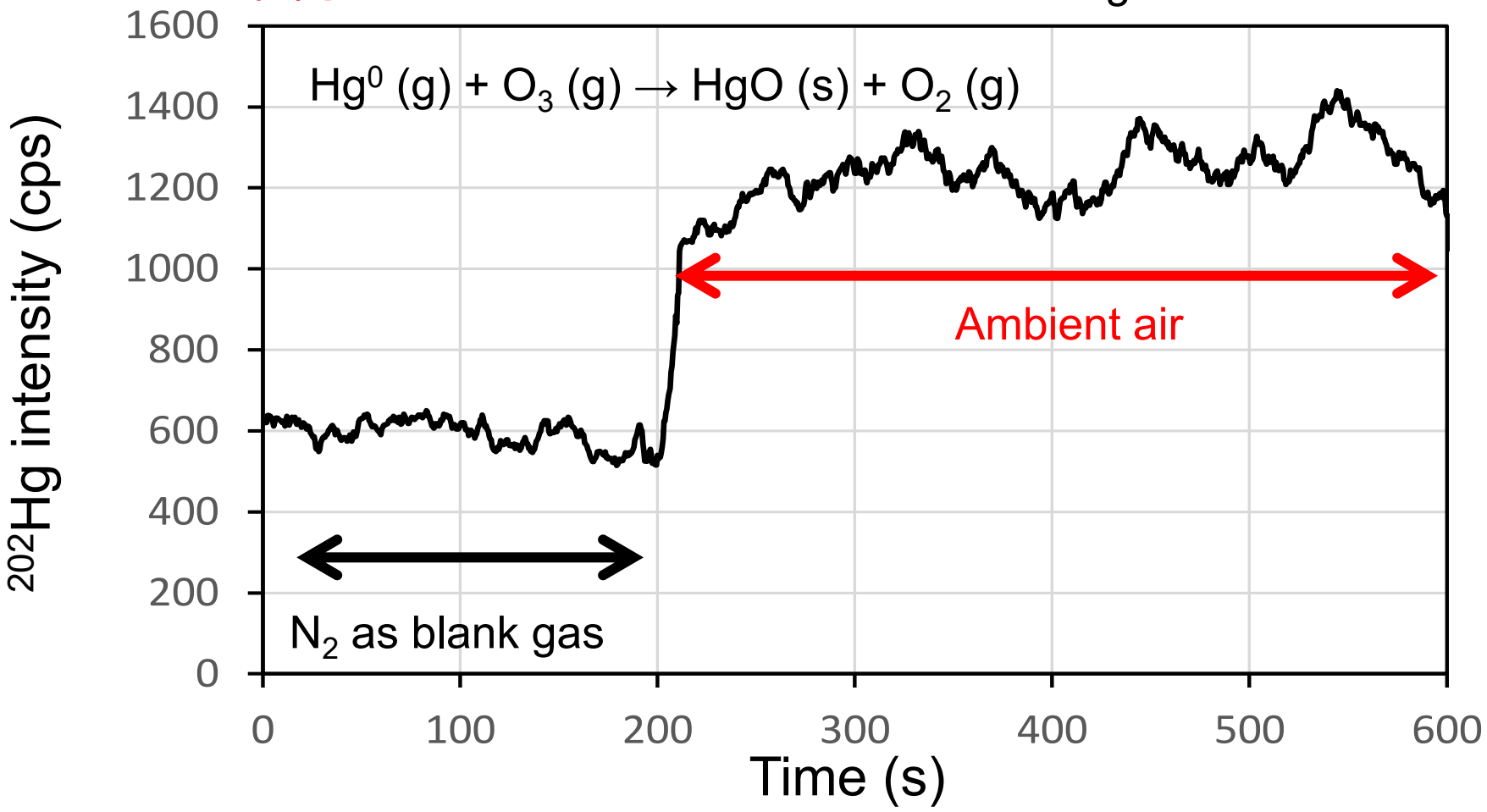
Calibration curve of ^{75}As obtained by GPD-GED-ICPMS for the introduction of AsH_3 in air



Time-resolved signal of ^{202}Hg from ambient air obtained by GPD-GED-ICPMS

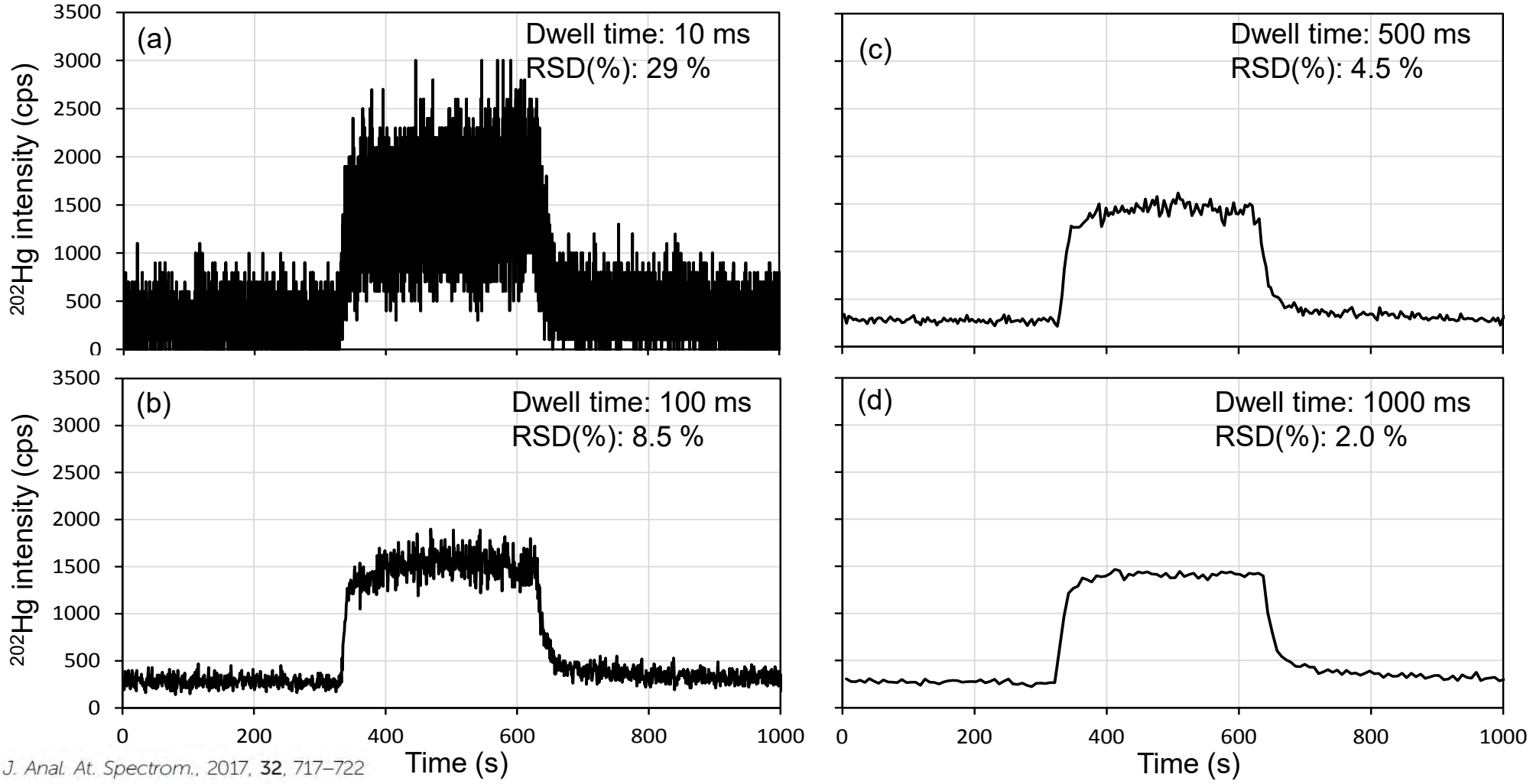
特開2017-198558

Integration time: 500 ms/data



Time-resolved signal of ^{202}Hg from ambient air obtained by GPD-GED-ICPMS with different dwell times for ICPMS

The RSDs were calculated from the data obtained between 200 s and 400 s.



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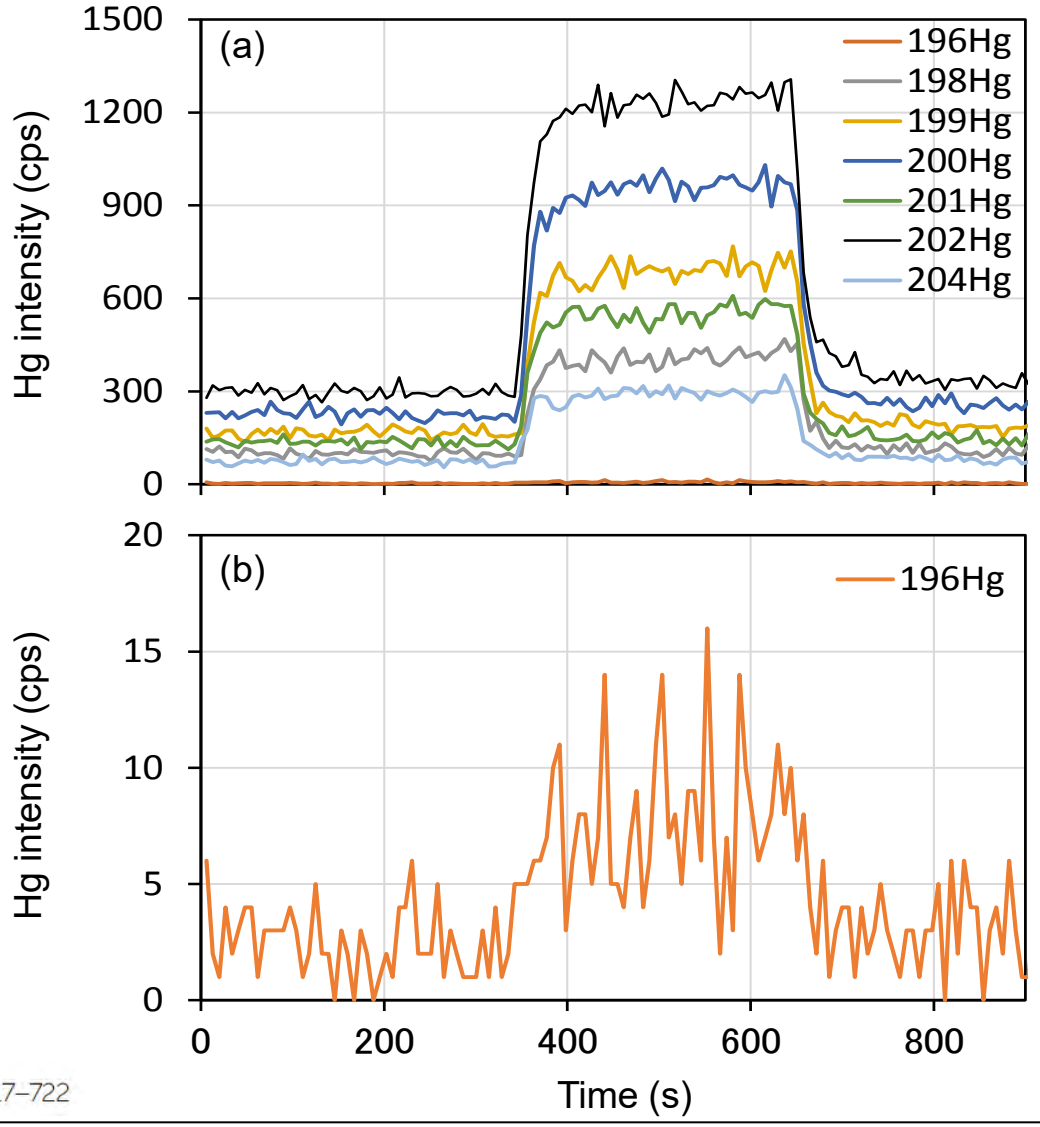
Time-resolved signals for (a) seven Hg isotopes and (b) ^{196}Hg from ambient air obtained by GPD-GED-ICPMS with 1000 ms of dwell time on ICPMS



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Isotope abundances of gaseous Hg from ambient air obtained by GPD-GED-ICPMS without mass bias correction

	^{196}Hg	^{198}Hg	^{199}Hg	^{200}Hg	^{201}Hg	^{202}Hg	^{204}Hg
Gaseous Hg in ambient air	0.17 (0.03)	9.75 (0.07)	16.65 (0.30)	23.35 (0.24)	13.19 (0.16)	29.90 (0.13)	6.99 (0.08)
IUPAC value	0.15 [0.01]	9.97 [0.20]	16.87 [0.22]	23.10 [0.19]	13.18 [0.09]	29.86 [0.26]	6.87 [0.15]
Deviation (%) from IUPAC value	11	-2.2	-1.3	1.09	0.09	0.12	1.8

The value in parenthesis indicates 2SD from measurement.
The value in square bracket indicates estimated uncertainty.

J. Anal. At. Spectrom., 2017, **32**, 717–722

Comparison of LODs (absolute amount) for gaseous Hg measurements (GEM or GEM + RGM)

CVAAS or CVAFS:

ca. 1 pg or *ca.* 0.1 pg, respectively

GPD-GED-ICPMS (GEM based estimation):

ca. 0.4 fg (@ 1s detection)

(0.12 ng m^{-3} @ 1 s measurement by 200 mL min^{-1} sample introduction)