Nanosystems and Technologies GmbH

nanoplus

TDLAS for Trace Gas Detection

Tunable Diode Laser Absorption Spectrosocopy

TECHNICAL NOTES

ESD Precautions

Thermal Management

DFB LaserConcept

Tunable Diode Laser Absorption Spectroscopy

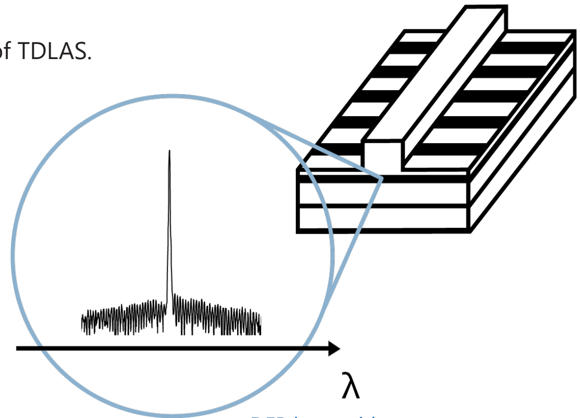
Reliability

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.

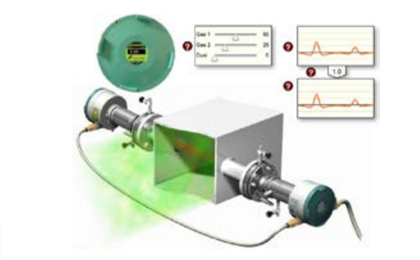
This technical note gives an insight into the basic principles of TDLAS.

Key features:

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



DFB laser with spectrum



Gas Sensor Sample: SensHy Project

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** 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 µm** (up to **0.1 nm accuracy**!) in various **custom packages** (**free space**, **fiber coupled**, **chip on heatspreader** etc.)

nanoplus laser in TO66 package with cap and collimating lens

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!

REGISTERED COMPANY ISO 9001 14001

ATTENTION OBSERVE PRECAUTION FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES

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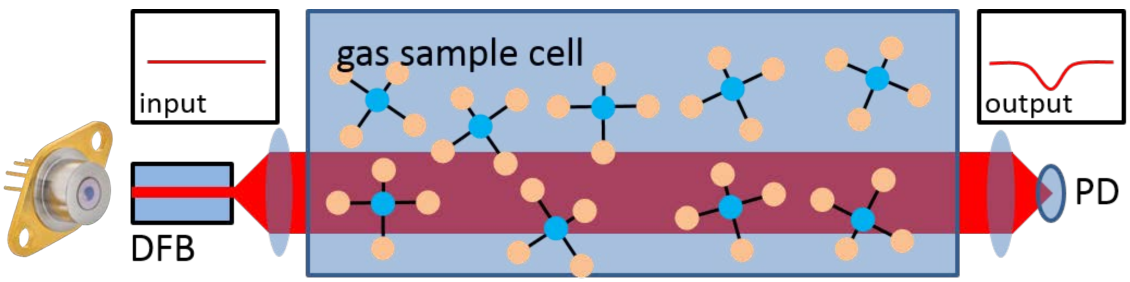
Setup & Concept: TDLAS in brief

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 CH_4
- 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:

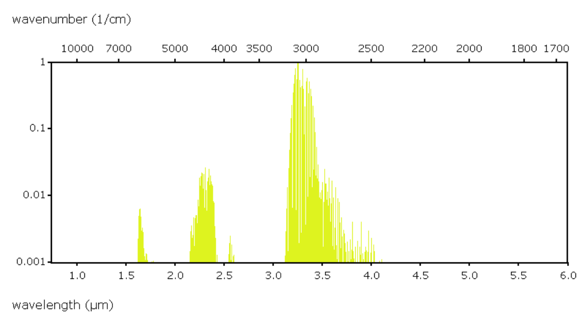
TDLAS employs continuous wave Distributed Feedback lasers to scan the gas molecule-specific absorption line by current or temperature.

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:

$I(\nu,t) = I_0(\nu)\, e^{-S(T)\, g(\nu,\nu 0)\, n\, L}$



Absorption spectrum of methane (CH_4)

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

Rev.TDLAS.01

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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