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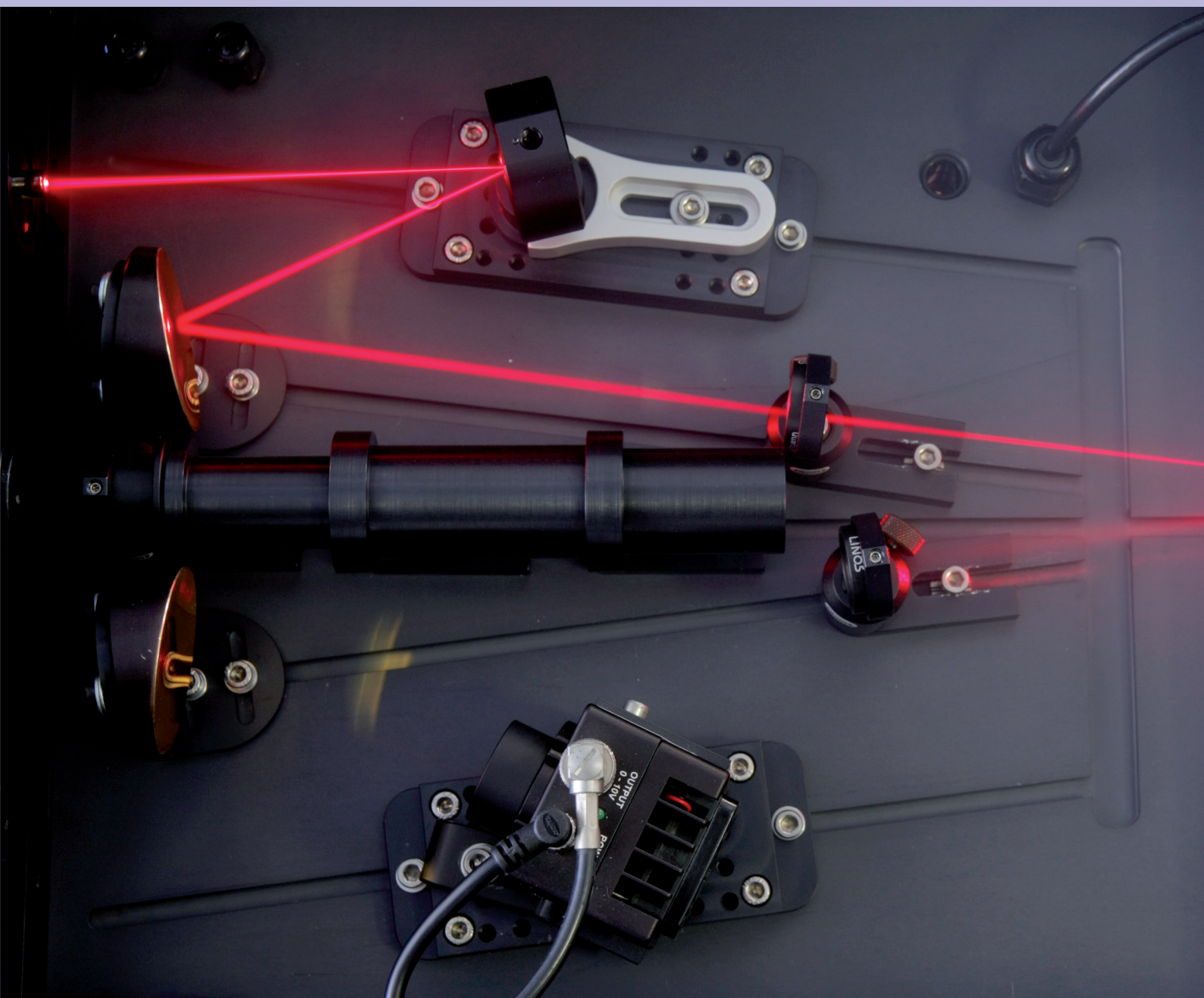
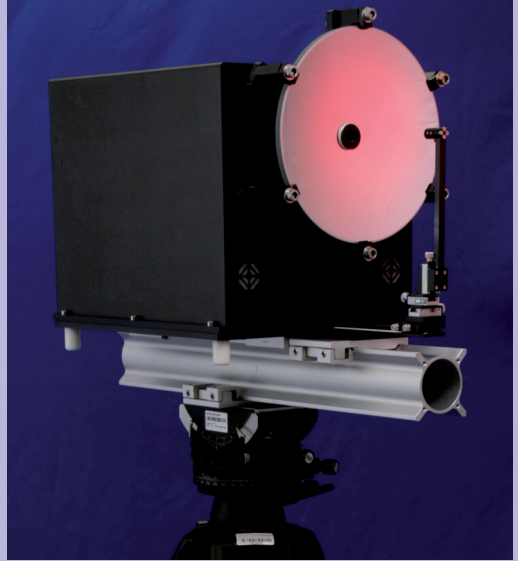
FRAUNHOFER INSTITUTE FOR CHEMICAL TECHNOLOGY ICT

HIGH-SPEED HIGH-RESOLUTION 2 CHANNEL AOTF-NIR-SPECTROMETER





PICTURE

Spectrometer in open-path configuration.

Introduction

A specific characteristic of this spectrometer type is the use of an acousto-optically tunable filter (AOTF) as a dispersive element. Light diffraction is achieved by photon-phonon coupling in a crystal exposed to a (tunable) high-frequency mechanical wave. The initial light beam passing through the crystal is split off into three parts: a non diffracted linear beam (zero-order beam), and an ordinary and extraordinary beam.These are sited at a specific angle around the zero-order beam and consist of light in the same (narrow) wavelength range that is perpendicularly polarized. No gratings, photo diode arrays or other mechanical parts are needed.

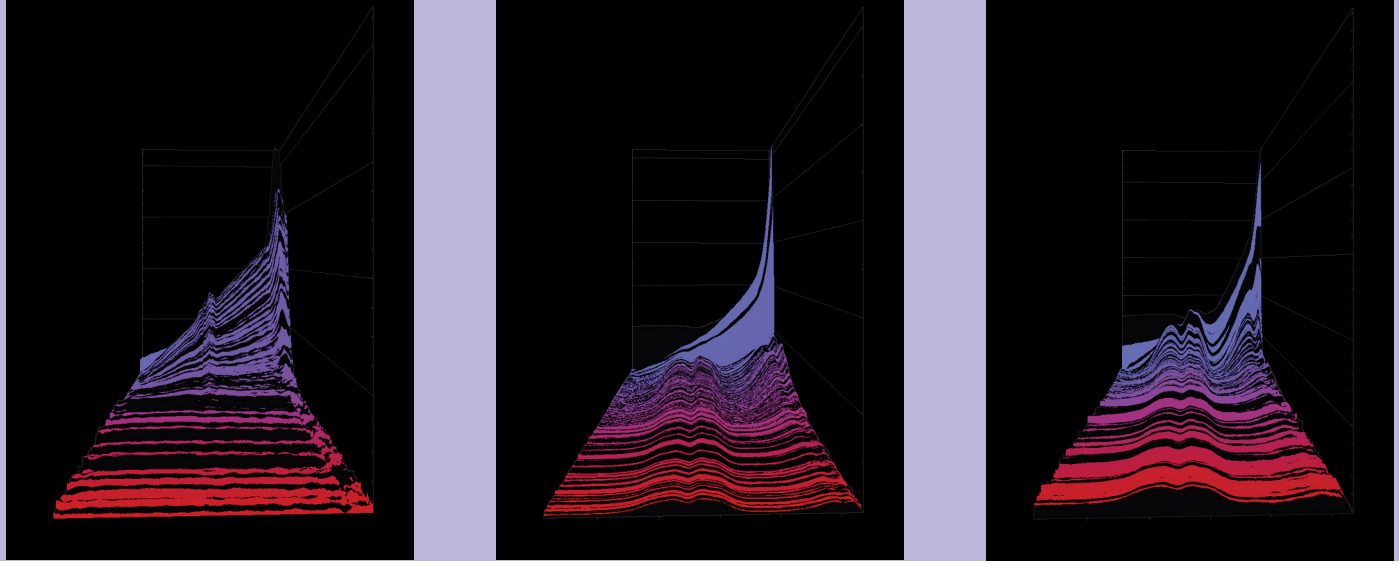
Layout

The NIR spectrometer developed at the Fraunhofer ICT consists of an AOTF (TeO_2) driven by a piezo quartz stimulated by a direct digital synthesizer (DDS). The detection of the two diffracted beams is achieved by extended InGaAs photo diodes, which are thermo-electrically cooled. The spectrometer can be operated in open-path mode or by using a glass fiber (SMA). The system is controlled by a high-performance C++ software (developed in-house) running on a connected PC. The software utilizes up-to-date modular programming concepts and allows easy adaptation to different applications as well as the ex-post integration of add-ons. For example, an online / offline material identification module is available.

Features

All spectrometer settings can be easily changed by the software. Any desired fine-tuning can be saved by combining all the parameters in a configuration set, which can be recovered by a single mouse click. By adjusting only a few key parameters the spectrometer's operation mode can be changed between high resolution and high performance or any desired inter-mediate. Due to the possibility of simultaneously recording the ordinary and the extraordinary beam, the 2 channel mode can be used either to improve the S/N ratio or to detect the optical anisotropy / activity of the examined material.

Since the spectrometer delivers equidistant spectra, calibration / identification parameters can be easily interchanged between individual devices. Numerous built-in spectra treatment operations can be selected and combined in cascade to process the spectra as required. Freely configurable digital input and output channels permit communication with external devices such as PLCs.



Applications

■ High-speed spectra sequences

Spectroscopic tracking of fast chemical reactions can easily be achieved by trigger-controlled high-speed spectra sequences. For example, using 128 points per spectrum up to 1500 spectra per second can be recorded.

■ High-resolution gas and liquid phase spectra

Using the whole wavelength range (1.25 – 2.6 µm), or any desired subsection, high sensitivity and a spectral resolution of 2.5 nm can be achieved. This is a particular advantage in material identification and / or content detection in industrial online applications.

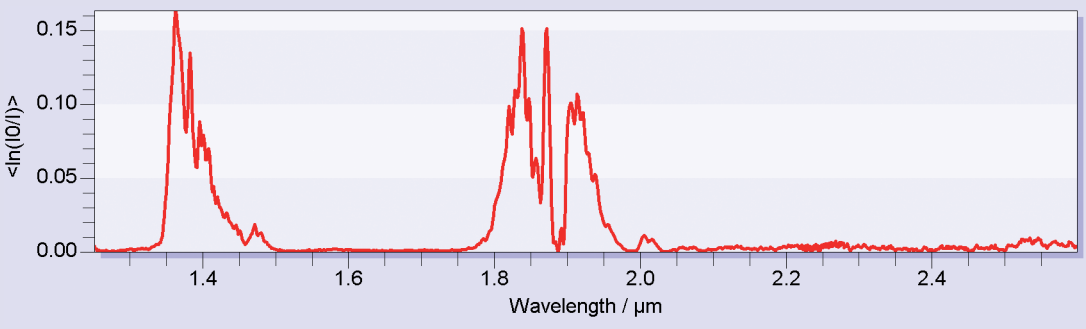
PICTURE GALLERY

High-speed spectra sequences taken from explosions with increasing water content in the plume.

Technical data

Wavelength range	1.25 µm - 2.6 µm
Resolution	2.5 nm
Spectral point count	2 – 2000
Maximum scanrate	1500 Hz (128 pixel, 1 channel)
Minimum acquisition (sweep) time	64 µs (128 pixel, 1 channel)
Channel count	1 – 2 (∥ and ⊥ mode)
Light input	Open-path or glass fiber (SMA)

High-resolution water vapor spectrum



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2 CHANNEL AOTF-NIR-SPECTROMETER

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