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smartGAS.

Why using NDIR gas sensors?

Overview about use cases of NDIR sensors and its advantages by Dipl. Ing. Andreas Hester (Head of Product Life Cycle)

Sensors with NDIR technology find application in diverse gas analysis and gas detection tasks within industrial processes, contributing to increased efficiency, better process control, and improved overall performance across a range of industrial operations. Through their highly stable and long lifetime the maintenance and replacement costs over time are very low. That's because the purely optical measurement method does not require any chemical reactants which are used up over time. Compared to sensors with electro chemical technologies the NDIR sensors stand out through higher accuracy, selectivity and lower drift.

Various applications for NDIR gas sensors

Industrial Emissions Monitoring: Industries use NDIR gas sensors to monitor and control emissions of greenhouse gases and air pollutants like carbon monoxide (CO), sulfur dioxide (SO₂), and nitrogen oxides (NO). Compliance with environmental regulations is crucial for minimizing the environmental impact of industrial processes. **Environmental Monitoring:** NDIR sensors are used for outdoor environmental monitoring to measure greenhouse gases such as carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). Monitoring these

Applications

- Industrial Emissions Monitoring
- Environmental Monitoring
- Process Control
- Biogas
- Medical Applications
- Leak Detection of Refrigerants and Hydrocarbons
- Medical Applications
- High Voltage Engineering
- Food Storage & Pest control

gases helps in understanding climate change, tracking emissions, and studying global carbon cycles. **Process Control:** NDIR gas sensors play a vital role in industrial process control by monitoring and regulating the concentration of specific gases in manufacturing processes. This ensures product quality, worker safety, and efficient operation. **Biogas:** NDIR sensors can be specialized to measure CO₂ in CH₄ environment for assessing the purity of biogas and its energy content. **Medical Applications:** NDIR gas sensors find applications in medical devices for monitoring patient gas concentrations of N₂O during anesthesia, respiratory therapy,

and metabolic testing. **Leak Detection:** NDIR sensors are used to detect gas leaks in various scenarios, such as natural gas pipelines, storage tanks, and industrial equipment, preventing potential hazards and environmental contamination. Furthermore, it detects leaking refrigerants in air conditioning systems. **High-Voltage:** They are utilized in leak detectors and gas detectors and can also be used for the monitoring of gas quality and filling in gas-insulated switchgear (GIS) or transformers. **Fruit storage and pest control:** Ripening Gas Monitoring of CO₂ and Ethylene (C₂H₄) for an efficient storage process and delicious fruits as well to monitor the level of pesticides during transportation.

Many advantages against common measurement technologies

High Sensitivity: NDIR gas sensors are highly sensitive and can detect even trace amounts of gas in the environment. They can measure gases in parts per million (ppm). **Specificity:** NDIR sensors are highly specific to the gas they are designed to detect. They operate based on the principle that different gases absorb infrared radiation at specific wavelengths. This specificity ensures accurate and reliable gas detection without interference from other gases present in the environment.

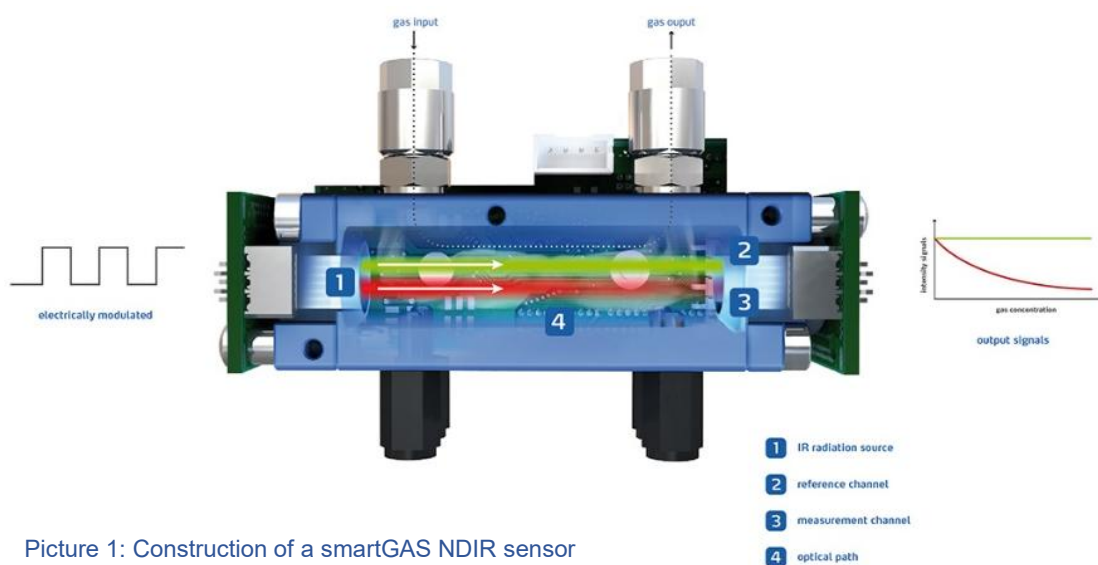
Stability and Longevity: NDIR sensors are known for their stability and long lifespan. They do not degrade or drift much over time, which means they can provide consistent and reliable measurements over extended periods, requiring minimal maintenance. **Fast Response Time:** NDIR gas sensors typically have fast response times, allowing them to detect gas concentrations quickly. This is particularly crucial in applications where rapid detection is necessary for safety or process control. **Wide Range of Gas Detection:** NDIR sensors can be designed to detect a wide range of gases, including carbon dioxide (CO₂), methane (CH₄), carbon monoxide (CO), and many other volatile organic compounds (VOCs). This versatility makes them suitable for various applications across different industries. **Minimal Calibration:** NDIR gas sensors require minimal calibration and maintenance, compared to some other gas sensing technologies. Once properly calibrated during the initial setup, they can continue to provide accurate readings with little intervention. **Cost-Effective:** Over the long term, NDIR gas sensors can prove to be cost-effective due to their long lifespan, low maintenance requirements, and stable performance.

Advantages

- High sensitivity
- High selectivity
- Stability and Longevity
- Process control
- Fast Response Time
- Medical Applications
- Wide Range of Gas Detection
- Minimal Calibration
- Cost-Effective

How the NDIR technology works with smartGAS sensors:

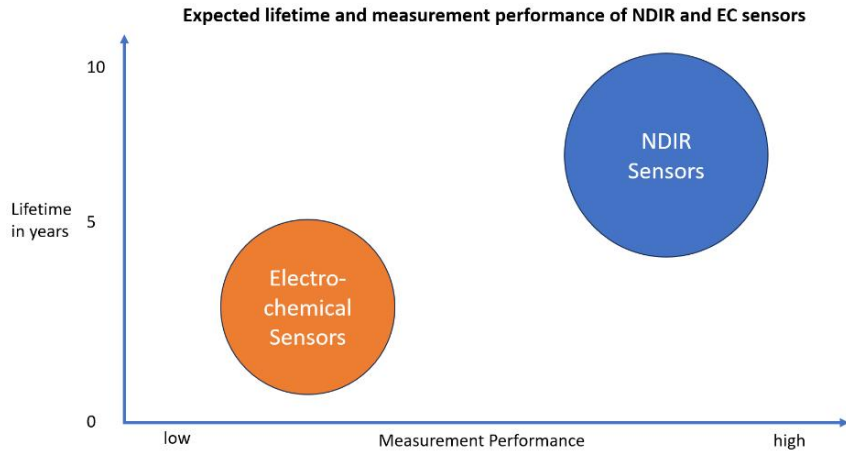
Picture 1 shows on the left-hand side of the sensor, an infrared source [1] which causes the gases to oscillate by the radiation from the light source. The higher the concentration of the gases, the more radiation they absorb. This loss is measured with a detector. The reference channel [2] determines the overall emitted energy from the light source. The measurement channel [3] detects the absorbed IR light which is directed through the sample chamber to a detector, which is limited by means of a filter, to the gas to be determined. The gas in the sample chamber [4] causes absorption of certain wavelengths according to the Beer-Lambert law, and the attenuation of these wavelengths is measured by the detector to determine the gas concentration to be measured. In front of the detector is an optical filter that eliminates all light except the wavelength that the selected gas molecules can absorb. smartGAS is a specialist in manufacturing and development of NDIR gas sensors. All sensors from smartGAS are drift and temperature compensated and feature stable linearity & repeatability. With high measurement performance and high selectivity, they are the best choice in their class.



Picture 1: Construction of a smartGAS NDIR sensor

Comparison NDIR vs. Electrochemical sensors:

Due to their purely physical measuring principle, NDIR sensors have a longer service life than electro-chemical sensors. A pre-requisite is that the sample gas is free of particles and moisture so that the sensitive optical components do not become contaminated or fogged, whereas electrochemical sensors prefer a relative humidity of 60%. In addition, NDIR sensors stand out due to their higher accuracy and measurement performance, which is also reflected in a faster response time. Diagram 1 shows that NDIR sensors have nearly a twice as long lifetime than electro chemical sensors.



That's the case because as in diagram 2 shown, the stability of the electro-chemical sensors decreases rapidly because the electrolyte will be consumed over time and consequently the drift of the measurement result will be very high. Table 1 gives a short overview about the specification of smartGAS NDIR sensors and electro-chemical sensors. It turns out that if high measurement performance is required, NDIR sensors are preferable to electrochemical sensors.

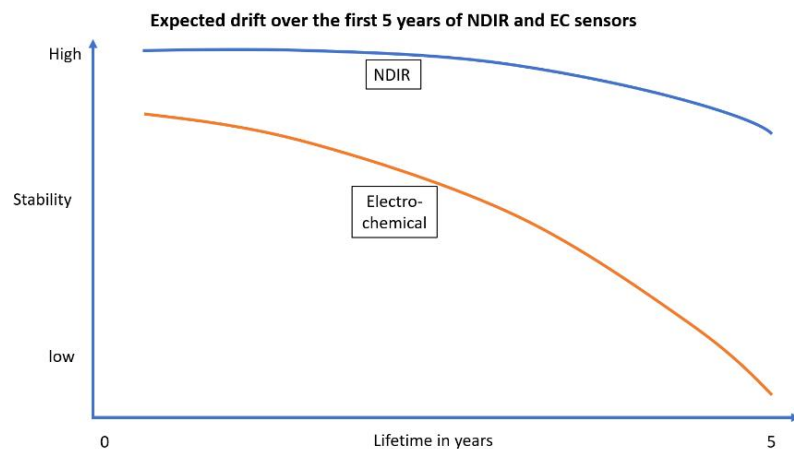


Table 1: Comparison of typical specifications of NDIR and electrochemical sensors

	smartGAS NDIR	Electrochemical
Drift	low	high
Maintenance costs	low	mid
Performance	high	low
Response time	fast	slow
Measurement ranges (typical)	ppm, Vol.-%	ppb, ppm, Vol.-%
Output signal	4...20mA, Modbus	4...20mA, Modbus
Additional equipment for analyzer or device needed	none	module adapter
Can be re-calibrated by environment change	yes	no
Aging by measurement	no	yes

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