



A Passion for Precision.

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Press Release

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Terahertz Spectroscopy and Imaging

Leading-edge technology – laser-based & all-electronic

TOPTICA Photonics has broadened its terahertz product portfolio. Exhibits at Photonics West feature

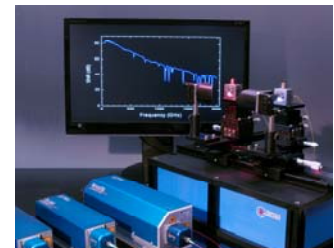
- latest femtosecond laser technology for time-domain applications,
- a spectroscopy kit for frequency domain (cw) terahertz generation,
- and a new all-electronic system for 3D terahertz imaging.

Light at terahertz frequencies (0.1 – 10 THz, or wavelengths between 3 mm and 30 μm) has unique properties. Terahertz waves can penetrate materials like synthetics, clothing, cardboard and paper. On the other hand, many gases and organic solids, including proteins, explosives and narcotics, show distinct spectral fingerprints in the terahertz range.

New ultrafast fiber laser FemtoFiber pro

Terahertz spectroscopy has become the domain of optoelectronic, laser-based techniques. Femtosecond lasers or tunable diode lasers irradiate a non-linear element (crystal, photoconductive switch or photomixer), which converts the near-infrared laser output into terahertz waves – either broadband or spectrally resolved.

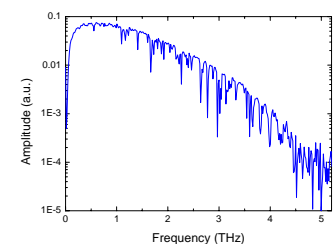
Advantages of a pulsed setup are a wide bandwidth and short acquisition times. TOPTICA's new FemtoFiber pro laser offers superior specifications in a compact, truly turn-key system. The FemtoFiber pro makes use of saturable absorber mirror (SAM) technology to initiate a stable pulse train, with pulse widths well below 100 fs. Both the fundamental wavelength (1560 nm) and the second harmonic (780 nm) are available from one unit, which can thus be used with GaAs, InP or DAST-based emitters. The average power is as high as 350 mW at 1560 nm and 140 mW at 780 nm – an industry-leading value for ultrafast fiber lasers. The entire assembly is made of polarization-maintaining fibers, increasing the reliability and robustness of the system. In combination with a suitable terahertz emitter, e.g. a low-temperature-grown GaAs photoconductive switch, pulse spectra with 5 THz bandwidth have been demonstrated.



Terahertz spectroscopy and imaging.



New femtosecond fiber laser FemtoFiber pro.



5 THz pulse spectrum acquired with FemtoFiber pro (courtesy Otsuka Electronics).

Author:

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New cw terahertz spectroscopy kit

Advantages of continuous-wave techniques are spectral purity, excellent resolution and a high signal-to-noise ratio of the terahertz power. Frequency-domain spectroscopy is thus the method of choice for precision measurements, e.g. in terahertz-based gas sensing.

TOPTICA's new cw Terahertz Spectroscopy Kit comprises all required components to get a real measurement started! Leading-edge photomixers provide record-level SNR values up to 90 dB and bandwidths up to 2 THz. The photomixers are equipped with a single-mode fiber pigtail, alleviating the need for cumbersome beam alignment. The Spectroscopy Kit further features TOPTICA's proprietary TeraControl unit TC110, a compact, digital lock-in amplifier module, as well as a low-noise transimpedance amplifier and an intuitive graphical user interface. Both amplitude and phase of the terahertz wave can be evaluated.

The Spectroscopy Kit complements the existing laser packages for cw terahertz generation. The Standard Package comprises two tunable DFB diode lasers with fiber-optic beam combination and laser driver electronics. The High Power Extension employs TOPTICA's established semiconductor amplifier technology to boost the optical power to the 0.5 W level. Ultimate spectral resolution is achieved with the High Precision Extension: By means of a patented interferometer design, the terahertz frequency can be controlled with single-MHz accuracy. All of the packages are modular and can be combined according to the needs of an individual experiment.

New all-electronic imaging system

Terahertz imaging benefits from the high power levels available with all-electronic sources. TOPTICA has signed a distribution agreement with Frankfurt-based terahertz imaging specialist SynView GmbH. SynView, a spin-off from the University of Frankfurt/Main, is a technology leader in the field of all-electronic millimeter-wave imaging.

The SynView systems use high-power electronic emitters at 100 GHz (SynViewScan 100) or 300 GHz (SynViewScan 300), and combine an xy scanning stage with a frequency modulation technique to acquire 3D terahertz data. The depth and thickness resolution is better than 20 μm , the spatial resolution is approx. 1 mm at 300 GHz. Using a heterodyne detection scheme, a dynamic range greater than 50 dB is attained. A full 3D image can thus be generated within only a few minutes.

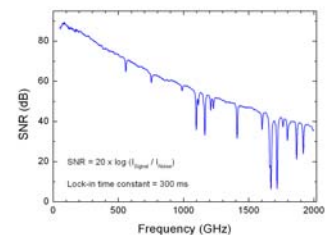
The SynViewScan is the system of choice for non-destructive testing applications. It lends itself to the analysis of hidden structures in compound materials, and identification of manufacturing defects in production lines of semiconductors or ceramics. 3D imaging also enables a precise characterization of surface structures and coatings, even if the object under test is covered.

TOPTICA is proud to be the only company worldwide that serves researchers and engineers in both frequency-domain and time-domain terahertz spectroscopy, as well as in terahertz imaging. See the new systems live at Photonics West 2010, booth # 517!

TOPTICA Photonics AG develops, manufactures, services and distributes technology-leading diode and fiber lasers and laser systems for scientific and industrial applications. Sales and service is offered worldwide through TOPTICA Germany and its subsidiary TOPTICA USA, as well as all through 14 distributors. A key point of the company philosophy is the close cooperation between development and research to meet our customers' demanding requirements for sophisticated customized system solutions and their subsequent commercialization.



cw photomixers with single-mode fiber pigtail.



Dynamic range of cw terahertz spectrometer. The dips are absorption lines of water vapor. Even fine spectral structures are resolved.



SynView transceiver head.



Photograph (top) and terahertz image (bottom) of a suitcase with various objects (courtesy Synview GmbH).

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