Custom Solutions Group LLC
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Agilent Technologies
Channel Partner

Electronic Gases

Electronic gases are gases used by the semiconductor industry. These gases are used to clean, etch, and build surfaces for the manufacture of microchips and other electronic components. Some electronic gases are also used for the manufacture of solar cells. Common electronic gases include, but are not limited to:

Ammonia
Arsine
Boron Trichloride
Boron Trifluoride
Carbon Dioxide
Carbon Monoxide
Chlorine
Chlorine Trifluoride
Diborane
Dichlorosilane
Disilane
Fluorine
Germane
Hydrogen Bromide
Hydrogen Chloride
Hydrogen Fluoride
Hydrogen Selenide
Nitric Oxide
Nitrous Oxide
Phophine
Silane
Silicone Tetrachloride
Silicone Tetrafluoride
Trichlorosilane
Tungsten Hexafluoride

A variety of halocarbons are also used in electronics manufacturing. Blends with inert and permanent gases like helium, neon, hydrogen, argon, nitrogen, krypton, and xenon, are also common.

Custom Solutions Group LLC provides a wide variety of high quality solutions for electronics gas chromatography. For the analysis of trace impurities in high purity gas, the Pulsed Discharge Helium Ionization Detector (PDHID) is the preferred, universal, trace detector. Other more selective trace detectors, such as the Flame Ionization Detector (FID), the Electron Capture Detector (ECD), and element-specific detectors, are also used for more selective trace analysis. Fractional percent and percent level blends are often analyzed via Thermal Conductivity Detector (TCD). Because most electronic gases are either highly toxic or highly flammable, special features and precautions are applied for analytical integrity and environmental safety. Most systems require the analysis of hydrogen, argon/oxygen, nitrogen, methane, carbon monoxide, and carbon dioxide, as impurities. All systems emphasize simplicity, serviceability, functionality and the highest quality construction, Made-in-the-U.S.A.

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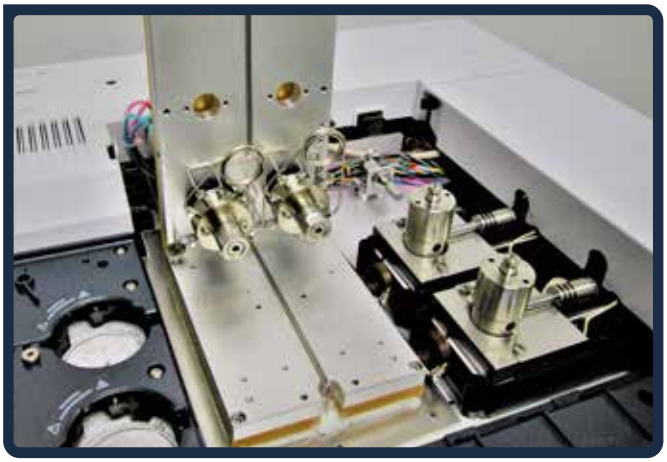
Trace Impurities Analysis via Pulsed Discharge Helium Ionization Detector

The Pulsed Discharge Helium Ionization Detector (PDHID) is the premier, trace gas detector in use in the world today. The PDHID is a non-radioactive, mostly non-destructive, universal detector that can analyze permanent gas impurities down to low parts-per-billion. For organics, the PDHID can achieve linearity of up to five orders of magnitude, and because it operates via the well-known Hopfield emission, it can analyze almost any compound, except for neon. For neon, Custom Solutions Group modifies the operation of the PDHID for greater neon ionization efficiency. The Model D2 also has a non-radioactive electron capture mode for the selective analysis of trace electron capturing compounds. This model is switchable between the electron capture and helium ionization modes. All helium ionization modes can be doped for greater selectivity, including: (1) argon doping for organics, (2) krypton doping for unsaturates, and (3) xenon doping for polyaromatic hydrocarbons.

Trace Impurities Analysis via Other More Selective Trace Detectors

Because the PDHID produces such a large response for the bulk gas, it is often necessary to backflush or heart cut the bulk gas to vent. If that is not possible, then a more selective detector must be used. The Flame Ionization Detector (FID), often coupled with a Jetanizer or methanizer for the trace analysis of carbon monoxide and carbon dioxide, is frequently used to provide more selectivity than the PDHID for organic compounds. Methanizers are high temperature, nickel oxide catalysts in a hydrogen atmosphere. They convert traces of carbon monoxide and carbon dioxide to methane. The methane is subsequently analyzed via FID, thus lowering detection limits compared to TCD. The nickel oxide catalyst in the methanizer is protected from contamination by either backflush or methanizer bypass.



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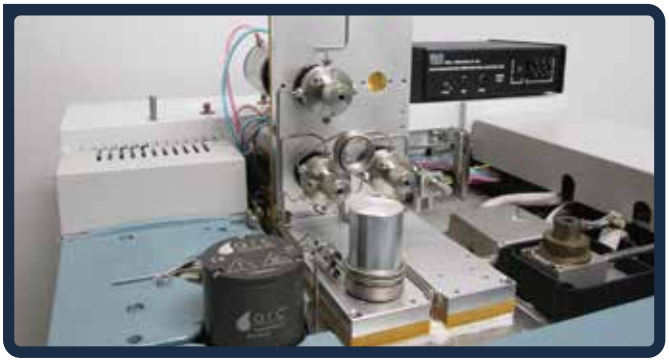
Trace Impurities Analysis via Other More Selective Trace Detectors

Other trace detectors include: (1) The Electron Capture Detector (ECD), which is highly selective toward electron capturing compounds, (2) the Sulfur Chemiluminescence Detector (SCD), which is highly selective toward trace sulfur-containing compounds, and (3) The Nitrogen Chemiluminescence Detector (NCD), which is highly selective toward trace nitrogen-containing compounds. Two other detectors, the Flame Photometric Detector (FPD) and the Pulsed Flame Photometric Detector (PFPD) are commonly used in the sulfur and phosphorous modes, but the PFPD has a couple of dozen unique, elemental operating modes. Each of these detectors has its own advantages and disadvantages. Custom Solutions Group listens to our clients and works with our clients to determine what combination of detection is best to meet the client's analytical needs and budget.



Special Features and Precautions

Because most electronic gases are either highly toxic or highly flammable, special features and precautions are applied for analytical integrity and environmental safety. First, for toxic and flammable gas systems, all Valco valves are installed with helium purges or in helium purged enclosures. The helium purge prevents the contamination of the sample by atmospherics, thus guaranteeing accuracy and precision down to low parts-per-billion. Second, the helium purge also protects against the escape of toxic, fugitive emissions into the surrounding environment. Special attention is paid to controlled vents for sample bypass, sample out, split vents, backflush-to-vent, foreflush-to-vent, helium purge out, and detector vents. Also, highly corrosive gas systems utilize special materials like Hastelloy C22 and electroform nickel for all installed components that may come into contact with corrosive gas. All valves that are used for trace systems with the PDHID are certified for use with the PDHID via helium mass spectrometer leak test. For the best possible background and the best possible sensitivity, only UHP helium is used on the PDHID. The UHP helium is then purified by a primary helium getter, and cleaned up again downstream

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Special Features and Precautions

of the carrier gas controls via secondary helium getters. Lastly, most electronic gases should not come into contact with air-ever. To this end, helium or argon purges are used to prevent back diffusion of air into the sample lines. For trace analysis, all columns are specially treated and conditioned to prevent the adsorption of active compounds. Silcosteel, where applicable, is commonly used for tubing, also to prevent the adsorption of active compounds at trace levels. All of these special features and precautions are intended to make Custom Solutions Group electronic gas analyzers the best in the world.

Special Services and Analytical Automation

Custom Solutions Group provides special services and analytical automation for our electronic gas clients. Special services include statistical gauge repeatability and reproducibility studies, analytical validation services, and IQ/OQ certifications. Custom Solutions Group can also provide automated and customized certificates of analysis, thus eliminating data transfer errors, inefficient uses of labor, and delays in reporting and shipments. All Custom Solution Group electronic gas analyzers can be adapted to automated, unattended operation and on-line, continuous use. Because of the hazardous nature of most electronic gases, gas sampling manifolds must be well-designed, well-built, and cleaned and passivated for specific uses. Custom Solutions Group can assist electronic gas manufacturers to ensure there is a clean, pre-conditioned, valid sample delivered to the GC.

This figure shows an example of a simple sampling panel for the introduction and injection of a hazardous gas-liquid to GC. This is necessary for both accuracy and precision with these types of samples. The panel also allows for the safe venting of all hazardous samples to scrubber, with no dead legs, no dead volume, and no interaction of the sample with air. Applicable gas-liquids include: liquid chlorine, trichlorosilane, and tetrachlorosilane.

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Electronic Gas Blends

Electronic gas blends are normally analyzed via Thermal Conductivity Detector (TCD). The TCD is rugged, linear over a wide range of concentrations, and universal in response. The PDHID is only used when blend concentrations go too low. Most TCD's are operated via helium carrier; however, due to thermal conductivity effects for binary mixtures of helium and hydrogen, argon and nitrogen are preferred carrier gases for helium and hydrogen analysis, especially for high and broad ranges of helium and hydrogen. The separations on these systems are matrix-dependent. Silanized materials are used for silane and chlorosilane analysis. Molecular Sieves are protected by backflush and series-bypass.

Conclusion

Custom Solutions Group offers the widest variety of high quality solutions in electronics gas chromatography. Custom SOlutions Group analyzers feature simplicity, serviceability, functionality and the highest quality construction, Made-in-the-U.S.A.