DECLARATION OF ROBIN F. RISSER

I, Robin F. Risser, state as follows:

1. I am the President and General Manager of Picometrix, LLC, the applicant of US Application No. 77/111,199.

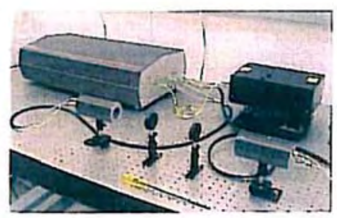
2. The mark "T-Ray" was first used at least as early as January 24, 2000 at the Photonics West conference. A copy of promotional materials evidencing the same is shown below:

PICOMETRIX

T-RAY SYSTEM

DEMONSTRATION

WITH VITESSE ULTRAFAST LASER



Coherent Laser Group,

Booth # 828, Photonics West, San Jose,

25-27 January 2000

Paper presented at Conference on Commercial and Biomedical Applications of Ultrafast Lasers II

Photonics West, San Jose, January 24, 2000

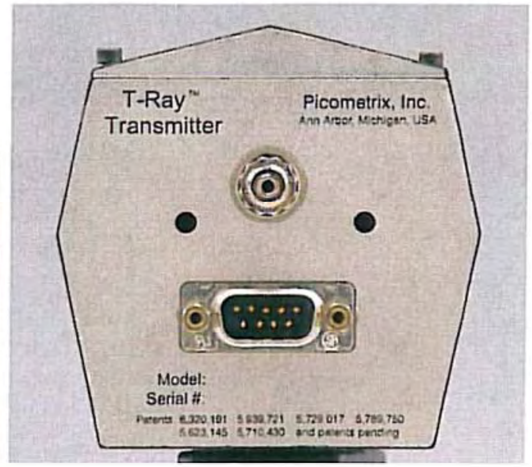
3. Goods were first sold under the mark "T-Ray" at least as early as December, 2000.

4. The best of my knowledge, for the last eight (8) years Applicant's use of the mark "T-Ray" in connection with imagining and spectroscopy systems and instrumentation has been substantially exclusive and continuous.

5. Goods bearing the mark "T-Ray" have been sold in the United States, Canada, Israel, Australia, Germany, and China.

6. The Applicant has sold over one hundred of imaging and spectroscopy systems and component products under the mark "T-Ray" since 2000. The cost of each system and/or components varies from tens of thousands dollars to hundreds of thousands of dollars and reflects careful and sophisticated purchasing.

7. The mark "T-Ray" has been silkscreened on all systems and products, as well as used in product brochures, manuals, the Internet, press releases and advertising. Examples of product marking with T-Ray trademark:



Example of product brochure with T-Ray trademark:

PICOMETRIX
an API company

T-Ray™ 4000 TD-THz System

The T-Ray™ 4000 changes the paradigm of time-domain terahertz (TD-THz) generation and detection. No longer is terahertz the experiment. Now it is the tool. With interchangeable fiber-coupled heads and all necessary components built-in, the T-Ray™ 4000 moves terahertz measurements from the lab table to the bench-top to the factory floor.

Operating in either reflection or transmission mode, the interchangeable fiber-coupled sensor heads deliver a picosecond duration TD-THz pulse, allowing high-speed, scanned images to be easily produced.

FEATURES

- Complete system in a 4 RU 19" enclosure
- Fiber-coupled sensor heads
- Transmitted or reflected data collection
- Full waveform resolution
- High-speed scanning and data acquisition
- Scanned images through most materials
- Multiple sensor heads available
- Dedicated software package
- Multiple lens configurations available

APPLICATIONS

- Gas, liquid and solid spectroscopy
- Nondestructive materials inspection
- Package inspection
- Semiconductor wafer inspection
- Reaction kinetics monitoring
- Medical and biological imaging research
- Remote threat detection
- Subsurface corrosion detection
- Homeland Security solutions

T-Ray™ 4000

8. The Applicant's annual advertising budget for goods sold under the T-Ray trademark have averaged approximately one million dollars per fiscal year.

9. The Applicant's advertising has been through national print advertising, international print advertising, exhibitions and conferences, and through the Internet. Examples of advertising bearing the T-Ray trademark are provided below:

PICOMETRIX
an API company

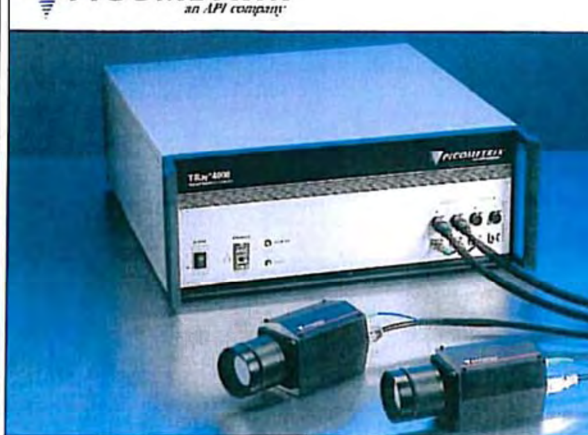
Leaders
in Terahertz Instrumentation for the Research Laboratory and the Factory Floor

Nondestructive Evaluation / Testing
Explosives and Weapons Detection
Industrial Process Monitoring

Feasibility Studies
Application Development
Material / Chemical Characterization

For more information visit the API website
www.advancedphotonix.com
or contact us at 734.864.5600
2925 Boardwalk.Ann Arbor.MI.48104.USA

PICOMETRIX
an API company



テラヘルツイメージングが実験からツールへ

卓上型テラヘルツシステム
T-Ray™ 4000 TD-THz* System

特長	用途	
・帯域：0.02~2THz (3THzオプション有)	・化学検査	・武器持込検査
・SN比：>70dB	・爆発物検査	・坪量(g/m²) 検査
・スキャンスピード：100Hz	・麻薬検出	・製品の品質安定性検査
・重量：約25kg	・コーティング厚測定	・構造完全性検査
・ヘッドレシーバーのマルチチャンネル接続可＝多ポイント計測可能	・水分分析	

*time-domain terahertz

株式会社オプトサイエンス

Innovative PRODUCTS

uses light in the range from 365 to 1100 nm at selected wavelengths. A precisely defined, constant light beam penetrates the process medium, is divided by a beam splitter and passes through the interference filters at application dependent wavelengths. Two hermetically sealed silicon photodiodes detect the attenuation of the light intensity and compensate for turbidity in the process streams. The optical window is made from a single crystal sapphire, providing resistance to abrasive and corrosive media. Line sizes range from ½ to 8 in., optical path length is from 1 to 1000 mm, and operating temperature is from 0 to 40 °C.
optek-Danulat
info@optek.com

COLOR SENSORS

For sorting, positioning and quality control in packaging and converting applications, Pepperl+Fuchs Inc.'s Dura-Vue DF12 series color sensors can be taught to recognize three independent colors with a single sensor. Programming is via a potentiometer setting at the sensor or via a remote teach signal from a programmable logic controller. Each of the three channels can detect even minute color variations, with user selected degrees of tolerance. The metal framed housing features a swivel connector.
Pepperl+Fuchs
sales@us.pepperl-fuchs.com

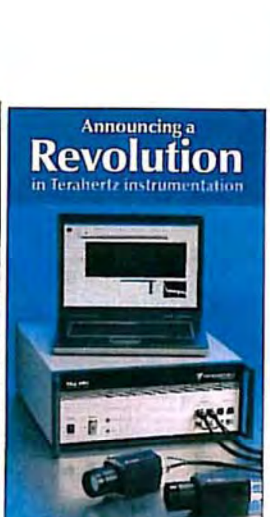
SOFTWARE

Photon Inc.'s NanoScan beam profiler software now operates on the Windows Vista operating system. The software can measure from one to 16 beams in the NanoScan aperture, all with submicron precision. The profiler uses a proprietary scanning-slit technique to generate accurate profiles to obtain beam size, position, M^2 value and other parameters. Scan heads are available to measure CW and pulsed beams across the entire spectral range, from the UV to the far-IR. The digital controller is based on PCI architecture, providing deep 16-bit digitization of the signal for an enhanced dynamic range of up to 35 dB.
Photon
beam@photon-inc.com

7-W BUCK LED DRIVER

A buck converter optimized for driving high-brightness, 350-mA LEDs at up to 94% efficiency has been released

Announcing a
Revolution
in Terahertz Instrumentation



The T-Ray™ 4000

The 4th Generation in Time-Domain THz Instrumentation from the Industry Leader in Commercial Terahertz Equipment

Full-Featured
long temporal window
high spectral resolution

Freely Positionable
fiber-coupled, solid-state sensors
remote measurement capacity

Stand-Alone
embedded processing

Multi-Channel
signal and reference
simultaneous measurements

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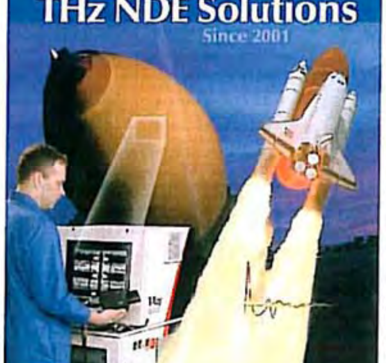
packages, or extremely low-profile military applications. The compound brackets achieve greatly enhanced performance by using a two-step weld process with stiff-spring/soft-spring attenuation to reduce the effect of the final weld shift. Initial positioning and bonding is executed by positioning and then welding the inner "coarse weld" feet, the outer "fine adjust" tabs are then adjusted, using the same manipulators, to reposition the lens or fiber by eliminating radial offset due to shifts taking place while attaching the inner feet. Throughout the second-stage process of fine adjustment and final welding, the spring attenuators perform the dual function of enhancing precision and then "absorbing" weld shift using the concept of series stiff-spring/soft-spring attenuation. Compound brackets typically reduce weld shift by a factor of five for typical 7 mm-wide brackets, with higher levels of attenuation possible in larger brackets. In applications that do not require tenth-micron-level precision, compound brackets allow for easy reworkability, since the outer feet can be used to correct for any process-related shifts that occur during product assembly or testing.

For a FOG to survive demanding environments such as those in guided weapons or military vehicles, the components must meet extremely harsh shock and vibration specifications. In addition, operating and storage temperatures vary widely (typically -54°C to +85°C), and of course reliability and long shelf life are of paramount importance. While the

> The lens mounting and positioning techniques have been specifically developed to meet these demanding criteria and are currently being used to produce IFOG transceiver packages with a high degree of hybrid integration.

exact specifications are often proprietary or classified, it is clear that traditional telecom-grade production techniques are not appropriate for these environments. The lens mounting and positioning techniques described here have been specifically developed to meet these demanding criteria and are currently being used to produce IFOG transceiver packages with a high degree of hybrid integration. The use of free-space optics permits the widest possible range of devices from multiple materials systems to be employed, including SLEDs, detectors, and other passive optical conditioning elements, and this is not possible today with monolithic waveguide integration techniques.

Delivering
THz NDE Solutions
Since 2001



Featuring:
- High resolution imaging/spectroscopy
- Reflection and transmission configurations
- Ruggedized for manufacturing environments
- Application development user facilities

PICOMETRIX
an API company

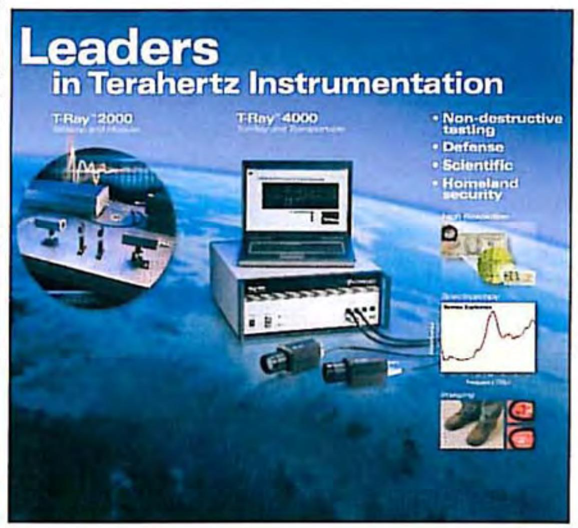
www.picometrix.com • 734.864.5600

10. The Applicant has exhibited and shown goods under the "T-Ray" mark in numerous exhibitions and conferences around the world, including:

Show	Date	Year	Location
Photonics West	Jan	2000	CA
Conference on Lasers and Electro-Optics	May	2000	MD
Interopto	July	2000	Japan
Space terahertz	May	2000	MI
Biomedical Imaging and Sensing Applications of THz Technology	Nov	2001	UK
Aerosense	Apr	2003	FL
Conference on Lasers and Electro-Optics	May	2003	MD
SURA Terahertz Applications Symposium	June	2003	DC
Lasers	June	2003	Germany
Interopto	July	2003	Japan
Fraunhofer	Feb	2004	Germany
Aerosense	Apr	2004	FL
Conference on Lasers and Electro-Optics	May	2004	MD
Great Lakes Photonics Symposium	June	2004	OH
Department of Homeland Security Conference	July	2004	CA
Quantitative Nondestructive Evaluation	July	2004	CO
Terahertz Systems Conference	Dec	2004	DC
Terahertz for Defense and Security	Dec	2004	Australia
Photonics West	Jan	2005	CA
Optical Terahertz Science & Technology	Mar	2005	FL
Aerosense	Apr	2005	FL
SURA Terahertz Applications Symposium	June	2005	DC
Quantitative Nondestructive Evaluation	July	2005	ME
International Conference on Infrared, Millimeter, and Terahertz Waves	Sept	2005	PA
Terahertz Systems Conference	Oct	2005	CA
International Foundation Process Analytical Chemistry	Jan	2006	MD
Photonics West	Jan	2006	CA
Pittsburgh Conference	Feb	2006	FL
Fraunhofer	Mar	2006	Germany
Photon Forum	April	2006	MA
Defense & Security Symposium	April	2006	FL
International Symposium on Spectral Sensing Research	May	2006	ME
SURA Terahertz Applications Symposium	June	2006	DC
Explosives Detection Conference	June	2006	FL
Quantitative Nondestructive Evaluation	July	2006	OR
European Conference on Nondestructive Testing	Sept	2006	Germany
Safeskies	Oct	2006	DC
International Foundation Process Analytical Chemistry	Jan	2007	MD
Optical Terahertz Science & Technology	Mar	2007	FL
Pittsburgh Conference	Mar	2007	IL
Defense & Security Symposium	Apr	2007	FL
Conference on Lasers and Electro-Optics	May	2007	MD
Conference on Lasers and Electro-Optics	May	2007	Baltimore

SURA Terahertz Applications Symposium	June	2007	DC
International Chemical and Petroleum Industry Inspection Technology	June	2007	Houston
Quantitative Nondestructive Evaluation	July	2007	CO
International Conference on Infrared, Millimeter, and Terahertz Waves	Sept	2007	Wales
Federation of Analytical Chemistry and Spectroscopy Societies	Oct	2007	Memphis
International Foundation Process Analytical Chemistry	Jan	2008	Baltimore
Pittsburgh Conference	Mar	2008	NO
Defense & Security Symposium	Mar	2008	Orlando
American Society of Nondestructive Testing	Mar	2008	Anaheim
Conference on Lasers and Electro-Optics	May	2008	San Jose
SURA Terahertz Applications Symposium	June	2008	DC
Electromagnetic Nondestructive Evaluation	June	2008	Korea
International Symposium on Spectral Sensing Research	June	2008	NJ

11. Examples of exhibit booth art using the "T-Ray" mark in the above-identified conferences and exhibitions include:



12. The Applicant has received extensive industry recognition and won many industry awards for its goods sold under the "T-Ray" mark, including:

   I. 2000 Photonics "Circle of Excellence" Award,

   II. 2001 R&D 100 Award,

   III. 2004 Photonics "Circle of Excellence" Award, and

   IV. 2008 PhAST/Laser Focus World Innovation Award

13. The Applicants goods sold under the "T-Ray" mark have been the subject of many third party articles, examples of which include:

COMPANY PROFILE

induced version of a spark-gap transmitter, which was the first kind of radio transmitter ever developed."

Secrets to success

At the heart of the Picometrix system is a saturated fibre-pigtailed THz module, which is permanently aligned and hermetically sealed. "Once you move from an optical table to a fibre-optic based system then you can make the unit much more rugged and portable," said Zimdars. "This has been a very important aspect of our success." Thanks to its umbilical connection, the THz head can be up to 30 m away from the main control box with the freedom to move over and around objects under challenging conditions.

"You can be in environments with high vibration, high humidity or high temperature swings and still get THz signals coming out," said Risser. "We transferred our telecoms packaging technology and fibre experience into our THz products." The firm's modular approach to design means that it can simply plug in the latest technology as it comes out of the lab. "It helps evolve the technology without making the customer's investment in the instrument obsolete," Risser added.

Stimulating the market

By targeting the research market, the hope is that new applications will emerge as scientists get to grips with the technology. "It takes a while, but I think all of the activity that you see today is basically those earlier applications beginning to open up," said Risser. "We've sold many T-Ray 2000 units to leading labs in the US and around the world."

Picometrix decided to take its T-Ray set-up a step further and migrated the instrument to a rugged 19-inch rack-mounted system in 2004. In fact, an industrial set-up was part of the company's plans from day one. "We had a customer who was paying right from the start for the development and deployment of online, real-time quality control apparatus," explained Risser, careful to abide by the terms of a non-disclosure agreement. "The client is looking to inspect up to 10000 units/min on the factory floor."

By engaging with real customers immediately, Picometrix has been fortunate in being able to home in on the technology's key features. "Obviously, the first things that attract users to the technique are big problems that are less price sensitive, because the technology is still marching down the curve in terms of cost and the aerospace market is driving this in some respects," commented Risser. "NASA's space shuttle is a high-profile example, but in general aircraft makers are moving to composite materials and there are all types of requirements for imaging defects in manufactured products as well as gathering specific spectroscopic information from packaged goods."

Other key markets for Picometrix include pharmaceutical and defence sectors as well as homeland security. "THz scanners can not only image in high resolution with radiation that is not harmful, but they can also be used to spot items non-visually," said Risser. "Concealed weapons can be identified automatically by detecting a chemical signature or fingerprint."

Picometrix at CLEO/QELS

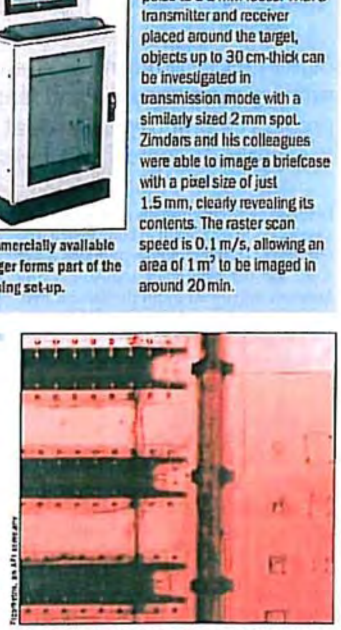
Security and non-destructive testing applications were the focus of David Zimdars' presentation at CLEO/QELS 2006. Speaking as part of the Terahertz Imaging and Sensing session, one of eight dedicated to THz at this year's event, Zimdars described the firm's latest high-speed set-up. Based around Picometrix's successful QA1000 instrument (see photo), a 5 m fibre-optic and electronic umbilical cord links the hardware to a gantry mounted THz head with a scan range of 1 × 1 m.

Picometrix's commercially available QA1000 THz imager forms part of the high-speed scanning set-up.

In reflection mode, the co-linear transceiver operates with a working distance of 30 cm and brings the THz pulse to a 2 mm focus. With a transmitter and receiver placed around the target, objects up to 30 cm-thick can be investigated in transmission mode with a similarly sized 2 mm spot. Zimdars and his colleagues were able to image a briefcase with a pixel size of just 1.5 mm, clearly revealing its contents. The raster scan speed is 0.1 m/s, allowing an area of 1 m^2 to be imaged in around 20 min.

"We transferred our telecoms packaging technology and fibre experience into terahertz."

Robin Risser, Picometrix



Non-destructive testing: NASA is using THz imaging to monitor the foam that covers the space shuttle's external fuel tank.

Raising funds

Having stimulated the market with the T-Ray 2000 and its rack-mounted cousin the QA1000, Picometrix is now moving up a gear. "We merged with a public company called Advanced Photonix Inc in May 2005 to become a wholly owned subsidiary," said Risser. "We are ready to start ratcheting up our sales and marketing programme and we wanted access to additional growth capital that public markets could provide at a lower cost than the private markets."

Today, Picometrix is busy working on next-generation compact, high-speed systems at its corporate headquarters and manufacturing facilities in Ann Arbor, Michigan, US. □

YVONNE CARTS-POWELL
CONTRIBUTING EDITOR

Terahertz imaging brings new capabilities to QC applications

An underused part of the spectrum offers new imaging and spectroscopic abilities for nonstructive testing and quality control.

FIGURE 1. Terahertz systems can image three planes (surface, interconnect layer, and bottom) of a microprocessor without destroying the device.

Quality control on the factory floor—and the closely related activity of nondestructive testing—has long used visible imaging systems. Some applications also use infrared, ultraviolet, or x-ray wavelengths. Now, systems operating at wavelengths on the edge of IR and microwaves (about 30 μm and 1 mm)—at terahertz frequencies—are providing information that isn't available in other parts of the spectrum. Researchers are actively developing new methods and finding applications, and at least two firms are selling terahertz-imaging systems for quality control (QC) and nondestructive testing.

Terahertz benefits

Pulsed terahertz systems can provide three-dimensional (3-D) images and spectroscopic information and terahertz radiation can penetrate some materials that are opaque to the human eye. Because of these abilities, terahertz imaging has significant potential for security applications (like identifications of plastic explosives) as well as for commercial applications in situations in which other sensors cannot provide enough information—and in which that information can save a manufacturer a lot of money (see Fig. 1).

At these longer wavelengths, the lateral resolution of images is not as fine as it is at visible wavelengths. It's similar to that of the human eye, according to Robin Risser, CEO of Picometrix (Ann Arbor, MI)—about 100 to 200 μm. However, "depth resolution is 8 to 10 μm," explains Don Arnone, president of TeraView (Cambridge, England), because the technique for imaging depth (time-of-flight) is different from lateral imaging. And many organic molecules display strong and distinctive absorption and dispersion (due to rotational and vibrational transitions) when exposed to subpicosecond terahertz pulses.

"The two show-stoppers for terahertz," says Risser, "are water and a reasonable thickness of metal—although foil-coated Mylar films can be imaged through." Because water absorbs this radiation and metal reflects it, terahertz imagers cannot see through these materials. Water and metal, however, can be used to advantage in some situations. Terahertz imaging can measure the moisture content of items inside plastic packaging, and a metal substrate below an item of interest can be used as a mirror to return more radiation to the sensor.

System basics

One reason this region of the spectrum has not been extensively explored until recently is that radiation sources were lacking. Techniques for directing and detecting the terahertz radiation come from the optical and radio-

14.

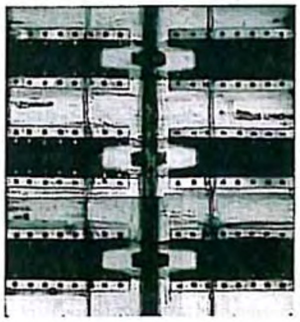


FIGURE 5. Terahertz images of foam insulation (light areas) on the external fuel tank of the space shuttle. Voids within and delamination between layers of foam insulation appear as dark areas. This composite image shows 25 defects, only two of which are visible on the exterior of the foam.

PICOMETRIX

What's next?

Many industries have unmet quality-control needs to which terahertz technology could be applied—but only if it is economically feasible. A major limiting factor of the current technology is the cost of a turnkey system, which ranges from $200,000 to $400,000.

The cost of the systems is expected to drop as more units are sold, but one of the challenges remains to find customers who can save substantial amounts of money by using the equipment for routine quality control, and possibly for NDT during product development.

Risser explains that the main market for terahertz technology today is in applications with no existing alternatives, or where existing NDT technology has very high operating expenses.

Much of the cost is associated with the ultrafast laser, says Arnone. If a less expensive, but still efficient, method of generating terahertz pulses is developed, the economics of the technology will improve. For groups that already own a femtosecond laser, Picometrix sells a cheaper version of its T-Ray 2000 for lab use without the laser, but the system is different from the ruggedized turnkey system sold for industrial applications.

Another challenge is in guiding terahertz radiation. To some extent Picometrix's fiber-coupled system circumvents the difficulty, and optics exist for manipulating the radiation in free-space, but more applications would be available if the systems did not require line-of-sight for imaging. Finding materials for waveguides is challenging because the most transparent materials tend to be crystalline (and therefore not flexible), while more flexible materials such as plastics and glasses have much higher absorption of these wavelengths. Furthermore, because the shape of the wave is of vital importance for many applications, the waveguide must be made of a material with low dispersion and distortion.

Researchers have demonstrated waveguiding with metal tubes, plastic ribbons, dielectric fibers, and photonic crystals designed for terahertz frequencies. Two promising approaches involve waveguiding using parallel metal plates, including work by Daniel Grischkowsky and others at Oklahoma State University (Stillwater); and a bare wire, including work by Daniel Mittleman at Rice University (Houston, TX). □

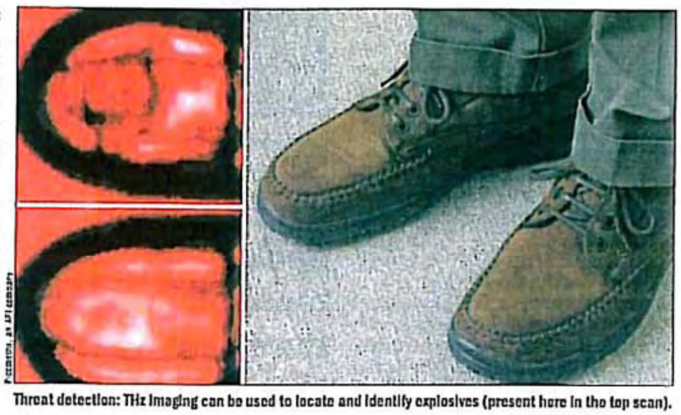
FURTHER READING
List (with links) of academic groups and companies engaged in terahertz time-domain spectrometry: www-ece.rice.edu/~daniel/groups.html

Terahertz technology discovers its market

CLEO/QELS' terahertz programme was a big hit with conference delegates this year, running over two days and featuring more than 50 international speakers. **James Tyrrell** profiles Picometrix, a firm that has successfully transferred its telecoms know-how into the terahertz sector, and looks at what is driving the market today.

Judging by the enthusiastic audience at this year's CLEO/QELS event in Long Beach, US, terahertz (THz) technology remains a hot topic for the photonics industry. Lying between microwaves and the far-infrared, non-ionizing THz radiation can safely penetrate materials such as clothing and plastics to image concealed objects and spot manufacturing flaws.

What's more, spectroscopic THz analysis can help identify explosives, detect biological agents and screen pharmaceuticals. If you couple these functions into the one device then you create a very powerful tool that has grabbed the attention of NASA and the US Department of Homeland Security, to name just two high-profile fans of the apparatus.



Threat detection: THz imaging can be used to locate and identify explosives (present here in the top scan).

One of the first firms to commercialize THz technology was Picometrix, US. "We began in 1992 when THz was still very research-based and so the foundation of the company was ultrafast optoelectronic instrumentation and optical receiver components," Robin Risser, president of Picometrix and CFO of its parent company, Advanced Photonix Inc, told *OLE*. "However, the fast GaAs and InGaAs material that we developed for our receivers was also suitable for THz."

Distributed firstly by Newport Corporation and then through test and measurement and telecoms equipment manufacturers, the optical components were adopted by the expanding communications sector for 10 and 40 Gbps networks. As the market segment started to move and generate more revenue, Picometrix was able to put its THz plans into action.

"In 1997 we launched a full-scale major development programme on THz instrumentation," said Risser. "We did an exclusive tech-transfer of all of the know-how from Lucent Bell-Labs and licensed the technology. This was just at the time when Lucent was restructuring to focus on telecommunications."

Picometrix introduced its T-Ray 2000™ product, a flexible research tool for both THz imaging and spectroscopy, in early 2000. At that time, applications for this promising technology were hard to explore because of the difficulty in generating a reliable THz signal. Risser and his colleagues were determined to change all of that and provide researchers with a user-friendly THz instrument.

"We wrapped our technology around the Lucent technology to harden the system and make sure that we had reliable products, which were easy to use," said Risser. "This was a big advantage to operators, because it allowed them to concentrate on the application, rather than worrying about generating a signal and re-aligning components."

Generating T-Rays

"The T-Ray 2000 is based on the photoconductive generation and detection of THz, which is a time domain method developed in the late 1980s and early 1990s," explained David Zimdars, Picometrix's manager of THz research and development. "One of the difficulties of working in the THz regime is that it is hard to build a purely electronic oscillator that will behave like a transistor and switch with any kind of power at these high speeds."

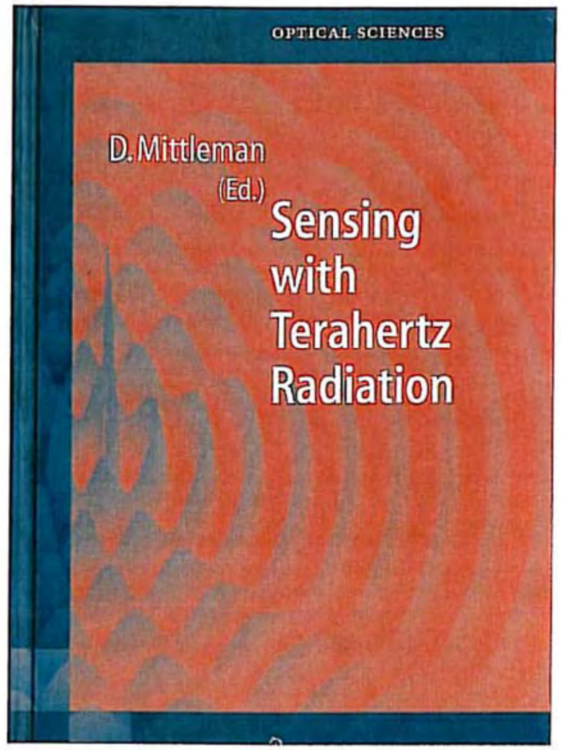
The solution is to use a femtosecond laser, which has fast optical transients. By firing high-speed laser pulses at a cleverly designed photoconductive switch, it is possible to generate THz radiation.

"We use a small 2 mm antenna [as the target] that is patterned on low-temperature grown GaAs and features a very small, biased gap," said Zimdars. "Ordinarily the resistivity is very high, for example you can have many mega-ohms across the gap."

When the laser pulse hits the switch, carriers are generated and current flows across the gap, which turns on in less than a picosecond and then turns off in less than a picosecond. It is this time-changing current flow that produces the THz emission.

"You obtain a broadband THz pulse with spectral content from 100 GHz and beyond, which suits spectroscopy and imaging applications," commented Zimdars. "In many ways this process is like an optically

15. The Applicant's goods have been positively referenced in the pertinent industry's definitive reference book, as shown below:



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4 Future Prospects

One of the most exciting aspects of this field is the tremendous prospects for the future. It should be clear from the examples shown here that there are numerous potential "real-world" applications of THz imaging. In some cases, THz radiation may provide the only feasible option for certain tasks, whereas in others it might be only one of several competing technologies. It is clear that, in these latter cases, crucial factors in the successful implementation of systems of the kind described here include their cost and ease of use. These issues have historically been beyond the purview of research scientists, but modern research can no longer afford to ignore such practical concerns. In the case of THz imaging, much concerted effort has led to the development of a commercially available system based on photoconductive generation and detection techniques [20]. A photograph of the recently announced "T-Ray 2000" spectrometer is shown in Fig. 27. This system is reliable and easy to operate, and can be reconfigured for either transmission or reflection imaging. As of this writing, this system is already operating in one factory, as an on-line quality control monitor, with a number of other exciting prospects on the horizon.

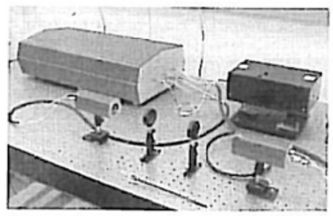

Fig. 27. Photograph of the "T-Ray 2000", the first commercial THz time-domain spectrometer, manufactured by Picometrix, Inc

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