Principle of common gas detection sensors

Gas sensors are the main devices used to detect gas composition and concentration. The working principles of gas sensors are usually as follows:

NO.1: Electrochemical detection principle

Description	Using the active chemical properties of the gas to be measured, which can be electrochemically oxidized or restored, it is possible to distinguish the composition of the gas and check the gas concentration.。
Measurable gas	Oxygen and most toxic gases, such as oxygen (O2), carbon monoxide (CO), ozone (O3), hydrogen sulfide (H2S), nitrogen (N2), chlorine (CL2), hydrogen (H2), formaldehyde (CH2O), nitrogen monoxide (NO), nitrogen dioxide (NO2), sulfur dioxide (SO2), ethylene oxide (ETO), phosphine (PH3), hydrogen cyanide (HCN), and other toxic gases.
Advantage	Fast response, high sensitivity, good linear output; relatively stable performance; the vast majority of toxic and hazardous gases can be measured by electrochemical sensors
Disadvantage	Must be used in an oxygenated environment (at least 1% oxygen); easy to break down over the range; more affected by temperature and pressure
Lifetime	Industrial 6 years, others 2-3 years (replacement required in 3-6 months in harsh environments)
Constraint	Oxidizing type sensors must be used in places containing oxygen (at least 1% oxygen), negative signal output sensors do not need oxygen to work properly, such as O3\CL2\NO2 and other reducing type sensors.

NO.2: Catalytic combustion detection principle

Description	The catalyst on its surface is used to catalyze the combustion reaction of combustible gases to release heat principle, that is, combustion makes the temperature of the platinum wire coil increases, the coil resistance value increases. Measurement of the size of the change in resistance value of the platinum wire can be derived from the concentration of combustible gases, applicable to the measurement of low concentration of combustible gases.
Measurable gas	Flammable and explosive gases; combustible, methane, hydrogen and other gases with a detection range of 0-100% LEL
Advantage	Stable performance, most combustible gases can be measured by catalytic combustion sensors, measurement linearity is very good, the cost is relatively low compared to the cost of gas detection principle.
Disadvantage	Can only detect flammable and explosive gases, need oxygen to work. For sulfur and silicon containing occasions must choose anti-poisoning sensor, the price is more expensive; belongs to the combustion sensor, must use the explosion-proof shell or intrinsically safe circuit can be used in explosive places, such as mines, otherwise it will lead to serious consequences.

Lifetime	2-3years
Constraint	Must be used in the presence of oxygen; key considerations for field applications are resistance to sulfide and silicon poisoning.

NO.3: Infrared detection principle

Description	Different gases have different absorption intensities of infrared rays in specific wavelength bands. By detecting the magnitude of the current output on the infrared photosensitive device, the concentration of the gas to be measured can be measured according to the Beer-Lambert law.
Measurable gas	Carbon dioxide, high-precision combustible or combustible purity measurement (but infrared combustible detection can not be H2, NH3), as well as some special gases requiring high detection accuracy: sulfur hexafluoride, bromomethane, sulfuryl fluoride, nitrous oxide, Freon, etc.
Advantage	High accuracy, good selectivity, high reliability, not dependent on oxygen, less susceptible to environmental disturbances; optical principle, suitable for all locations, especially explosive areas
Disadvantage	Measurement of gas types are few, generally can be measured CO2, hydrocarbon combustible gases, CO, NOX, SO2, SF6, etc., by the pressure, temperature, humidity and dust have a greater impact, so the pre-processing should be good!
Lifetime	Conventional 3-5 years; high precision 10 years
Constraint	Absorption of similar gases can interfere with each other

NO.4: Photo Ionization Detectors

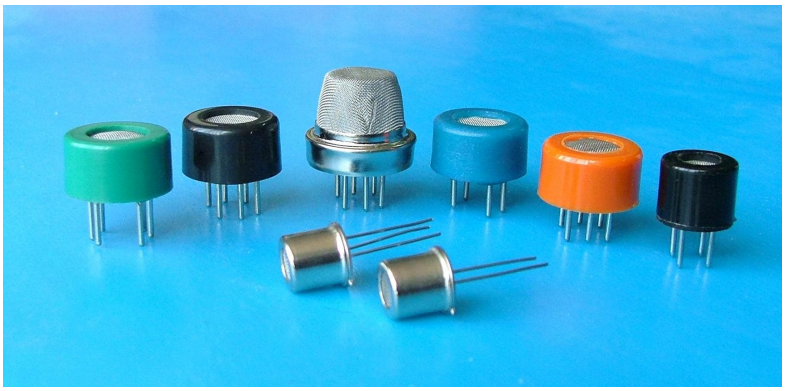
Description	There is a source of ultraviolet light, and chemicals can be easily detected by a detector when they are excited by it to produce positive and negative ions. Ionization occurs when molecules absorb high energy UV light, and the molecules produce negative electrons and form positive ions upon excitation. The current generated by these ionized particles is amplified by the detector and the concentration can be displayed on the meter. These ions pass through the electrodes and soon recombine back into the original organic molecules.
Measurable gas	Detection of Volatile Organic Compounds (VOCs), VOC-containing benzenes, chlorinated organic compounds, freons, ketones, amines, alcohols, ethers, esters, acids and petroleum hydrocarbons, etc., either in total or as a single organic gas.
Advantage	Fast response time and high sensitivity, capable of measuring VOCs at the ppb level
Disadvantage	The cost of sensors is relatively high. PID light ion ultraviolet lamp is prone to pollution
Lifetime	10000 hours (13 months)

NO.5: Thermal conductivity detection principle

Description	It is based on the principle that the conductivity of some metal oxide semiconductor materials changes with the composition of the surrounding gas at a certain temperature.
Measurable gas	Measure the purity of hydrogen, helium, argon, ethylene oxide, etc., or detect some special gases that require only low price: sulfur hexafluoride, bromomethane, sulfuryl fluoride, nitrous oxide, etc.
Advantage	High Concentration Thermal Conductivity Sensors are mainly used to accurately detect high concentrations of hydrogen, helium, argon, ETO, SF6, etc. They are resistant to high pressure and have good repeatability.
Disadvantage	Most of the low-concentration gases can be detected, can not distinguish a specific gas, can only measure the presence or absence of gas, used for leak detection, can not be accurately detected; subject to changes in temperature and humidity of the external environment has a great impact on the linearity of the poorer Although the linearity is not good, but can be calibrated through the multi-point calibration can also achieve high accuracy; measurement of low concentration ppm level effect is not good, measurement of mixed gases can not be measured, there is interference, can only be measured by a single gas, the background gas for the nitrogen or air are possible.
Lifetime	5years
Constraint	Such as CO2, H2, Ar, He, ETO, SF6 high concentration detection, thermal conductivity measurement, high pressure resistance, without oxygen

NO.6: Semiconductor detection principle

Description	Using the adsorption of semiconductor materials on the gas, change the resistance of the gas-sensitive resistor, so as to determine the presence or absence of the gas.
Measurable gas	The price is low, but the stability is not good, at present our company has only 2 kinds of gas: ozone low concentration, VOC low price.
Advantage	Low cost and high sensitivity. Our low concentration thermal conductivity sensors are also based on this principle.
Disadvantage	Subject to changes in temperature and humidity of the external environment has a large impact, there is no linearity. Can only be applied in some background gas environment is simple, the gas concentration is not large in the case of detection only in the measurement of leakage. Measure the leakage effect is good, the accuracy is not high; household alarms in the application of more, not applicable to industrial gas detector.
Lifetime	2-3years
Constraint	Oxygen required. Sensitivity but no linearity, no measurement.



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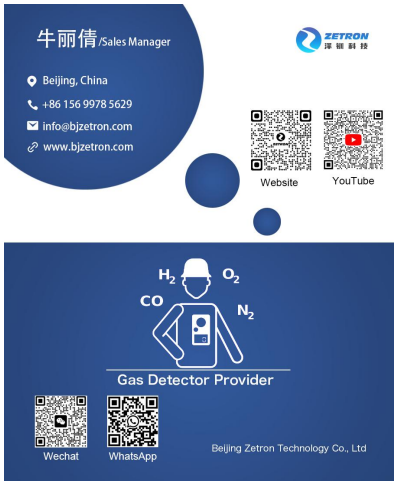

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