High Purity Ozone Gas Generator

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Equipment to Supply Pure Ozone Gas (≒100%) Continuously
**Pure Ozone Generator**

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### Features

**Continuous supply of high purity ozone gas**

**Principle**
This apparatus uses the ozone gas produced from oxygen gas via an ozonizer and subjects it to separation and accumulation through a liquefaction method in an ozone chamber cooled by a cryogenic chiller, producing highly concentrated liquid ozone and then subjecting it to regasification, thereby supplying ozone gas of high purity (95% or higher).

**Continuous supply system**
Continuous supply of high purity ozone gas free of heavy metal impurities
Through the parallel connection of multiple ozone chambers, this system enables continuous supply of high purity ozone gas.

### Application

**A promising technology and method utilizing pure ozone gas**

**Pure ozone processing technology**

- This method involves causing direct reaction of ozone which has strong oxidizing power without impurities.
- This is an effective technology for low-temperature, high-speed oxidation of semiconductor chips and for providing an oxidation gas source and in-situ cleaning for high-performance thin-film production equipment (molecular beam epitaxy, etc.).

**Pure ozone-ethylene technology**

- This method involves the addition of a reaction-accelerating gas (ethylene) to pure ozone (Patent No. 5287558).
- This is an effective technology for removal of organic matter at room temperature and surface reforming.

**Low-temperature deposition technology**

- This technology enables low-temperature oxidation by powerful OH radicals formed from pure ozone-ethylene (oxidation at room temperature can also be expected).
- A reaction does not occur unless it is pure ozone (100%).
- The technology is also capable of accommodating R2R and can be expected to improved productivity.

### Safety Measurement

Always keep the system safe by operating under the condition of high purity and low pressure.

**Safe Design**
- Explosion-proof Design
- Temperature / pressure control with the fail safe system by power failure / trouble.

**Reliability**
- Has an emergency purge mechanism to dilute ozone in the process gas line and discharge residual ozone within the apparatus in times of power outage.
- Can be switched off manually by an EMO (emergency off) switch in the event of any anomaly (chiller has an operation maintenance function to prevent ozone explosion).
- Even in the unlikely event of an ozone explosion, the structure is designed to prevent any mechanical damage to external equipment by having the liquefaction chamber housed within a vacuum-insulated stainless steel container.
- The liquid ozone cooling unit has sufficient capacity for the amount of accumulated liquid ozone so as to reduce the risk of rapid vaporization due to vibration, which otherwise is a risk factor for explosion.

**Standards Certification**
- The unit is conformed to international standards: SEMI-S2, UL, NFPA, CE etc.

**Quality Assurance**
- Safety against gas leakage is verified by tracer gas test of a third-party certifier.
### Example

**Deposition on film (low-temperature deposition technology)**

- Deposition on film at room temperature

![Cross-sectional TEM image](image)

- PEN has resistance to the ozone CVD process.

**Ashing in the semiconductor process (pure ozone-ethylene technology)**

- Ashing after high ion implantation (resist removal)

![Silicon substrate with high ion implantation resist](image)

- Resist ashing apparatus using pure ozone

- Pure ozone ashing (<100℃)

### Application

<table>
<thead>
<tr>
<th>Field</th>
<th>Application</th>
<th>Applied technology</th>
<th>Expected effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Water treatment</td>
<td>Pure ozone processing</td>
<td>Sterilization, deodorizing</td>
</tr>
<tr>
<td></td>
<td>Recycling</td>
<td></td>
<td>Carbon fiber decomposition</td>
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<tr>
<td>Medicine</td>
<td>New drug manufacturing (biotech)</td>
<td>Pure ozone processing</td>
<td>Organic synthesis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Low-temperature deposition</td>
<td>Removal, adhesion, thin film</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Pure ozone-ethylene</td>
<td></td>
</tr>
<tr>
<td>Film</td>
<td>Organic EL</td>
<td>Pure ozone-ethylene</td>
<td></td>
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<tr>
<td></td>
<td>Food packaging/medical devices</td>
<td>Pure ozone-ethylene</td>
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<tr>
<td></td>
<td>Solar cells</td>
<td>Pure ozone-ethylene</td>
<td></td>
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<tr>
<td>Materials</td>
<td>Electrode components</td>
<td>Pure ozone-ethylene</td>
<td>Oxide film</td>
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<tr>
<td></td>
<td>Carbon nanotubes</td>
<td>Pure ozone-ethylene</td>
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<tr>
<td>Semiconductors</td>
<td>Mask manufacturing process</td>
<td>Pure ozone-ethylene</td>
<td>Removal</td>
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<td></td>
<td>Pre-process</td>
<td>Pure ozone-ethylene</td>
<td>Oxide film removal</td>
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<tr>
<td>High technology</td>
<td>MEMIS</td>
<td>Pure ozone-ethylene</td>
<td>Cleaning, reforming</td>
</tr>
<tr>
<td></td>
<td>Molecular beam epitaxy (MBE)</td>
<td>Pure ozone processing</td>
<td>Pure oxide source</td>
</tr>
<tr>
<td></td>
<td>Printed electronics</td>
<td>- Low-temperature deposition</td>
<td>Reforming, adhesion, low-temperature thin film</td>
</tr>
</tbody>
</table>

### Device Configuration (Continuous Supply Type)

- **Ozone processing**
- **Resist ashing apparatus using pure ozone**
- **Pure ozone ashing (<100℃)**

![Diagram of device configuration](image)
## Specification

<table>
<thead>
<tr>
<th>Type</th>
<th>Batch Type (Standard)</th>
<th>Continuous Supply Type (Large capacity)</th>
<th>Continuous Supply Type (Auto Flushing Function Available)</th>
</tr>
</thead>
</table>

### Unit Configuration

<table>
<thead>
<tr>
<th>Number of Ozone Chamber</th>
<th>Main</th>
<th>1</th>
<th>2</th>
<th>3</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>For Standby</td>
<td>0</td>
<td>0</td>
<td>1</td>
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</table>

### Rating

<table>
<thead>
<tr>
<th>Store Part</th>
<th>Main Ozone Gas Value (cc)/Chamber</th>
<th>Continuous Supply Rate (sccm)</th>
<th>Ozone Gas Purity Rate (%)</th>
<th>Continuous Supply Time</th>
<th>National Safety Standards: SEMI-S2, UL, NFPA, CE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8,000/ Chamber</td>
<td>1 to 20</td>
<td>More than 92</td>
<td>6h to 130h</td>
<td>Conformable</td>
</tr>
<tr>
<td></td>
<td>16,000/ Chamber</td>
<td>20</td>
<td>More than 92</td>
<td>Max. 13h</td>
<td>Conformable</td>
</tr>
<tr>
<td></td>
<td>16,000/ Chamber</td>
<td>100</td>
<td>More than 92</td>
<td>Continuous Supply</td>
<td>Conformable</td>
</tr>
</tbody>
</table>

### Safety Control

- Negative Pressure Control
  - Available
- Shutdown Function by Power Failure/Earthquake
  - Available
- Auto Flushing Function
  - Available
- In Unit Operation
  - Available

### National Safety Standards

- Conformable

### External View (Measurement without protrusion) [unit: mm]

#### Continuous Supply Type

- Chiller
- CAB (Side)
- CAB (Front)
- POGB

#### Batch Type

- CAB
- POGB

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1. Standard Ozone Gas Values are the capacity/flow rate values at the 0℃, 1 atm.
2. This function checks the negative pressure and controls not to leak ozone out of board.
3. This function detects the power failure/earthquake (100-200 GAl) and stops the whole unit automatically.
4. This function automatically flushes with the auto mode accumulated impurities in the ozone chambers.
5. This unit can always be on-standby with flushing an idle chamber automatically.
Applications/ Notifications(for the Domestic Use in Japan)

By Establishment of this Equipment, you need to submit applications/ notifications to the Prefecture. We support by creating the forms.

- High Pressure Gas Production Notification
- High Pressure Gas Production Facilities Change Notification
- Class 2 Storage Place Establishment Notification
- Class 2 Storage Place Position Change Notification

This Equipment is developed by AIST (National Institute of Advanced Industrial Science and Technology) and Meidensha.

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