smart GasDetection Technologies

Unique solutions
for potential hazards.

# Gas Safety Solutions for the Lithium-Ion Battery Industry

GfGsafety.com/us-en

# GfG Solutions in Lithium-Ion Battery Manufacturing

## Welcome to Cutting-Edge Gas Detection Solutions

Gas detection plays a critical role in ensuring the safety, quality, and efficiency of operations within the lithium-ion battery industry. Lithium-ion batteries are widely used in various applications, including electric vehicles, consumer electronics, and energy storage systems. While these batteries offer numerous advantages, they also present unique safety challenges due to the potential for thermal runaway events and gas emissions during manufacturing, storage, and use.

## Key Gas Hazards

Several gases pose potential hazards in lithium-ion battery manufacturing facilities. These include:

» **Hydrogen ($H_2$):**
Hydrogen is generated during charging, discharging, and thermal runaway events, hyrdogen is highly flammable and can lead to fire or explosion hazards.

» **Carbon Monoxide (CO):**
CO is produced during thermal decomposition events, such as fires involving lithium-ion batteries, CO is toxic and poses health risks.

» **Carbon Dioxide ($CO_2$):**
Carbon dioxide is generated during normal battery operation and thermal runaway events, $CO_2$ can indicate battery performance issues and ventilation requirements.

» **Hydrogen Fluoride (HF):**
Though less common, HF may be produced during certain manufacturing processes and poses health and environmental risks.

» **Volatile Organic Compounds (VOC's):**
VOC's can be emitted from materials and solvents, VOC's require monitoring to prevent exposurerelated health risks.

» **Oxygen ($O_2$):**
Monitoring oxygen levels prevents oxygen depletion in confined spaces and ensures proper ventilation.


*CC 33 Transmitter*


*IR 22 D Transmitter*


*CC 28 Transmitter*

# Choosing the Right Gas Detection System: Key Features and Considerations

*G999 C with integrated pump*

*G888 C 4-gas monitor*

*DS400 Docking Station*


*GMA 200-RT16 Relay Module*

*GMA 200 Control Panel*

*GMA 200 Rack System with Visualization PC*

## GfG Has a Wide Selection of Gas Detection Systems

Gas detection is essential for maintaining a safe and productive working environment in the lithium-ion battery industry. By implementing comprehensive gas detection systems capable of monitoring key gas hazards, manufacturers can mitigate risks, protect personnel and assets, and ensure regulatory compliance. Regular calibration, maintenance, and employee training are critical components of an effective gas detection program. As the demand for lithium-ion batteries continues to grow, the importance of robust gas detection measures cannot be overstated.

## Gas Detection Systems

Effective gas detection systems for the lithium-ion battery industry should include:

» **Multi-Gas Detection:**
Capable of detecting multiple gases simultaneously to address the diverse range of hazards present.

» **High Sensitivity:**
Ability to detect low concentrations of gases to provide early warning of potential safety issues.

» **Real-Time Monitoring:**
Continuous monitoring of gas levels to promptly identify and respond to hazardous conditions.

» **Alarm Systems:**
Audible and visual alarms to alert personnel in the event of gas leaks or unsafe conditions.

» **Data Logging and Analysis:**
Recording gas concentration data for analysis, trend monitoring, and regulatory compliance purposes.

» **Explosion Proof Design:**
Intrinsically safe gas detection equipment for use in potentially explosive atmospheres.

» **Calibration and Maintenance:**
Regular calibration and maintenance to ensure accuracy and reliability of gas detection systems.

*Did you know?*

# Safety concerns with lithium-ion batteries primarily revolve around the potential for thermal runaway events, which can lead to the release of gases and pose serious safety hazards.

## Key points to consider

» **Lithium Plating:**
During charging, if the lithium ions plate onto the anode unevenly, metallic lithium formations called dendrites can occur. These dendrites can pierce the separator between the anode and cathode, causing a short circuit and potentially leading to thermal runaway.

» **Overcharging/Overheating:**
Overcharging or exposure to high temperatures can cause the battery to generate gases due to electrolyte decomposition. This can result in pressure buildup within the battery, leading to swelling, leakage, or even rupture.

» **Internal Short Circuits:**
Internal short circuits can occur due to physical damage, manufacturing defects, or electrode contamination. These shorts can generate heat rapidly, leading to thermal runaway and the release of gases.

» **Venting and Thermal Runaway:**
In extreme cases, if the battery undergoes thermal runaway, it can release gases such as hydrogen, carbon dioxide, and small amounts of carbon monoxide. The buildup of pressure within the battery can cause it to vent or rupture, releasing these gases along with potentially flammable electrolytes.

» **Fire and Explosion Risk:**
The release of gases during thermal runaway can exacerbate the fire and explosion risk associated with lithium-ion batteries. Hydrogen, in particular, is highly flammable, and if ignited, can lead to intense fires.

To mitigate these risks, manufacturers implement safety features such as protective circuits, thermal management systems, and flame-retardant materials. Additionally, proper handling, charging, and storage practices are essential for minimizing the likelihood of gas-related incidents with lithium-ion batteries.

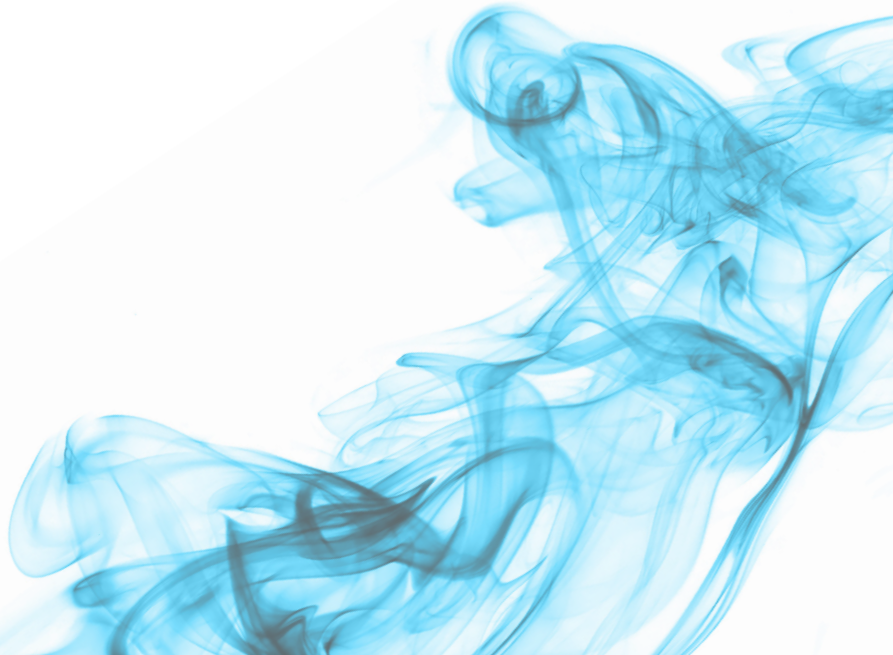
## Hydrogen fluoride off-gas from lithium-ion EV batteries

Hydrogen fluoride (HF) is not typically present as a direct byproduct of lithium-ion batteries themselves. However, in the event of a fire involving lithium-ion batteries, especially at high temperatures, there is a possibility of fluorinated compounds being released, which may include hydrogen fluoride.

The electrolyte in lithium-ion batteries typically contains lithium salts dissolved in organic solvents, but these do not typically contain fluoride ions. However, if the battery components are exposed to extreme heat or fire, there is a potential for fluorinated compounds to form due to interactions between the lithium salts and other materials present in the battery.

When lithium-ion batteries catch fire, the electrolyte can decompose, producing various gases and compounds, including carbon dioxide, carbon monoxide, and small amounts of hydrogen fluoride if fluorine-containing materials are present. Hydrogen fluoride is highly toxic and corrosive, posing significant health and environmental risks.

However, it's important to note that the likelihood of significant hydrogen fluoride off-gassing from lithium-ion batteries under normal operating conditions is low. The primary concerns regarding lithium-ion batteries are related to thermal runaway events, which can lead to fires and the release of other gases, as previously mentioned.



# Hydrogen Fluoride Emmisions from EV Batteries

## The importance of hydrogen fluoride gas detection

Hydrogen fluoride (HF) gas detection is critical in electric vehicle (EV) manufacturing for several reasons:

» **Safety:**
HF gas is highly toxic and corrosive. Exposure to even low concentrations of HF gas can cause severe health effects, including skin burns, eye damage, respiratory irritation, and in high concentrations, it can be fatal. Therefore, detecting HF gas leaks in EV manufacturing facilities helps protect the health and safety of workers.

» **Process Monitoring:**
HF gas can be generated during certain manufacturing processes involved in the production of lithium-ion batteries, which are a key component of electric vehicles. For example, HF gas may be released during the formation of electrode materials or during the assembly of battery packs. Monitoring HF gas levels allows manufacturers to ensure that these processes are being conducted safely and efficiently.

» **Quality Control:**
Detection of HF gas can also be used as an indicator of potential problems or defects in the manufacturing process. An increase in HF gas levels may signal equipment malfunction, improper handling of materials, or other issues that could affect the quality and reliability of the batteries used in electric vehicles.

» **Environmental Protection:**
HF gas leaks can also pose environmental hazards if released into the atmosphere. Monitoring and promptly addressing HF gas leaks help prevent environmental contamination and ensure compliance with regulations governing air quality and emissions.


## Hydrogen fluoride off-gas from lithium-ion EV batteries

Overall, HF gas detection plays a crucial role in maintaining safety, quality, and environmental standards in EV manufacturing facilities, particularly in areas where lithium-ion batteries are produced or handled.

Hydrogen fluoride (HF) can be generated during certain stages of lithium-ion battery manufacturing, particularly in processes involving the use of fluorine-containing materials or compounds. One common step where HF may off-gas is during the formation of the cathode material.

The cathode material in lithium-ion batteries often contains lithium hexafluorophosphate ($LiPF_6$) as the electrolyte salt. During the manufacturing process, particularly during the coating and drying of cathode materials, there is a potential for $LiPF_6$ to decompose and release HF gas. This decomposition can occur at elevated temperatures, typically above 150°C, and may also be accelerated by moisture or impurities.

Another stage where HF generation may occur is in the formation of the solid electrolyte interface (SEI) layer on the anode. During the initial charging cycles of lithium-ion batteries, an SEI layer forms on the surface of the anode to protect it from further electrolyte decomposition. This process can also generate HF gas if the electrolyte reacts with the anode material.

It's important to note that HF off-gassing during lithium-ion battery manufacturing is typically a controlled process, and manufacturers take precautions to minimize exposure and ensure worker safety. This may include implementing engineering controls such as local exhaust ventilation, as well as personal protective equipment (PPE) for workers handling materials that may release HF. Additionally, monitoring systems may be employed to detect HF gas leaks and maintain safe working conditions.

# GfG Maintenance and Service:

## Key advantages of choosing GfG Instrumentation

The GfG technical service team is your proactive partner, from installation to commissioning and support during operation. Our biggest concern is that our portable controllers, transmitters and detectors contribute to the safety of people in your business. This is why our service is as reliable as our equipment.

As a globally active company, GfG offers a comprehensive service. GfG devices are synonymous with safety and quality. If repairs are necessary, they are carried out quickly and reliably. The GfG service consists of trained sales engineers and service technicians who provide you with individual support.

This is why we always advise you directly on site, if possible. In this way, GfG specialists get a clear idea of the application and offer you tailor-made solutions. Simply describe your task to us and we will find the right solution for you. Each technology is individually tailored to your needs. This ensures the greatest possible safety for people and systems.

## GfG services include:

| | |
|---|---|
| Maintenance routine: | Regularly scheduled maintenance |
| Replacement parts: | A reliable supply of wear and spare parts |
| Timely repair: | Rapid repair in the event of a defect |



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