Fiber coupled THz time-domain spectrometer

FC TDS

Main Features

- Pulsed THz spectroscopy up to 1.5 THz
- Low form factor, few components
- Fiber coupled emitter and detector modules
- Transmission and reflection geometry
- Focused or collimated THz-beams
- Including software

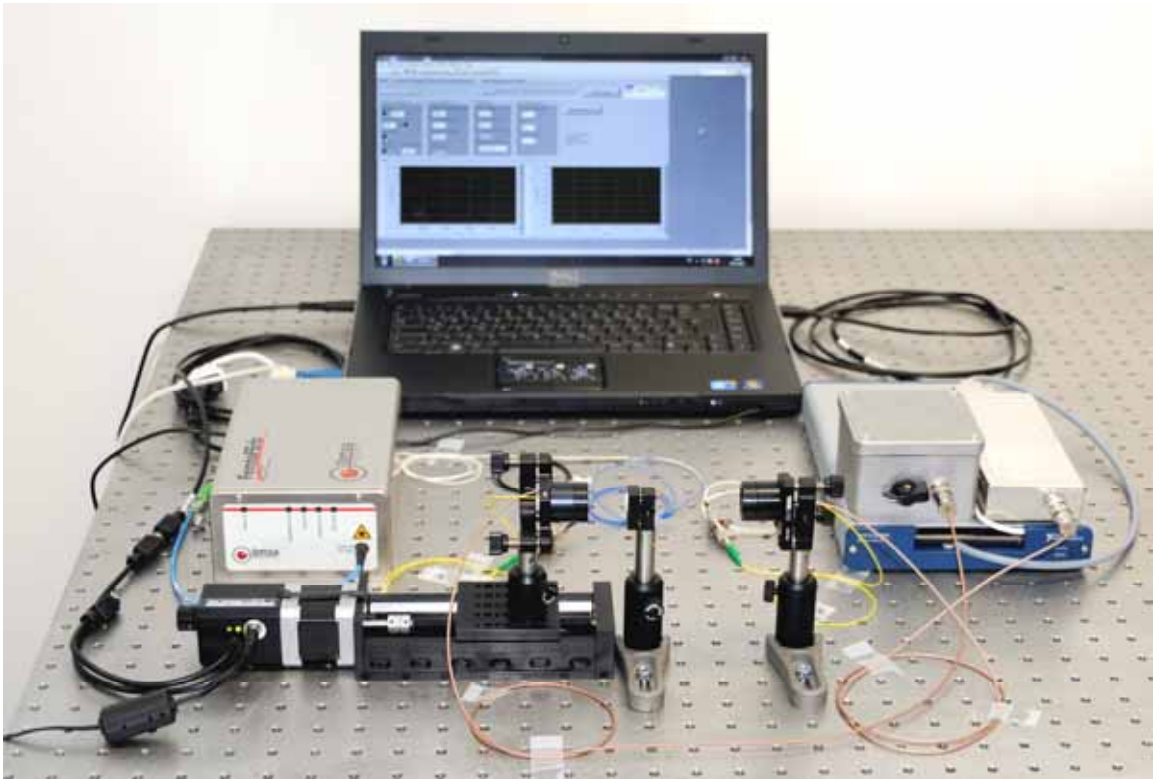

Fig. 1: Fiber-coupled THz time-domain spectrometer with THz focus

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Spectrometer description:

BATOP's fiber-coupled THz time-domain spectrometer generates and detects pulsed terahertz radiation. Emitter and detector are photoconductive antennas (PCA). By repeatedly introducing a known time delay between the laser pulses, which gate the PCAs, the THz waveform is sampled. This is done by placing one of the PCAs on a translation stage. This is possible due to utilization of one or two collimating substrate lenses. The time delay of 500 ps, which corresponds to the maximum displacement of the linear stage, leads to a frequency resolution smaller than 3 GHz. The spectrometer comes with a laptop and appending software, which enables PC-controlled measurements and subsequent evaluation. Complete electronics for a lock-in detection scheme (pulse generator, amplifier and DAQ-board) complete the device.

This setup offers high flexibility and a variety of possible experimental setups (pls. see options section), that can be changed within minutes.

A selection of possible applications is material characterization, nondestructive quality control, chemical and biomedical research.

Schematic diagram

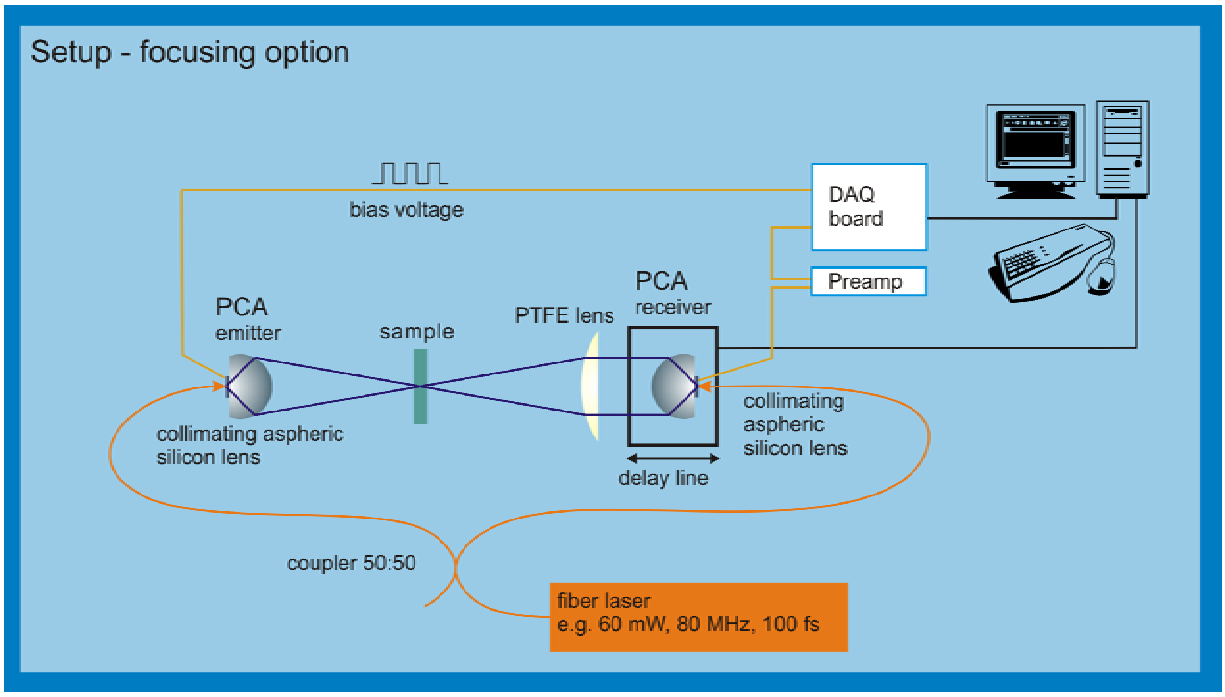

Fig. 2: Schematic diagram - focusing option

Specifications

Useable spectral range	0.05 to 1.5 THz
Dynamic range (THz power)	> 50 dB
Scan range	500 ps (< 3 GHz frequency resolution)
THz beam diameter	12 mm (collimated option)
THz spot size	1.5 mm @ 1 THz (focusing option)
Fast scan duration	0.5 s
Slow scan duration	8 min
Emitter bias voltage	10 V
Modulation frequency	1 to 30 kHz, (10 kHz default)
Supply voltage	115 .. 230 V

Components

The spectrometer comes with the following items:

- THz emitter module (fiber-coupled PCA with substrate lens)
- THz detector module (fiber-coupled PCA with substrate lens)
- delay line
- signal amplifier
- DAQ-Board
- Laptop including spectrometer software
- fiber and electronic cables
- optional: sample holder
- optional: PTFE-lens including mount and post

Options

Collimated THz beam

This option utilizes two PCAs with collimating substrate lenses. The THz-beam diameter is 12 mm. The distance between both antennas can varied depending on sample thickness and fiber cable difference. The emitter will be placed on the delay line.

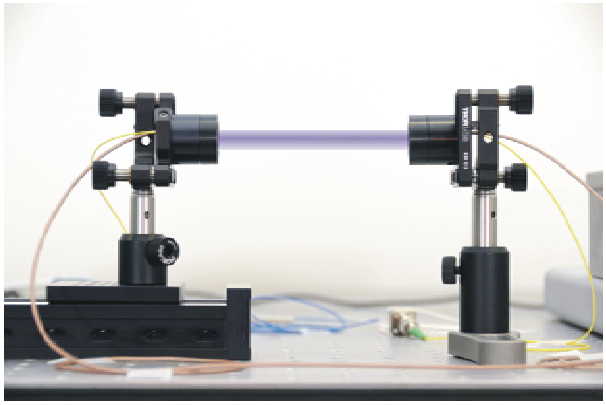

Fig. 3: figurative terahertz path - collimated option

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Focused THz beam

The receiver is equipped with a focusing substrate lens. A PTFE lens with the same focal length is placed twice this distance away to collimate the THz-radiation. The emitter holds a collimating substrate lens and is placed on the delay line.

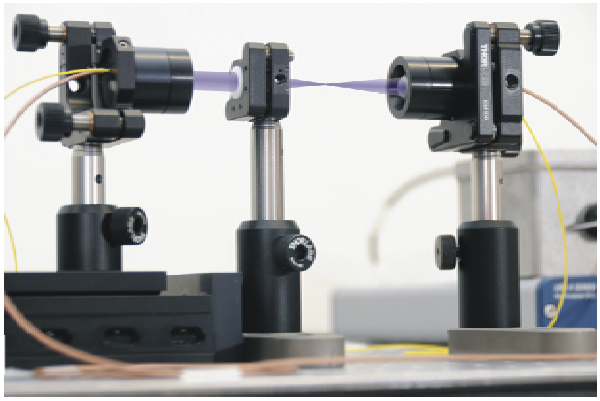
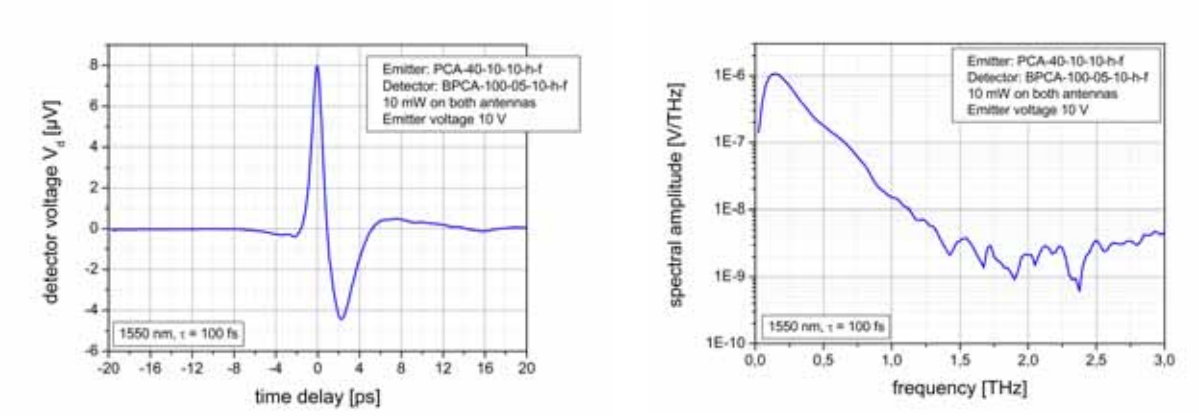


Fig. 4: figurative terahertz path - focused option

Performance examples



1560 nm fs laser with emitter PCA-40-10-10-1550-h-f and detector BPCA-100-05-10-1550-h-f

Software

The Tool for Terahertz Time-Domain Spectroscopy (T3DS) controls the spectrometer. It handles delay line and data acquisition, records, displays and stores THz-waveforms. There are two measurement modes: a fast scan mode for adjustment and a slow step mode for experiments. It is possible to sample and keep a Reference. It will be displayed simultaneously to later measurements. Naturally the program performs the Fourier-Transformation of the recorded time-domain signals. Within Reference and measurement spectra can be compared and their ratios are calculated. The whole dataset can be exported for further analysis.

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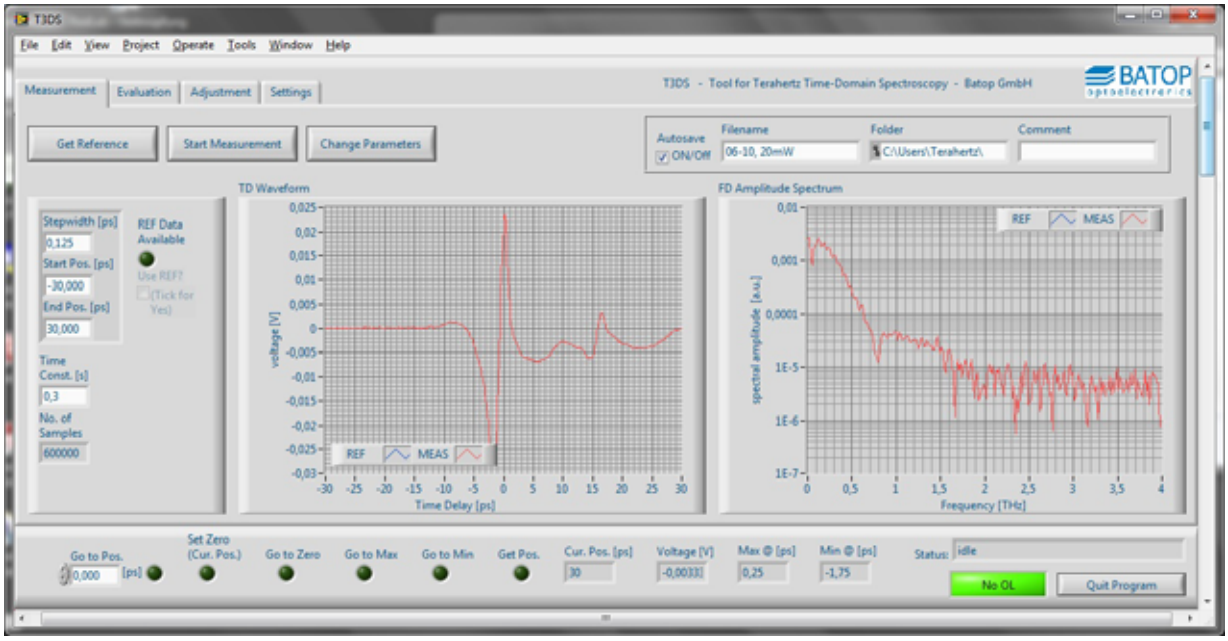

Fig. 5: Screenshot of T3DS

Laser requirements

Wavelength: 1 µm, 1.56 µm

Pulse duration: up to 200 fs (the shorter the better)

Repetition rate: ~ 100 MHz

Mean optical power: ≥ 60 mW

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