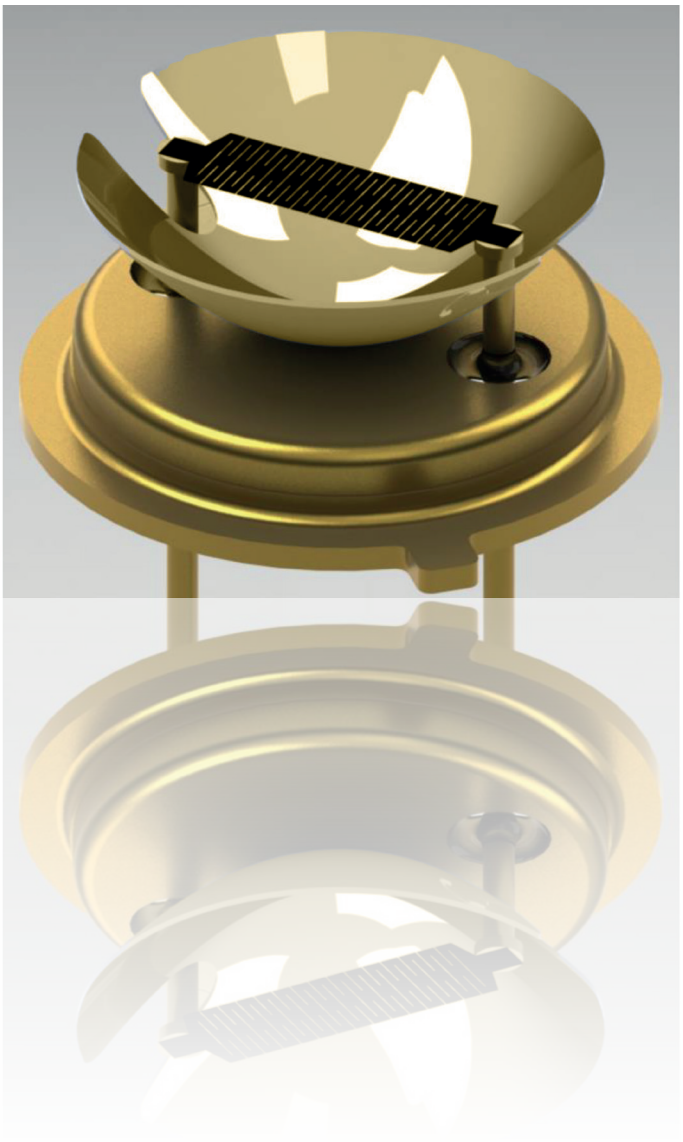
WHITE PAPER



WHY INFRASOLID THERMAL IR EMITTERS ARE THE BEST CHOICE

Rainer Ihra | Sales & Marketing

This white paper describes typical NDIR applications, the important parameters for infrared sources used in these analysis systems and the innovative technology from Infrasolid to achieve the best parameters and measurement results.

INFRASOLID®

WHY INFRASOLID THERMAL IR EMITTERS ARE THE BEST CHOICE

IR Emitters - general design considerations

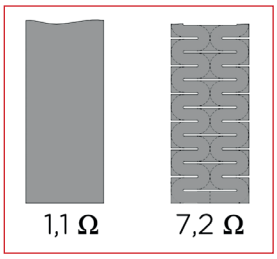


Fig. 1: Increased electrical resistance with double meander, patented by Infrasolid GmbH

The robust emitting filament is designed as a patented double meander which adds mechanical stability even during operation and increases the electrical resistance. Typically, the resistance is increased from around 1Ω to ranges up to 10Ω. This way, the source delivers up to 1 watt optical power with only 2.5 watt electrical power. A recommended driving circuit is shown in Fig. 15.

The high output power of Infrasolid thermal IR emitters in TO packages is achieved with three innovations:

1. The patented coating technology increases the emissivity on both sides of the filament (Fig. 2)

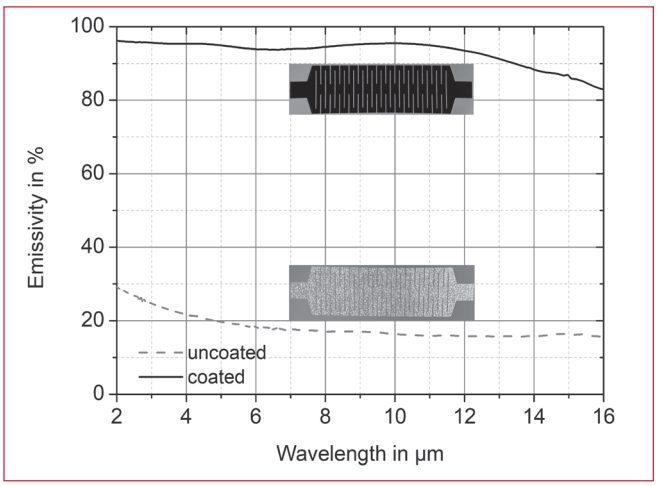


Fig. 2: Coating of the emitting filament to increase black body emissivity, patented by Infrasolid GmbH - used on **both sides** of the filament

2. Since the filament is coated on both sides, the radiating element area is doubled and the backside emission is transmitted to the front through the special designed reflector at the bottom of the housing.

3. The total IR emitted radiation is further collimated with a second reflector designed as a Winston Cone, thus increasing the total optical power reached at the detector side.

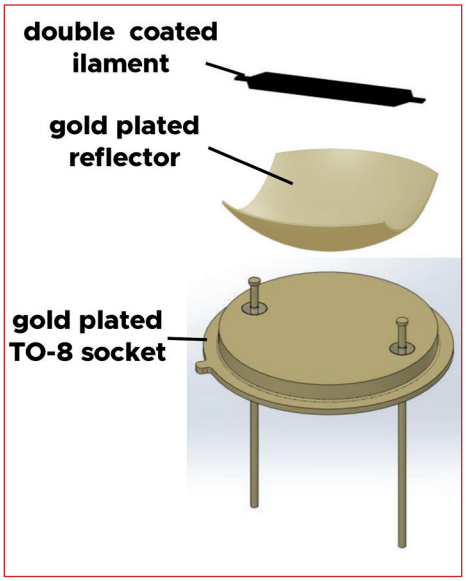


Fig. 3: Package design of Infrasolid's TO-8 package, without Winston cone reflector

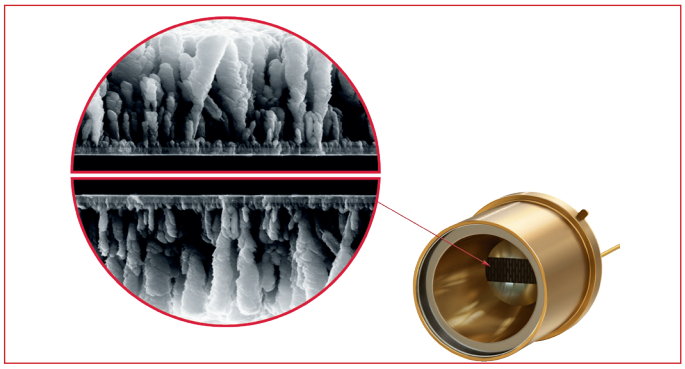


Fig. 4: Highest power thermal emitter in TO-8 housing using **double coated** filament and **two reflectors**, bottom reflector and Winston cone collimator.

Infrasolid's TO-8 infrared sources deliver the highest sensor signal compared to other available emitters in the market. Fig 5. compares the optical output power of encapsulated infrared emitters in TO-8 package with CaF_2 filter. Furthermore, the sensor noise signal can be reduced by a factor of 2 due to the stable optical output of Infrasolid's emitter and its patented IR emitter setup. This results in a tremendous performance enhancement in classical NDIR setups.

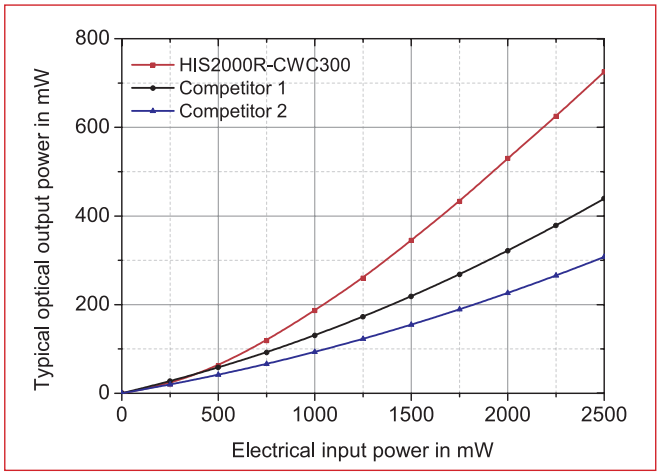


Fig. 5: Optical output power of encapsulated IR emitters in TO-8 package with CaF_2 filter

Fig. 6 compares the sensor signal at different wavelengths from encapsulated infrared emitters in TO-8 package (2.5 W input power, 5 Hz modulation frequency) in a typical NDIR gas sensor set-up (4-channel detector, 200 mm optical path length). Especially for Sulfur hexafluoride (SF_6) analysis, the MIR range around 10.5 µm is very important and shows the greatest advantage for Infrasolid's TO8 emitters.

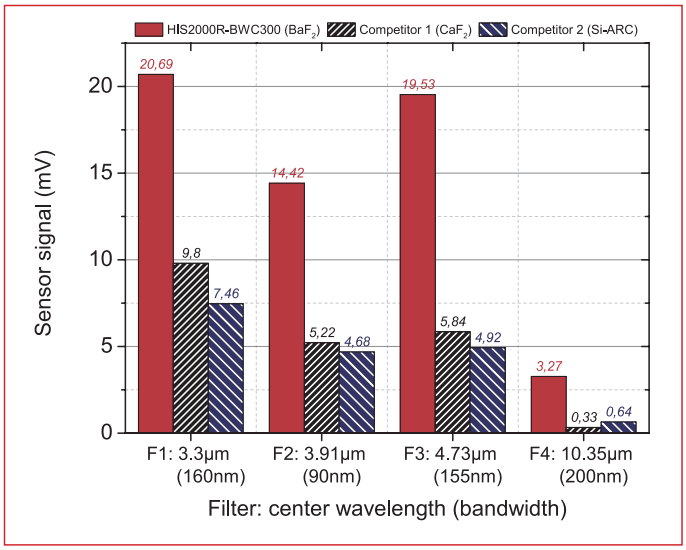


Fig. 6: Performance comparison of encapsulated IR emitters in NDIR setup.

Applications

With Infrasolid's patented technology and innovation it is possible to build TO-8 infrared emitters which deliver up to 500% more IR emitting power than any other thermal TO-8 emitter on the market.

NDIR gas analysis

The innovative thermal infrared emitters add many benefits to industrial applications, for example to NDIR gas analysis systems. Typically, such NDIR systems consist of three essential components:

A cuvette or gas chamber through which the gas mixture flows, a sensor which detects the change of radiation intensity after the absorption process and of course the IR radiation source which emits the broadband IR signal. With higher IR output power more accurate signals can be detected. Additionally, the two reflectors, one formed as a Winston cone collimator providing a more focused beam and reducing the reflections inside of the cuvette delivering the maximum signal to the detecting element. With the availability of 4-, 8-, and even 16-channel detectors, it is most important that the infrared source delivers high optical power to the relatively small detector areas.

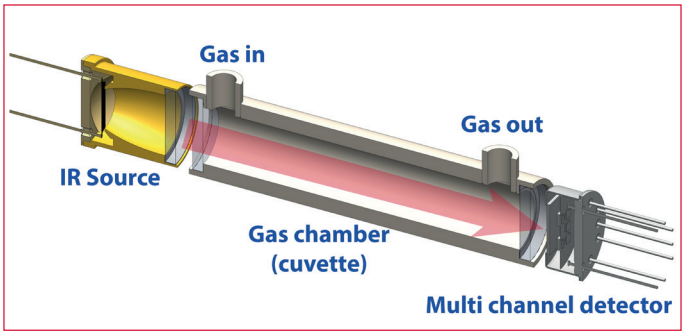


Fig. 7: NDIR gas measurement system

Fig. 7 shows a typical NDIR setup with a broadband, high-power infrared source using a focus beam Winston Cone collimator, an additional reflector at the bottom of the housing and a multichannel IR detector as an infrared sensor.

High radiation power is important because smaller detector and window areas of multi channel detectors reduce the sensitivity and detectivity. A typical 4-channel detector has a detector area of about 4 mm^2 and a window area of about 10 mm^2. With 8 channels the areas are only about half as large. As a consequence, sensitivity and detectivity are reduced significantly. The radiation through the gas chamber with a TO-8 inner diameter of 14 mm results in an irradiation area of about 154 mm^2. The sensor area of a 4-channel detector with 4 mm^2 per channel means that only 2.6 % of the receiving radiation is available for each channel and less than 1.3% for a 8-channel detector.

IR spectroscopy

Especially, in handheld systems, the higher efficiency becomes a big advantage, reducing the battery drain in mobile and handheld systems.

Fig. 8 Shows a mobile FTIR spectrometer which uses a broadband, high-power infrared emitter as IR source to get the most energy over a broad spectrum to the detection area of the sensor.

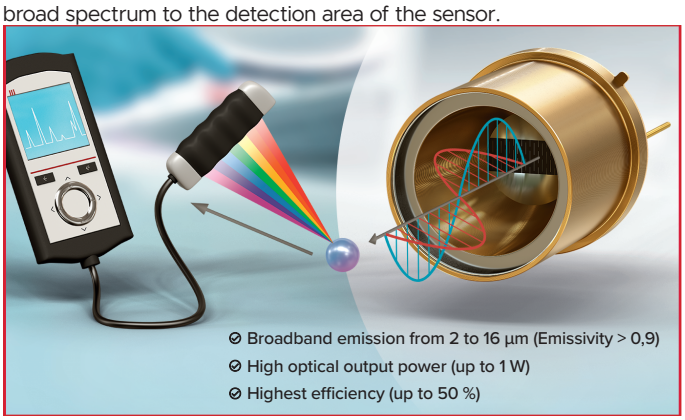


Fig. 8: FTIR handheld spectrometer system

Pure water and waste water analysis (TOC)

TOC (total organic compound) analysis is a non-specific test, which means it is simply a measure of the carbon found in any organic compound in the water. All EPA (environmental protection agency) approved methods for organic carbon analysis require NDIR methods.

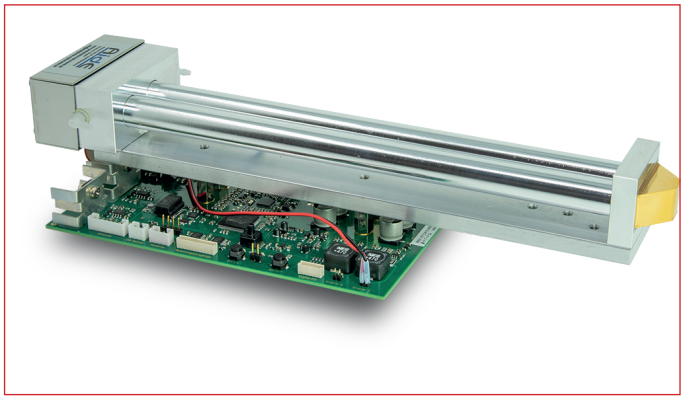


Fig. 9: Module with Lowest range 0 ... 20 ppm CO2 for ultrapure/drinking water analyzers (© AIDE www.analytische-instrumente.de)

Fuel gas, biogas analysis

With multi channel sensors and two independent gas sampling cells the IR gas sensor bench is used for simultaneous measurement of CH4, CnHm, CO and CO2.

Emission monitoring (CEMS)

Best results and a wide dynamic range in emission monitoring and analysis is reached with TWIN IR gas sensors for simultaneous measurement of CO, NO, SO2 and CO2. in this exmple (Fig. 10) other sensors (EC, TCD) are additionally connectable to the IR gas sensor.

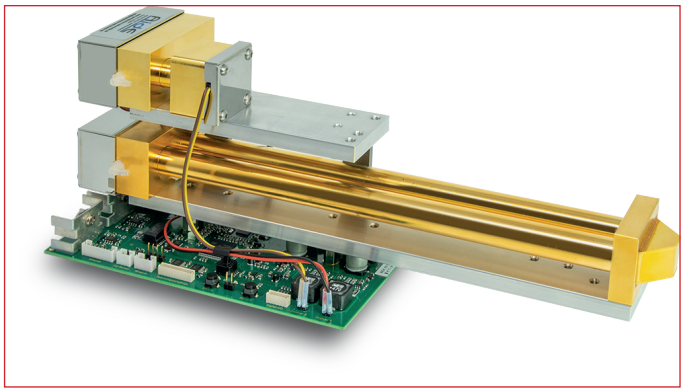


Fig. 10: Example of a very low ppm and wide range twin IR Bench (© AIDE www.analytische-instrumente.de)

Respiratory gas diagnostics

Modern respiratory gas analyzers (e.g. for lung function diagnostics) need fast response times and high resolution for CO and CO2. They use CH4 in lowest concentrations as reference gas. Therefore, no additional sensor, e.g. for He is necessary.

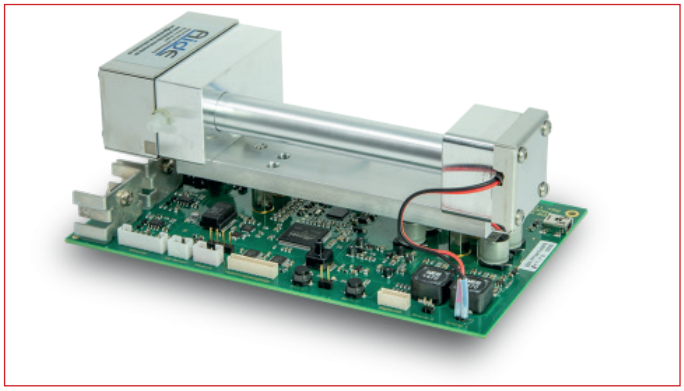


Fig. 12: Example of a modern respiratory gas analyzer module (© AIDE www.analytische-instrumente.de)

Transformer gas diagnostics

Modern optical sensors support applications in monitoring transformers and on-load tap-changers for fault gases. Carbon monoxide, methane and ethylene (acetylene) are detected online in low concentrations.

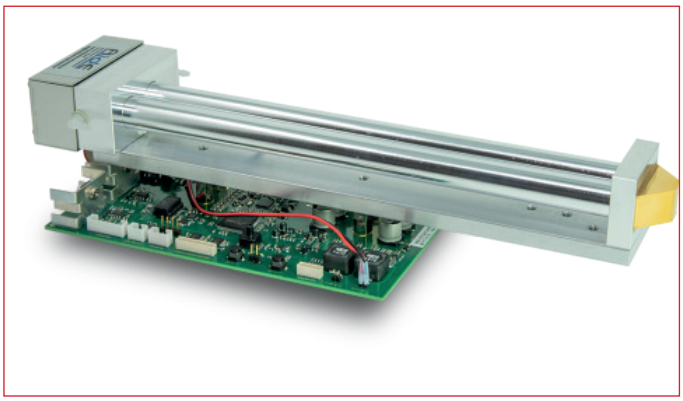


Fig. 13: Example of a modern respiratory gas analyzer module
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C/S elemental analysis

Modern combustion analyzers are ideal for rapid and precise, simultaneous determination of carbon and sulfur in a large variety of solid materials.

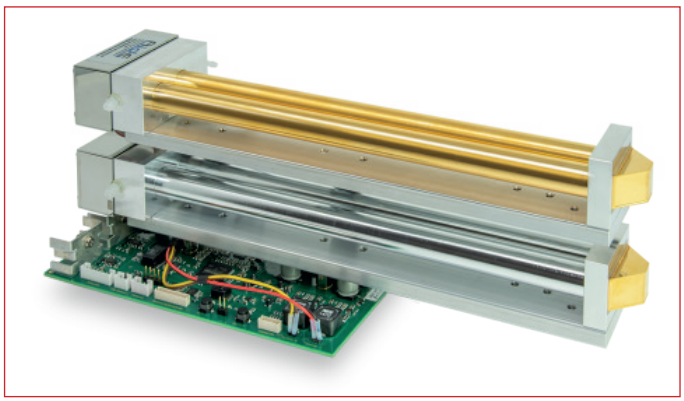

Fig. 14: Example of a modern C/S analysis bench
(© AIDE www.analytische-instrumente.de)

Driving circuit

Infrared emitters from Infrasolid work with simple constant voltage or constant current sources. For highest stability, however, a constant power source is recommended. Fig. 11 shows an example of a simple constant power source to drive TO8 emitters. Further details of the circuit are available from Infrasolid.

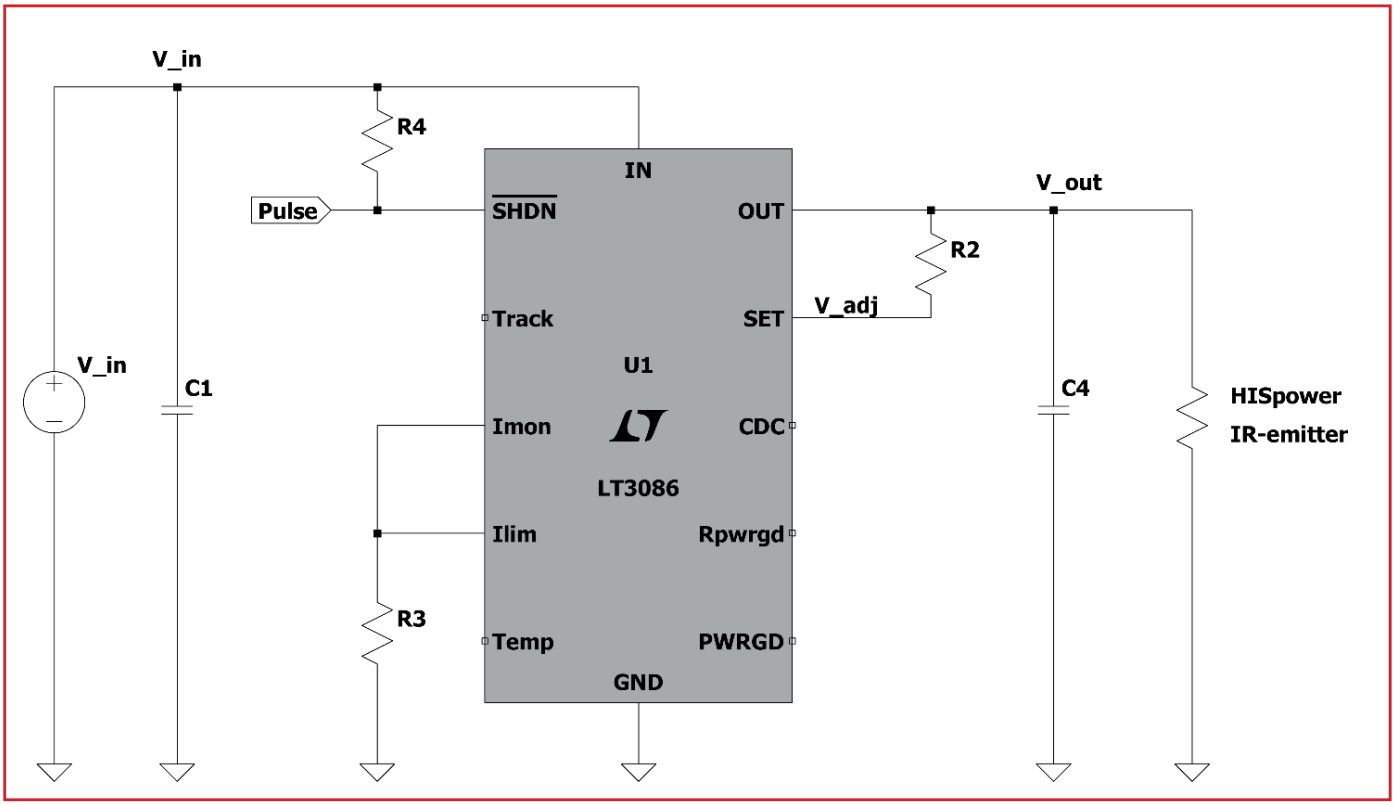

Fig. 15: Example circuit to drive HISpower TO-8 IR emitters from Infrasolid

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