

TECHNICAL
NOTES

ESD Precautions

Thermal
Management

DFB LaserConcept

Tunable Diode
Laser Absorption
Spectroscopy

Reliability

TDLAS for Trace Gas Detection

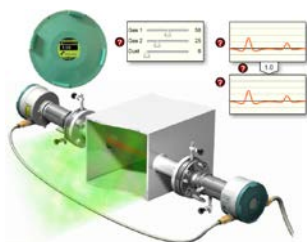
Tunable Diode Laser Absorption Spectroscopy

TDLAS is a laser-based, contactless optical method for trace gas analysis. It is used to measure the concentration of gases (e.g. water vapour, carbon dioxide, methane) in a gas mixture. Due to its many advantages TDLAS has become the mainstream technology for gas monitoring.

This technical note gives an insight into the basic principles of TDLAS.

Key features:

- IN SITU
- IN REAL-TIME
- CONTACTLESS
- PPM LEVEL



Gas Sensor Sample: SensHy Project

making it the ideal **contactless technology** for **portable gas detectors** and the analysis of sticky gases.

Compared to other technologies, such as gas chromatography, TDLAS enables highly

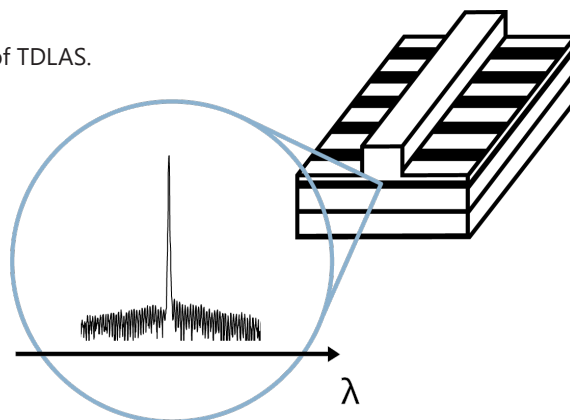
sensitive measurements (**high selectivity** of absorption lines), causes **little operating costs** (**simple system & low cost of ownership**), and can be used in the most **remote and harsh environments** thanks to its **fail-safe operation**.

**"Customized DFB lasers
for your TDLAS application."**

The availability of **distributed feedback lasers (DFB)** at custom wavelengths has helped open up many new markets and applications for TDLAS applications. As an OEM manufacturer, nanoplus offers DFB lasers at any wavelength in the range from **760 nm to 14 μ m** (up to **0.1 nm accuracy!**) in various **custom packages** (**free space, fiber coupled, chip on heatspreader** etc.)

Our sales and R&D teams have many years of experience in laser development. They advise you in your design and realization phase as well as after-sales.

We make market leaders!



DFB laser with spectrum

TDLAS uses the **rotational vibrational absorption features** of molecules to detect trace gases with semiconductor lasers. Sometimes it is also referred to as **TDLAS, TLS, TLAS or TDLARS**.

A powerful and robust technology for gas sensing, TDLAS can detect the **lowest gas concentrations** (**ppm to ppb or even ppt!**). It allows **in situ** measurements in **real-time** (**rapid response**) at or around **room temperature**



nanoplus laser in TO66
package with cap and
collimating lens

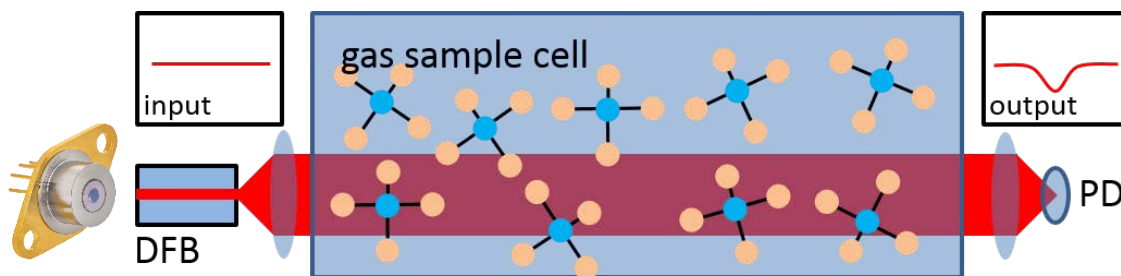
Setup & Concept: TDLAS in brief

TDLAS is as simple as it is reliable and precise compared to other technologies. In the following, we will briefly explain the standard TDLAS setup and the Physics behind it. You can find more detailed information in our extensive literature collection: nanoplus.com/literature

Standard TDLAS setup:

The basic TDLAS setup consists of four main components:

- a **Distributed Feedback laser** - wavelength tuning and emitting monochromatic light at the absorption line of the trace gas
- an **optical lens** to collimate the laser light
- a **gas sample cell** - in this case filled with CH₄
- a **photo detector** on which the laser light is focused - measuring the transmis-



Typical setup of TDLAS application including light source, gaseous mixture and photo detector

TDLAS concept:

TDLAS employs continuous wave Distributed Feedback lasers to scan the gas molecule-specific absorption line by current or temperature.

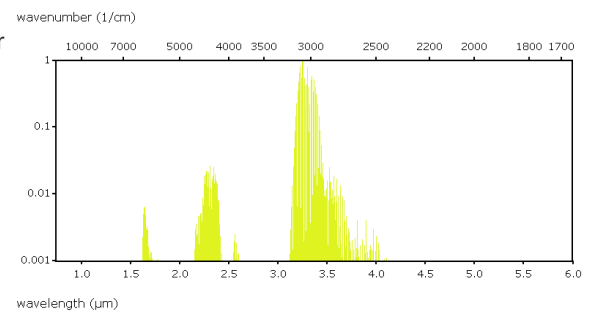
TDLAS is one of the most sensitive, selective and robust technologies for trace gas monitoring. It is based on the **Lambert-Beer law** which states a logarithmic relation between the

- transmission of light through a gas
- product of the attenuation coefficient of the gas
- distance the light travels through the gas

When a gas has an absorption feature at a specific wavelength, the transmitted intensity declines exponentially with:

$$I(v,t) = I_0(v) e^{-S(T) g(v,v_0) n L}$$

With n being the number density of the molecular absorbers, $I_0(v)$ the initial laser intensity and $I(v,t)$ the intensity detected after the probe with an absorption length L .



Absorption spectrum of methane (CH₄)

Further technical notes

DFB laser concept: What is so unique about nanoplus DFB technology?

Reliability: Why nanoplus lasers are fail-proof.

Technical notes: nanoplus.com/downloads

Please contact sales@nanoplus.com for customized specifications, quotes and further questions. Visit our website for technical notes, application samples or literature referrals.

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