Gas Exchange Device was developed to analyze the metallic element constituting particles in a gas sample by ICP-MS directly. This system is particularly effective in the finding of the emission source of a metallic element by the monitoring of environmental atmosphere changing every moment. The time resolving power is extremely high, and this system can be used to monitor multiple metallic elements simultaneously. The Gas Exchange Device can efficiently replace oxygen, nitrogen and other gas components contained in the sample gas with argon gas without lose fine particle in Sample gas.

Direct analysis by ICP-MS of metallic elements constituting fine particles in a gas sample using Gas Exchange Device

Gas Exchange Device was developed for to analyze the metallic element constituting particles in a gas sample by ICP-MS directly. This system is particularly effective in the finding of the emission source of a metallic element by the monitoring of environmental atmosphere changing every moment. The time resolving power is extremely high, and this system can be used to monitor multiple metallic elements simultaneously. The Gas Exchange Device can efficiently replace oxygen, nitrogen and other gas components contained in the sample gas with argon gas without lose fine particle in Sample gas.

Monitoring metal elements of the suspended particulates in the atmosphere

The intensity trend of $^{209}$Pb and $^{205}$TI in the atmosphere for 36 hours.

The intensity trend of $^{238}$U and $^{235}$U in the atmosphere for 36 hours.

With the GED-ICP-MS method, it is possible to measure changes in metal elements in atmosphere in real time.
Gas Exchange Device, GED  
GED-01

The Gas Exchange Device can directly introduce the gas sample to the ICP by converting the sample gas component to argon.

**GED** converts various gases to the high purity argon gas without lose the fine particles contained in the gas.

**Principle**

Gas Exchange Device converts various gases to the high purity argon gas without lose the fine particles contained in gas. Introducing the sample gas into the Gas Exchange Device, as the sample gas passes through DMM, the gas component is replaced with argon.

The workings of DMM; When the sample gas is introduced into the inner tube of the DMM, the difference in pressure (concentration) between the sweep gas flowing outside the membrane and the inside produces driving force and diffuses to the outside of the membrane.

Argon gas diffuses inside the membrane and the diffusion rate of the particulates in the gas is very slow so that they stay inside of membrane.

This gas exchange process is carried out continuously. The transportation of particles is not affected in the gas exchange process and, therefore, introduced into the ICP-MS unchanged.

**Characteristic**

- High gas exchange efficiency and high particles recovery.
  - Gas exchange efficiency: More than 99.99%
  - Particle Recovery: More than 98%
- Sample gas flow rate: 250ml/min. (Atmospheric gases)
- High sensitivity measurement. \(10^{-18}\) g level
- High temporal resolution – Real-time monitoring (Multi element)

**Application**

- Metal Monitoring of SPM (Suspended Particulate matter).
- The measurement of the suspended particulate out of the Vehicle exhaust.
- The measurement of the suspended particulate out of the various cylinder gas.
- Particulate measurement from various apparatuses. (ex. Hard disk drive)
- Atmosphere monitor of the nuclear power plant.
- The measurement of the fine particles out of combustion gases.
- The measurement of the suspended particulate at the research institute.
The GPD-GED-ICP-MS system can measure trace amounts of Arsine, Phosphine, Germane, etc, in semiconductor process gas. This device makes it possible to make trace amounts of gas constituents contained in a gas into large particles in the reaction process. By using in combination with the Gas Exchange Device, large particles are not passing through the membrane of DMM. Therefore, large particles are carried into ICP-MS. As a result, it will be able to measure the ultra trace gases.

GED-ICP-MS system uses in principle the difference between the gas and the solid-state diffusion speed. Therefore, GED-ICP-MS is not able to measure the gaseous component.

Note: A trace amount of gas component diffuses to the outside of the DMM membrane.

The Gas Particulation Device can make large particles from trace amounts of gas components by the reaction process.

By using in combination with the Gas Exchange Device, large particles are not passing through the membrane of DMM. So, generated large particles are carried to ICP. As a result, it will be able to measure the ultra trace gases.
**Gas Particulation Device, GPD**

**GPD-01**

**Measurement example**

![Graph](image)

Measurement result of arsine. Good linearity is obtained over a wide range from vol.ppt to vol_ppb. Pretreatment is unnecessary and rapid analysis is possible with a small amount of sample. This analysis method is useful for various analyzes such as environmental evaluation and catalytic reaction gas.

**Characteristic**

- Simultaneous multi component analysis is possible under one measurement condition.
- Ultra-sensitive measurement. (vol.ppt Level)
- The sample volume required for one analysis is 3L.
- Measurement time: 5min
- Less interfering ions.
- Simple ICP-MS condition setting.

**Specification**

<table>
<thead>
<tr>
<th>Connectable equipments</th>
<th>Every ICP-MS or ICP-OES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection limit</td>
<td>It depends on the equipments</td>
</tr>
</tbody>
</table>

**Argon Gas**

- Flow rate: 26ml/min.
- Purity: 99.995 %
- Supply pressure: 0.2~0.6MPa
- Tube connector: 4mm ID

**Oxygen gas**

- Flow rate: 26ml/min
- Purity: 99.995%
- Supply pressure: 0.2~0.6MPa
- Tube connector: 1/8 (inch) SUS connector

**Input voltage**

DC24V 105W
- Please use POW-01. (DC24V power supply)

**Size (mm)**

300(W) × 355(H) × 540(D)

**Weight (kg)**

20
- Sample Gas Flow rate: 200ml/min
- Pressure of Sample gas: Atmospheric pressure

**Pump Unit (Option)**

- PU-01 (Flow rate): 250ml/min.

- The maximum sample gas flow rate – in the case of Air.
- Pump unit is optional.
- Please contact us if you introduce the sample gas without pump.
- Please contact us if you introduce corrosive gases or toxic gases.
- Depending on the type of gas you can not use GED.
Gas Exchange Device, GED

- Maximum sample gas flow rate: 250ml/min
- The pump unit is option accessory.

Gas Exchange Device HV

- Maximum sample gas flow rate: 800ml/min
- The pump unit is option accessory.

Pump Unit

For Gas sampling
- PU-01: For GED-01 (250ml/min)
- PUQ-01: For GEDQ-01 (800ml/min)
- Pump unit is controlled by Gas Exchange Device

Power Supply

- DC24V power supply, supplies for each device.

Metallic Standard Gas Generator

- Generated metal gas: Cr, Mo, W
- Sensitivity calibration of ICP-MS

Nitrogen Gas Flow Controller

- Improves ICP-MS sensitivity

Gas Particulation Device

- This device makes it possible to make trace amounts of gas constituents contained in a gas into large particles in the reaction process.
- This device is used in combination with Gas Exchange Device.
  - GPD-GED-ICP-MS Method
  - High sensitivity measurement of trace amounts of Arsine, Phosphine, Germane, etc in semiconductor process gases.
- Pump unit is option accessory.

Note: Particulation is a coined word

We will change the specification without prior notice for performance improvement.
Please use our genuine parts for performance maintenance.

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