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Room: Emmy Destinn hall (2nd floor)

09:00-09:15 **OPENING BY THE CHAIRS**

Petr Kužel, Institute of Physics, Academy of Sciences of the Czech Republic (CZ)
Peter Uhd Jepsen, DTU Fotonik, Technical University of Denmark (DK)

09:15 - 10:00 **KEYNOTE TALK**

Equation Chapter 1 Section 1THz wave air photonics: bridging the "gap" and beyond

X.-C. Zhang; The Institute of Optics, University of Rochester (US).

THz wave air photonics involves the interaction of intense femtosecond laser pulses with air. The very air that we breath is capable of generating and detecting THz field strengths greater than 1 MV/cm and useful bandwidth from 0.1 THz to over 10 THz. Remote broadband THz wave sensing is feasible. [5153]

1

10:00-11:30
TERAHERTZ NONLINEAR

Chair: *M. Tonouchi, Osaka University (JP)*

10:00-10:45

Masterclass talk

High-field THz pulse generation and nonlinear THz spectroscopy

K.A. Nelson, Massachusetts Institute of Technology (US).

Generation of intense THz pulses has enabled nonlinear THz spectroscopy and THz coherent control of solid, liquid, and gas phase systems including THz-induced structural and chemical rearrangements. Methods for high-field THz pulse generation and results of nonlinear spectroscopy will be illustrated. [6217]

3

10:45 -11:00

STUDENT PRESENTATION

Dynamics of Optically Excited Carriers under Intense Terahertz Pulse in GaAs Multiple Quantum Wells

K. Shinokita^{1,2}, H. Hirori^{2,3}, M. Shirai^{1,2,3}, S. Tan^{1,2}, Y. Kadoya^{2,4}, K. Tanaka^{1,2,3};

¹Kyoto University, Department of Physics (JP); ²CREST, Japan Science and Technology Agency (JP); ³Kyoto University, WPI-iCeMS (JP); ⁴Hiroshima University, Dept. Quantum Matter (JP).

We investigate carrier dynamics under intense terahertz (THz) pulse with time-resolved luminescence measurement. Luminescence intensity generated by optical pulse is enhanced by THz pulse excitation, showing a THz electric field induces the multiplication of the optically generated carriers. [5322]

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11:00-11:15

STUDENT PRESENTATION

Terahertz Electric Field Induced Tunnel Ionization of p-type Germanium

Y. Mukai¹, H. Hirori^{2,3}, K. Tanaka^{1,2,3}; ¹Kyoto University, Department of Physics (JP);

²CREST, Japan Science and Technology Agency, (JP); ³Kyoto University, Institute for Integrated Cell-Material Sciences (WPI-iCeMS) (JP).

The field ionization of acceptors in p-Ge under intense terahertz (THz) electric field is studied by THz pump-THz probe spectroscopy. The observed THz induced changes of absorption spectra indicate that the bound impurity carriers ionized by intense THz electric field contribute the free carrier absorption. [5319]

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11:15-11:30

THz field induced pair-breaking in YBCO thin films

C. Zhang¹, A. Glossner^{1,2}, S. Kikuta¹, I. Kawayama¹, H. Murakami¹, P. Müller², M. Tonouchi¹;

¹Osaka University, Institute of Laser Engineering (JP); ²Universität Erlangen-Nürnberg, Department of Physics (DE).

In this paper, we demonstrate how to control the superconductivity and pair-breaking of YBaCu3O7- δ (YBCO) thin films by the use of intense single-cycle terahertz pulses with photon energies well below the superconductor's energy gap. [5276]

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11:30-12:00 **Coffee break**

Room: Emmy Destinn hall (2nd floor)

12:00-13:15

THz SPECTROSCOPY: TECHNIQUE & METHODOLOGY

Chair: H. Němec, Institute of Physics, Academy of Sciences of the Czech Republic (CZ)

12:00-12:15

All-solid-state THz ATR spectroscopy module

D. Malter^{1,2}, G. Torosyan¹, J. Klier¹, C. Matheis¹, C. Petermann¹, S. Weber^{1,2}, F. Ellrich¹, J. Jonuscheit¹, R. Beigang^{1,2}; ¹Fraunhofer Institute for Physical Measurement Techniques IPM, Kaiserslautern (DE); ²Department of Physics and Research Center OPTIMAS, University of Kaiserslautern (DE).

We present a novel miniature module for terahertz attenuated total reflection spectroscopy. It is made of high resistivity silicon by applying free form optics fabrication and features two parabolic surfaces which act as the sensitive interfaces. Fiber coupling of highly integrated emitter and detector chips provides a high degree of flexibility. [5379]

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12:15-12:30

STUDENT PRESENTATION**Interpolation of frequency gaps between THz comb modes by precise tuning of laser mode-locked frequency**

Y.-D. Hsieh¹, Y. Iyona¹, Y. Sakaguchi¹, S. Yokoyama¹, H. Inaba², K. Minoshima², T. Iwata³, T. Yasui^{1,3}, T. Araki¹; ¹Osaka University, Graduate School of Engineering Science (JP); ²National Institute of Advanced Industrial Science and Technology, National Metrology Inst. Japan (JP); ³University of Tokushima, Institute of Technology and Science (JP).

We fully interpolated frequency gaps between THz comb modes by tuning mode-locked frequencies in dual fiber lasers used for generation and detection of THz comb. The sweeping of THz comb implies a possibility to enhance the spectral resolution in THz spectroscopy up to the linewidth of each comb mode. [5279]

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12:30-12:45

Accurate determination of the complex refractive index of scattering materials by THz time-domain spectroscopy

S. Joly, F. Garet, J.-L. Coutaz, M. Bernier; IMEP-LAHC, UMR CNRS 5130, Université de Savoie (FR).

We study the THz response of mixtures of powders, in which a substance has to be identified. Scattering by powder grains is responsible for absorption overestimation and distortion of the spectral resonance peaks of the substance. This scattering is well described by the Christiansen model. We are interested on the dependence of the fitting parameters in the Christiansen model on the physical properties of the studied substance (size of grain, concentration, etc.) in order both to get rid of the scattering influence and to predict the THz signature of scattering mixtures. [5407]

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12:45-13:00

Step-scan terahertz time-domain magneto-optics

D. Malter^{1,2}, G. Torosyan¹, G. Ballon³, L. Drigo³, J. Léotin³, R. Beigang^{1,2}; ¹Fraunhofer Institute for Physical Measurement Techniques IPM (DE); ²Department of Physics and Research Center OPTIMAS, University of Kaiserslautern (DE); ³Laboratoire National des Champs Magnétiques Intenses, CNRS-UJF-UPS-INSA (FR).

Terahertz time-domain magneto-optics using pulsed magnetic fields is demonstrated in this contribution. We introduce a novel method employing a stepwise delay scan and a portable, short-duration pulsed magnet with a comparatively high repetition rate. Results of several semiconductor samples are presented and compared with numerical simulations based on the Drude model. [5387]

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13:00-13:15

Precise determination of the complex refractive index of samples showing low-transmission bands by THz time-domain spectroscopy

M. Bernier, F. Garet, J.-L. Coutaz, S. Joly; IMEP-LAHC, UMR CNRS 5130, Université de Savoie (FR).

We propose and demonstrate a method to determine the refractive index and the coefficient of absorption of samples showing spectral bands of very low transmission. The method is based on both transmission and reflection terahertz time-domain spectroscopy. We apply this method to characterize TlInS₂ superionic crystals. [5405]

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13:15-14:30 **Lunch break** (Location: Kaiserstejnsky Palace, 1st floor)

Room: Emmy Destinn hall (2nd floor)

14:30-16:15

METAMATERIALS, WAVEGUIDES AND NEAR-FIELDS

Chair: O. Mitrofanov, University College London (GB)

14:30-15:00

Invited talk

Metamaterial Terahertz Transmission Optics and Surface Waves

B. Reinhard¹, T. Fip^{1,2}, M. Volk^{1,2}, K. Schmitt^{1,2}, J. Neu¹, M. Höh^{1,2}, M. Rahm^{1,2}; ¹Department of Physics and Research Center OPTIMAS, University of Kaiserslautern (DE); ²Fraunhofer Institute for Physical Measurement Techniques IPM (DE).

We demonstrate a metamaterial-based terahertz gradient index (THz-GRIN) lens that allows focusing of THz radiation to a focus diameter of the order of one wavelength or slightly below. Furthermore, we investigate the confinement, dispersion and spatial propagation of surface waves on tailored meta-surfaces and evaluate their potential for sensing applications. [5455]

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15:00-15:15

STUDENT PRESENTATION

THz near-field Faraday imaging in hybrid metamaterials

N. Kumar¹, A. Strikwerda², K. Fan³, X. Zhang³, R. Averitt², P. Planken¹, A. Adam¹; ¹Delft University of Technology, Faculty of Applied Sciences (NL); ²Boston University, Department of Physics (US); ³Boston University, Department of Mechanical Engineering (US).

We have demonstrated direct measurement of the time-dependent terahertz magnetic near-field of metamaterial split-ring resonators by using terahertz timelapse spectroscopy. We also show that the local magnetic field in these structures is strongly enhanced relative to the THz magnetic field incident on these structures. [5333]

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15:15-15:30

Near-field terahertz imaging of a defect in split ring resonator

F. Blanchard^{1,2}, K. Ooi³, T. Tanaka^{1,2}, A. Doi⁴, K. Tanaka^{1,2,3}; ¹Institute for Integrated Cell-Material Sciences (WPI-iCeMS), Kyoto University (JP); ²CREST, Japan Science and Technology Agency (JP); ³Department of Physics Graduate School of Science, Kyoto University (JP); ⁴Olympus Corporation (JP).

We investigate the spatiotemporal evolution of single cycle terahertz pulses transmitted through split ring resonator array including a void. Using large field of view terahertz microscope, resonances from the array and cavity are revealed. [5364]

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15:30-15:45

Resonant magnetic response of TiO2 microspheres at terahertz frequencies

C. Kadlec¹, H. Němec¹, F. Kadlec¹, F. Dominec¹, R. Yahiaoui², U.-C. Chung³, C. Ellissalde³, M. Maglione³, P. Mounaix², P. Kužel¹; ¹Institute of Physics, Academy of Sciences of the Czech Republic (CZ); ²LOMA, Univ. Bordeaux 1, CNRS, UMR 5798 (FR); ³ICMCB, CNRS – UPR9048 (FR).

We developed an experimental approach allowing the evaluation of the effective dielectric permittivity and magnetic permeability of single-layer films made of independent resonators. The resonant magnetic response of TiO2 dielectric microspheres was observed in the THz range. Experimental results are in agreement with simulations. [5330]

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15:45-16:00

STUDENT PRESENTATION

Fabrication and characterization of terahertz anisotropic anti-rod dimer planar metamaterials

M. Zalkovskij¹, R. Malureanu¹, A. Novitsky¹, P. U. Jepsen¹, A. V. Lavrinenko¹, C. Kremers², D.N. Chigrin²; ¹Technical University of Denmark, Department of Photonics Engineering (DK); ²University of Wuppertal, Institute of High-Frequency and Communication Technology, Faculty of Electrical, Information and Media Engineering (DE).

In this work we describe the fabrication and characterization of free-standing membranes with thick anti-rod dimers metamaterials for terahertz waves. Two different designs with parallel and V-shape anti-rods were analysed. Even though both structures consists of simple elements, namely anti-rod dimers, they reveal interesting birefringent and dichroic transmission properties. [5370]

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Room: Emmy Destinn hall (2nd floor)

16:00-16:15

STUDENT PRESENTATION

Effect of coupling between stacked resonators of an inkjet-printed THz metamaterial

S. Waselkowskij¹, P. Bollgruen², D. Mager², J. Korvink^{2,3}, M. Walther¹; ¹Freiburg Materials Research Center, University of Freiburg (DE); ²Laboratory for Simulation, Department of Microsystems Eng. IMTEK, University of Freiburg (DE); ³School of Soft Matter Research, Freiburg Institute of Advanced Studies (FRIAS), University of Freiburg (DE).

Double and multi-layer metamaterials consisting of stacked, L-shaped resonators have been fabricated by ink-jet printing of silver nanoparticle ink onto the opposite sides of dielectric substrates. Using THz time-domain spectroscopy and numerical simulations the effect of coupling between the stacked structures is investigated. [5350]

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16:15-16:45 Coffee break

16:45-18:15

METAMATERIALS, WAVEGUIDES AND NEAR-FIELDS (continued)

Chair: M. Rahm, Department of Physics and Research Center OPTIMAS, University of Kaiserslautern (DE) & Fraunhofer Institute for Physical Measurement Techniques IPM (DE)

16:45-17:15

Invited talk

Progress in development of waveguides for terahertz applications

O. Mitrofanov¹, J.A. Harrington²; ¹University College London (GB); ²Rutgers University (US).

We overview the recent progress in development of terahertz (THz) waveguides and waveguide characterization methods, and outline promising directions in future research on THz waveguides. [5416]

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17:15-17:30

STUDENT PRESENTATION

Enhanced THz transmission through a single plasmonic nano slot antenna

J. Flock¹, T. Rybka¹, H. Park², D.S. Kim², T. Dekorsy¹; ¹University of Konstanz, Dep. of Physics (DE); ²Center for Subwavelength Optics and Dep. of Physics and Astronomy (KR) & National University (KR).

The transmission of nano slot antennas fabricated in thin gold films is investigated. The high signal-to-noise ratio of 107 of our measurement setup allows us to detect the transmission through one single antenna with a width of 600 nm. [5334]

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17:30-17:45

Sample-probe interactions in terahertz near field imaging

S.R. Andrews¹, M. Misra¹, S.A. Maier²; ¹Dept. of Physics, University of Bath (GB); ²Centre for Plasmonics and Nanophotonics, Physics Department, Imperial College (GB), current address: Dept. of Physics, University of Warwick (GB).

Experimental and computational studies of the interaction between a photoconductive probe and a planar sample have been performed. We find that the excitation of TEM waveguide modes in the gap between sample and probe, together with a cross-polarization effect must be taken into account when interpreting images. [5326]

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17:45-18:00

Improving homogenization and spatial dispersion in THz-metamaterial fibres

B.T. Kuhlmev¹, A. Tuniz¹, N. Singh¹, R. Lwin¹, B. Pope¹, A. Argyros¹, S. Fleming¹, A. Wang¹, M.C.J. Large¹, E.M. Pogson², R.A. Lewis², A. Bendavid²; ¹Institute of Photonics and Optical Science (IPOS), School of Physics, University of Sydney (AU); ²Institute for Superconducting and Electronic Materials, University of Wollongong (AU); ³Commonwealth Scientific and Industrial Research Organization, Materials Science and Engineering (AU).

Fibre drawing techniques are a scalable approach to the fabrication of metamaterials for THz radiation. Here we demonstrate metamaterial fibres with magnetic responses in the THz with improved homogenized properties and overcome spatial dispersion resulting from the longitudinal invariance of such fibres. [5296]

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18:00-18:15

STUDENT PRESENTATION

Direct measurement of local THz electric field and its enhancement in the gap of dipole antennas

S. Miyamoto¹, H. Tanaka¹, D. Armand², J. Kitagawa^{1,2}, Y. Kadoya^{1,2}; ¹Hiroshima Univ. ADSM (JP); ²Japan Science and Technology Agency, CREST (JP).

Local electric field near the gap of dipole antenna was measured using excitonic Franz-Keldysh effect in a quantum well film on which the antenna was formed. The field was found to be enhanced by shortening the gap, consistently with the simulation. The enhancement factor of 20 was obtained with a 2 μm gap length. [5278]

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19:30-22:00 CONFERENCE DINNER

Location: Kaiserstejnsky Palace, 1st floor

Room: Emmy Destinn hall (2nd floor)

09:00-09:45

Masterclass talk

Terahertz Quantum Cascade Lasers

E.H. Linfield; *School of Electronic and Electrical Engineering, University of Leeds (GB).*

This Master Class will review the rapid progress that has been made in engineering the electronic and photonic properties of terahertz frequency quantum cascade lasers since their first demonstration in 2002, and highlight some of the recent international developments in the field. [5571]

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09:45-10:45

SPECTROSCOPY: PHONONS & VIBRATIONS

Chair: *A. Pashkin, University of Konstanz, Department of Physics and Center for Applied Photonics (DE)*

09:45-10:00

Ferroelectric phase transition in GeTe studied by time-domain THz spectroscopy

F. Kadlec, *C. Kadlec, P. Kužel, J. Petzelt; Institute of Physics, Academy of Sciences of the Czech Republic (CZ).*

GeTe is the simplest ferroelectric, earlier considered to be of displacive type. We employ time-domain THz spectroscopy to study a GeTe film in a furnace. We detect the ferroelectric phase transition and observe, in the paraelectric phase, a relaxation which is attributed to an order-disorder character of the phase transition. [5328]

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10:00-10:15

STUDENT PRESENTATION

Glassy dynamics in concentrated sorbitol solutions: study by terahertz spectroscopy

J. Sibik, *J.A. Zeitler; University of Cambridge, Department of Chemical Engineering and Biotechnology (GB).*

We present the dielectric spectra of water-sorbitol solutions obtained from terahertz transmission spectroscopy in frequency range 0.2-2 THz. A temperature interval of 80-310 K is measured covering dynamics in both glassy and liquid state and bridging the interplay between the dielectric relaxation and the vibration of molecules. [5458]

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10:15-10:30

STUDENT PRESENTATION

Electric field tuning of dielectric properties of SrTiO₃ crystals with possible applications in the terahertz technology

V. Skoromets, *C. Kadlec, H. Němec, P. Kužel; Institute of Physics, Academy of Sciences of the Czech Republic (CZ).*

We investigate an electric-field tunability of the dielectric properties of bulk SrTiO₃ crystals at temperatures from 90 to 293 K using time-domain terahertz spectroscopy. The low-frequency polar phonon is demonstrated to be responsible for the electric-field dependence of SrTiO₃ dielectric properties in the terahertz frequency range. [5324]

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10:30-10:45

Strain-induced ferroelectricity of a SrTiO₃ thin film observed by terahertz time-domain spectroscopy

I. Kawayama, *R. Kinjo, H. Murakami, M. Tonouchi; Institute of Laser Engineering, Osaka University (JP).*

We measured strain effects of SrTiO₃ (STO) thin films on MgAl₂O₄, MgO, and LSAT substrates by terahertz time-domain spectroscopy (THz-TDS). The frequency shifts of the soft mode, which implied that the in-plane strain enhanced or depressed ferroelectric fluctuations were observed. [5313]

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10:45-11:15 Coffee break

Room: Emmy Destinn hall (2nd floor)

11:15-13:00

THZ IMAGING

Chair: G. Scaraf, Institute of Quantum Electronics, ETH Zürich (CH)

11:15-11:30

STUDENT PRESENTATION

Terahertz and micro four point probe conductivity mapping of large area CVD grown graphene films

52

J.D. Buron^{1,2}, D.H. Petersen², P. Bøggild², D. Cooke³, J. Sun⁴, M. Hilke³, E. Whiteway³, P.F. Nielsen⁵, A. Yurgens⁴, P.U. Jepsen¹; ¹Technical University of Denmark, Department of Photonics Engineering (DK); ²Technical University of Denmark, Department of micro- and nanotechnology (DK); ³McGill University, Physics Department (CA); ⁴Chalmers University, Quantum device physics laboratory (SE); ⁵Capres A/S, Diplomvej (DK).

We demonstrate mapping of magnitude and variation of the electrical conductance of large area CVD graphene films by terahertz time-domain spectroscopy (THz-TDS) and micro four-point-probe (M4PP). Non-trivial correlations between results obtained with the two techniques are discussed in relation to electrical properties of the graphene films. [5376]

11:30-11:45

Large aberration-free diffractive lenses for the THz range

54

M. Sypek¹, M. Makowski¹, J. Suszek¹, Ag. Siemion¹, A. Siemion¹, E. Hérault², F. Garet², J.-L. Coutaz², M. Bernier²; ¹Faculty of Physics, Warsaw University of Technology (PL); ²JMEP-LAHC, UMR CNRS 5130, Université de Savoie (FR).

We present the design, modelling and experimental characterization of aberration-free large aperture diffractive lenses for imaging applications in the terahertz frequency range. The first studied element is a double-side multi-spherical lens and the second one is a dielectric binary lens made with paper. [5414]

11:45-12:00

STUDENT PRESENTATION

3D-Terahertz Tomography using a more realistic beam propagation model applied to different image reconstruction methods

56

J.P. Guillet¹, B. Recur², I. Manek-Höninger¹, J.C. Delagnes¹, W. Benharbone¹, P. Desbarats², J.P. Domenger², L. Canioni¹, P. Mounaix¹; ¹Univ. Bordeaux, LOMA, UMR 5798 (FR) & CNRS, LOMA, UMR 5798 (FR); ²LaBRI, Université de Bordeaux/CNRS (FR).

Tomography is a 3D imaging technique that reconstructs the volume of a sample from a set of projections acquired in transmission through the object. This technique, widely developed in X-Ray CT scan imaging, is mathematically described by the Radon transform which models the X-Ray attenuation process along a line (proportionally to the density and thickness of the object). The inverse Radon theorem allows the reconstruction of a slice by using the set of projection lines measured. Usually, the well-known Backprojection of Filtered Projections is used both in X-Ray and THz computed tomography to perform the reconstruction.

Since this method suffers from well-known artifacts and is not effective from sparse data (a few number of projections), we adapt from X-Ray to THz CT several iterative algorithms such as the Simultaneous Algebraic Reconstruction Technique (SART) and the Ordered Subset Expectation Maximization (OSEM). Then, we explain the efficiency of these algorithms to reconstruct images from sparse data compared to the BFP. [5391]

12:00-12:15

Line-field terahertz computed tomography of continuously rotating object

58

T. Yasui^{1,2}, Y. Ohgi¹, M. Minami¹, M. Jewariya³, M. Nagai¹, T. Araki¹, E. Abraham⁴; ¹Osaka Univ., Grad. Sch. Eng. Sci. (JP); ²Univ. of Tokushima, Inst. Tech. and Sci. (JP); ³Osaka Univ., Renovation Center of Instrum. for Sci. Ed. Tech. (JP); ⁴Univ. Bordeaux, LOMA Talence (FR).

We demonstrated fast terahertz (THz) computed tomography by combination of non-collinear electro-optical time-to-space conversion and line focusing of a THz beam for real-time line projection across the sample. Cross-sectional images of continuously rotating samples have been measured in only a few seconds. [5308]

Room: Emmy Destinn hall (2nd floor)

12:15-12:30

Advantage of terahertz radiation versus X-ray to detect hidden organic materials in sealed vessels

60

M. Bessou², H. Duday², J.-P. Caumes¹, S. Salort¹, B. Chassagne¹, C. Pradère⁴, A. Ziégélé⁶, A. Dautant³, E. Abraham⁵; ¹ALPhANOV (FR); ²PACEA, Univ. of Bordeaux/CNRS (FR); ³IBGC, Univ. of Bordeaux/CNRS (FR); ⁴TREFLE, Univ. of Bordeaux/CNRS (FR); ⁵LOMA, Univ. of Bordeaux/CNRS (FR); ⁶Museum of Aquitaine (FR).

Terahertz imaging and conventional X-ray have been used to investigate a sealed Ancient Egyptian jar preserved at the Museum of Aquitaine (France). Terahertz radiation revealed an unknown content that could not be visualized by X-ray. By comparison with a model object, we concluded that this content was certainly constituted of organic materials explaining their relative radiolucency. [5272]

12:30-12:45

Challenges Facing Terahertz Pulsed Reflectometry of Historical Architecture

62

J.B. Jackson¹, J. Labaune¹, G. Walker², M. Menu³, G.A. Mourou¹; ¹ENSTA-École Polytechnique, Institut Lumière Extrême (FR); ²School of Systems Engineering, University of Reading (GB); ³Centre de Recherche et de Restauration des Musées de France (FR).

We have used terahertz pulse reflectometry as a technique to investigate obscured wall paintings in several medieval churches and a Neolithic settlement. Initial experiments on models were very successful; however the uniqueness and unpredictability of field sites have posed challenges for data acquisition and analysis. [5368]

12:45-13:00

Terahertz Microscopy of Stratum Corneum by using SASPase-Deficient Dry Skin Model Mice

64

I. Tanaka^{1,2}, T. Matsui¹, F. Blanchard^{1,2}, A. Doi^{2,4}, A. Kubo⁵, M. Amaga³, K. Tanaka^{1,2,3}; ¹Kyoto University, WPI-iCeMS (JP); ²Japan Science and Technology Agency, CREST (JP); ³Kyoto University, Department of Physics (JP); ⁴Olympus Corporation (JP); ⁵Keio University School of Medicine, Department of Dermatology (JP).

We apply real-time terahertz near-field microscopy to observe the stratum corneum (SC) of hairless mice with/without skin-specific retroviral-like aspartic protease (SASPase) deficiency. Clear difference has been visualized in the frequency-resolved THz images originated from the difference of water contents in their SC. [5312]

13:00-15:15 **LUNCH BREAK & POSTER SESSION**

Location: Kaiserstejnsky Palace, 1st floor

15:15-16:30

SOURCES & DETECTION

Chair: M.S. Vitiello, CNR- Istituto Nazionale di Ottica and LENS (European Laboratory for Non-linear Spectroscopy) (IT) & NEST, CNR - Istituto Nanoscienze and Scuola Normale Superiore (IT)

15:15-15:45

Invited talk

Nonlinear optical THz sources and applications

66

K. Kawase^{1,2}, S. Hayashi², S.R. Tripathi^{1,2}; ¹Nagoya University, Ecotopia Science Institute (JP); ²RIKEN, Advanced Science Institute (JP).

We obtained a wideband terahertz generation using a prism-coupled Cherenkov phase-matching method, in which a prism with a suitable refractive index at terahertz frequencies is coupled to a thin nonlinear optical crystal. [5341]

15:45-16:00

Prospects of Increasing the THz Pulse Energy in Optical Rectification from the Sub-mJ to the mJ Level

68

J.A. Fülöp¹, Z. Ollmann¹, L. Pálfalvi¹, G. Almási², J. Hebling¹; ¹University of Pécs, Department of Experimental Physics (HU); ²University of Pécs, Department of Physical Information Technology (HU).

The so far highest THz pulse energy (125 μ J) with 0.25% efficiency was measured by optical rectification of 1.3 ps pulses in LiNbO₃. The generation of mJ-level THz pulses with focused electric field strengths up to 100 MV/cm is predicted by calculations. Detailed design of a compact contact-grating THz source is given. [5342]

Room: Emmy Destinn hall (2nd floor)

16:00-16:15

> 1 kW-peak-power single-mode tunable terahertz-wave generation pumped by a microchip Nd:YAG laser

70

S. Hayashi¹, K. Nawata¹, K. Kawase^{1,2}, H. Minamide¹; ¹RIKEN ASI (JP); ²Nagoya Univ. (JP).

We report on the development of a high-peak-power (> 1 kW), single-longitudinal-mode and tunable (1.0 - 2.8 THz) injection-seeded terahertz-wave parametric generator using MgO:LiNbO₃, which operates at room temperature. The small footprint size (A3 paper: 29.7 × 42 cm) are suitable for a variety of applications. [5338]

16:15-16:30

STUDENT PRESENTATION

Enhanced THz emission from a two-color plasma filament in a slot waveguide

72

D. Dietze, K. Unterrainer, J. Darmo; Vienna University of Technology, Photonics Institute (AT).

In this contribution, we present THz emission in forward direction from a long two-color filament placed in the center of a slot waveguide. The waveguide improves the collection and imaging of the generated THz radiation leading to an increase of the detected electric field by 40% and of the THz pulse energy by over four times. [5274]

16:30-17:00 Coffee break

17:00-18:15

SOURCES & DETECTION (continued)

Chair: P.C.M. Planken, Delft University of Technology (NL)

17:00-17:30

Room Temperature Terahertz detection in nanowire- and graphenebased nanotransistors

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M.S. Vitiello¹, D. Coquillat², L. Vicarelli¹, L. Viti¹, A. Pitanti¹, D. Ercolani¹, F. Teppe², A.C. Ferrari³, G. Scalari⁴, J. Faist⁴, M. Polini¹, F. Beltram¹, L. Sorba¹, V. Pellegrini¹, W. Knap², A. Tredicucci¹; ¹NEST, Istituto Nanoscienze-CNR and Scuola Normale Superiore (IT); ²Université Montpellier 2 and CNRS, TERALAB-GIS, L2C UMR 5221 (FR); ³Engineering Department, Cambridge University (GB); ⁴Institute of Quantum Electronics, ETHZ (CH).

Antenna-coupled field effect transistors have been developed as plasma-wave THz detectors in both InAs nanowire and graphene (mono and bilayer) channel material. Room temperature operation has been achieved up to frequencies of 1.5 THz, with noise equivalent powers as low as a few 10⁻¹¹ W/Hz^{1/2}, and high-speed response. [5409]

17:30-17:45

STUDENT PRESENTATION

Generation of low phase noise signals up to 1 THz with a dualfrequency laser and a UTC photodiode

76

J. Börner¹, G. Pilliet¹, L. Morvan¹, D. Dolfi¹, A. Beck², P. Latze², F. Pavanello², G. Ducournau², J.-F. Lampin²; ¹Thales Research & Technology (FR); ²Université de Lille, Institut d'Electronique de Microélectronique et Nanotechnologie,UMR CNRS 8520 (FR).

We present the generation of low phase noise and tunable THz-signals from 300 GHz up to 1 THz. The signals are obtained with a combination of a univtravelling carrier (UTC) photodiode and a solid-state dual-frequency laser (DFL) at 1.5 μm. The spectral purity is precisely characterized with an RF synthesizer and a harmonic mixer up to 700 GHz. Phase noises as low as -20 dBc/Hz at 1 kHz offset are achieved independently from the carrier frequency. [5372]

17:45-18:00

STUDENT PRESENTATION

Increase in Output Power Using Thin-Well Resonant Tunneling Diodes

78

H. Kanaya, H. Shibayama, K. Shizuno, S. Suzuki, M. Asada; Interdisciplinary Graduate School of Science and Technology, Tokyo Institute of Technology (JP).

We achieved ~10 times greater output power using resonant tunneling diodes with a 3.5 nm well than that with a 4.5 nm at ~400 GHz. This increase was due to the large resulting current density and voltage width in the negative differential conductance region. An oscillation frequency of up to 963 GHz was also obtained from a 3.5 nm well. [5299]

18:00-18:15

Band-tunable THz generation by optical rectification in PPLN

80

C. Zhang¹, Y. Avetisyan², I. Kawayama¹, H. Murakami¹, M. Tonouchi¹; ¹Osaka University, Institute of Laser Engineering (JP); ²Yerevan State University, Microwave Eng. Dept. (AM).

We demonstrate a new scheme of optical rectification in periodically poled lithium niobate (PPLN) crystal, which generates high power, band-tunable THz pulses. The bandwidth could be easily and smoothly tuned from a few tens of GHz to a few THz by change the pump optical spot size on PPLN crystal. [5277]

Room: Emmy Destinn hall (2nd floor)

09:00-11:00

QUANTUM CASCADE LASER (QCL)

Chair: A. Tredicucci, Scuola Normale Superiore (SNS) (IT)

09:00-09:30

Invited talk

Quantum Cascade Lasers as versatile, narrow-linewidth sources in the Terahertz range*M.S. Vitiello^{1,2}; ¹CNR- Istituto Nazionale di Ottica and LENS (European Laboratory for Nonlinear Spectroscopy) (IT); ²NEST, CNR - Istituto Nanoscienze and Scuola Normale Superiore (IT).*

Quantum Cascade Lasers (QCLs) witness how materials engineering can actually forge objects that, with conventional technologies, could never exist. Being fully designed from scratch, they represent a powerful testing ground for fundamental properties relying on the quantum nature of the device. These devices are then a powerful testing ground for the fundamental physical parameters determined by their quantum nature.

Despite the cryogenic operation temperatures (≤ 195 K), QCLs working in the far infrared have now a realistic chance to deeply impact technological applications, thanks to the high output power (>100 mW), the quite broad operating frequency range (1.2-4.7 THz), the tunability of nearly 10% of the emission frequency, the coherence and the compactness. Frequency- and phase-stabilized, high-power and reliable, solid-state terahertz sources can indeed find application in a large number of fields spanning from far-infrared astronomy and high-precision molecular gas spectroscopy, to high resolution coherent imaging and telecommunications, providing the carrier wave for broadband wireless links. To address such application requirements, high frequency stability ultra-narrow and ultra-stable sources are almost mandatory.

Here we report experimental evidence of intrinsic linewidth (LW) values approaching the quantum limit in THz QCLs. [5456]

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09:30-09:45

Mode-locking of a terahertz laser by direct phase synchronization*K. Maussang¹, J. Maysonnave¹, N. Jukam¹, J.R. Freeman¹, P. Cavalieri¹, S.P. Khanna², E.H. Linfield², A.G. Davies², H.E. Beere², D.A. Ritchie³, S.S. Dhillon¹, J. Tignon¹; ¹Laboratoire Pierre Aigrain, Ecole Normale Supérieure, CNRS (UMR 8551) & Université Paris P. et M. Curie, Université D. Diderot (FR); ²School of Electronic and Electrical Engineering, University of Leeds (GB); ³University of Cambridge (GB).*

Mode-locking of a terahertz quantum cascade laser is achieved using multimode injection seeding. Contrary to standard methods that rely on gain modulation, here a fixed phase relationship is directly imprinted to the laser modes. A direct measurement of the emitted field phase shows that it results from the phase of the initial injection. [5332]

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09:45-10:00

STUDENT PRESENTATION

Operating direction of terahertz quantum cascade lasers*C. Deutsch¹, H. Detz², T. Zederbauer², A.M. Andrews², W. Schrenk², A. Benz¹, G. Strasser², K. Unterrainer¹; ¹Vienna University of Technology, Photonics Institute and Center for Micro- and Nanostructures (AT); ²Vienna University of Technology, Institute for Solid-State Electronics and Center for Micro- and Nanostructures (AT).*

By studying symmetric active region designs we investigate the influence of growth-induced asymmetries in terahertz quantum cascade lasers. Those asymmetries are the origin for a polarity-dependent performance. In addition, we compare devices realized in the GaAs/Al_{0.15}Ga_{0.85}As and In_{0.53}Ga_{0.47}As/GaAs_{0.51}Sb_{0.49} material system. [5403]

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10:00-10:15

STUDENT PRESENTATION

Coupled microdisk THz quantum cascade lasers*M. Brandstetter¹, M. Janits¹, C. Deutsch¹, M. Martl¹, A. Benz¹, H. Detz², T. Zederbauer², A.M. Andrews², W. Schrenk², G. Strasser², K. Unterrainer¹; ¹Photonics Institute and Center for Micro- and Nanostructures, Vienna University of Technology (AT); ²Institute of Solid-State Electronics and Center for Micro- and Nanostructures, Vienna University of Technology (AT).*

We present the coupling of microdisk terahertz (THz) quantum cascade lasers (QCLs) via the evanescent field. In this way the lasing behavior of one disk can be controlled by the other one. Furthermore using this concept the gain and loss behavior of the device can be investigated. [5406]

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10:15-10:30

STUDENT PRESENTATION

THz quantum cascade laser absorption studies with coupled cavities*M. Martl¹, M. Krall¹, C. Deutsch¹, A. M. Andrews², W. Schrenk³, G. Strasser^{2,3}, K. Unterrainer^{1,3}, J. Darmo¹; ¹Vienna University of Technology, Photonics Institute (AT); ²Vienna Univ. of Technology, Institute of Solid State Electronics (AT); ³Vienna Univ. of Techn., Center for Micro- and Nanostructures (AT).*

Coupled cavity THz quantum cascade lasers are used for the study of absorption within the conduction band states. Terahertz time-domain spectroscopy is employed to reveal bias-dependent gain and loss. The observed absorption at the lasing transition is proved with one section operating as a photodetector. [5310]

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Room: Emmy Destinn hall (2nd floor)

10:30-11:00

Invited talk

THz LC microcavities: from quantum cascade lasers to ultrastrong light-matter coupling

92

G. Scalari¹, C. Maissen¹, M. Geiser¹, C. Walther¹, D. Turčinková¹, D. Hagenmüller², S. De Liberato², C. Ciuti², C. Reichl³, D. Schuh⁴, W. Wegscheider³, M. Beck¹, J. Faist¹;
¹Institute of Quantum Electronics, ETH Zürich (CH); ²Laboratoire Matériaux et Phénomènes Quantiques, Université Paris Diderot-Paris 7 and CNRS (FR); ³Laboratory for Solid State Physics, ETH Zürich (CH); ⁴Institut für Experimentelle und Angewandte Physik, Universität Regensburg (DE).
 We present here recent progress in the design and realization of THz devices based on sub-wavelength metallic resonators operating on LC resonances. By combining these resonators with different semiconductor heterostructures we realize extremely small laser sources and composite THz metamaterials for strong light-matter coupling experiments. [5457]

11:00-11:30 Coffee break

11:30-13:15

ELECTRON LOCALIZATION, ELECTRON-PHONON COUPLING AND GRAPHENE

Chair: D.G. Cooke, Department of Physics, McGill University (CA)

11:30-12:00

Invited talk

What can we learn about charge transport from terahertz spectra?

94

H. Němec¹, Z. Mics², P. Kužel¹; ¹Institute of Physics, Academy of Sciences of the Czech Republic (CZ); ²Max Planck Institute for Polymer Research (DE).
 Far-infrared conductivity spectra contain rich information on nanoscale charge transport in nanostructured semiconductors. In order to fully exploit this relation, we develop models of terahertz conductivity in semiconductor nanoparticles and we characterize the influence of depolarization fields. [5282]

12:00-12:15

STUDENT PRESENTATION

Electron transport in niobium-doped titania nanoparticles investigated by time-domain THz spectroscopy

96

Z. Mics^{1,2}, H. Němec², M. Kempa², P. Kužel², O. Hayden³, Y. Liu⁴, T. Bein⁴, D. Fattakhova-Rohlfing⁴;
¹Max Planck Institute for Polymer Research (DE); ²Academy of Sciences of the Czech Republic, Institute of Physics (CZ); ³Corporate Technology, Siemens AG (DE); ⁴Department of Chemistry and Biochemistry, University of Munich (DE).
 Measurement of the complex permittivity of Nb-doped anatase (NTO) nanoparticles in the THz frequency range reveals hopping conduction in contrast with bulk NTO, where band-like conduction dominates. We evaluate the effect of the material preparation conditions (growth temperature, doping) on the carrier transport and crystal quality. [5367]

12:15-12:30

Development of solar cell inspection system based on a laser terahertz emission microscope

98

H. Nakanishi¹, K.A. Salek², S. Fujiwara², K. Takayama², L. Kawayama², H. Murakami², M. Tonouchi²;
¹Dainippon Screen Mfg. (JP); ²Institute of Laser Engineering, Osaka University (JP).
 We have succeeded in detecting the terahertz waves generated from the solar cell excited by femtosecond laser pulses, and the intensity of terahertz radiation was decreased by CW laser illumination. This technique has enabled to visualize instantaneous power generation in the solar cell. [5291]

12:30-13:00

Invited talk

Unconventional superconductors studied by ultrafast multi-terahertz spectroscopy

100

A. Pashkin¹, K.W. Kim^{1,2,3}, M. Porer^{1,4}, M. Beyer¹, H. Schäfer¹, A. Dubroka², C. Bernhard², X. Yao⁵, T. Wolf⁶, J. Demsar^{1,7}, R. Huber^{1,4}, A. Leitenstorfer¹;
¹University of Konstanz, Department of Physics and Center for Applied Photonics (DE); ²University of Fribourg, Department of Physics and Center for Nanomaterials (CH); ³Chungbuk National University, Department of Physics (KR); ⁴University of Regensburg, Department of Physics (DE); ⁵Shanghai Jiao Tong University, Department of Physics (CN); ⁶Karlsruhe Institute of Technology, Institute for Solid State Physics (DE); ⁷Jozef Stefan Institute, Complex Matter Department (SI).
 We present a review of our recent ultrafast multi-THz spectroscopy studies of the cuprate superconductor YBa₂Cu₃O₇ and the parent pnictide system BaFe₂As₂. A substantial electron-phonon scattering is observed in the former material, while the latter system demonstrates a strong spin-phonon coupling. [5306]

Room: Emmy Destinn hall (2nd floor)

13:00-13:15

Multi-THz-Photon-Induced Ionization of Coherent Excitons

S. Chatterjee¹, B. Ewers¹, N.S. Köster¹, M. Koch¹, H.M. Gibbs², G. Khitrova², A.C. Klettke¹, M. Kira¹, S.W. Koch¹; ¹Faculty of Physics and Materials Science Center, Philipps-Universität Marburg (DE); ²College of Optical Sciences, The University of Arizona (US).

The interaction of coherent excitons with intense, single-cycle-THz pulses is investigated by monitoring the changes in the weak optical beam. The observed characteristic line shapes are identified as signatures of multi-THz-photon ionization by an analysis with a rigorous quantum-mechanical many-body theory. [5365]

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13:15-15:00 Lunch break (Location: Kaiserstejnsky Palace, 1st floor)

15:00-15:45

ELECTRON LOCALIZATION, ELECTRON-PHONON COUPLING AND GRAPHENE (continued)

Chair: M. Johnston, University of Oxford (GB)

15:00-15:15

STUDENT PRESENTATION

Ultrafast Carrier Transport in Graphene under High Electric Field

S. Tanii^{1,2}, F. Blanchard^{2,3}, H. Hirori^{2,3}, K. Shinokita^{1,2}, G. Asai¹, M. Shirai^{1,2,3}, K. Tanaka^{1,2,3}; ¹Kyoto University, Department of Physics (JP); ²CREST, Japan Science and Technology Agency (JP); ³Kyoto University, WPI-iCeMS (JP).

Time-resolved high-field carrier transport in graphene is studied using terahertz-pump optical-probe technique. The experimental results show good agreement with our numerical results which suggest nonlinear carrier transport at the initial stage of terahertz excitation and the possibility of higher harmonic generation. [5318]

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15:15-15:30

Investigation of THz photoconductivity and carriers lifetime in narrow-gap Hg_{1-x}Cd_xTe/Cd_{1-x}Hg_xTe QW and bulk structures with graphene-like energy-momentum law

S.V. Morozov¹, V.V. Romyantsev¹, V.Ya. Aleshkin¹, A.V. Antonov¹, M.S. Joludev¹, K.E. Kudryavtsev¹, V.I. Gavrilenko¹, N.N. Michailov², O.Drachenko³, S.Winner³, H.Schneider³, M.Helm³; ¹Institute for Physics of Microstructures RAS (RU); ²A.V. Rzhanov Institute of Semiconductor Physics SBIRAS (JP); ³Forschungszentrum Dresden-Rossendorf Institute of Ion Beam Physics and Materials Research (DE).

Spectra and relaxation kinetics of THz photoconductivity in narrow gap bulk HgCdTe solid solutions and HgTe/CdTe based QWs have been measured at $T = 4.2 - 77$ K. The estimations show possibilities for bandgap detectors as well as optically pumped lasers for THz frequency range. [5317]

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15:30-15:45

STUDENT PRESENTATION

Environmental Impact on the Photoconductivity of Graphene Observed by Terahertz Spectroscopy

C.J. Docherty¹, C.-T. Lin², H.J. Joyce¹, R.J. Nicholas¹, L.-J. Li², M.B. Johnston¹; ¹Clarendon Laboratory, Department of Physics, University of Oxford (BG); ²Institute of Atomic and Molecular Sciences, Academia Sinica (TW).

Chemical vapour deposition (CVD) grown graphene sheets were investigated using optical-pump terahertz-probe spectroscopy, revealing a dramatic variation in the photoinduced terahertz conductivity of graphene in different atmospheres. [5386]

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15:45-16:15 Coffee break

Room: Emmy Destinn hall (2nd floor)

16:15-17:45

POLYMERS: CHARGE TRANSPORT AND VIBRATION MODES

Chair: C. Otani, Riken Sendai (JP)

16:15-16:45

Invited talk

Sub-picosecond THz spectroscopy of polymer bulk heterojunction films

D.G. Cooke¹, F.C. Krebs², P. Uhd Jepsen³; ¹Department of Physics, McGill University (CA);

²Department of Energy Conversion and Storage, Technical University of Denmark (DK);

³Department of Photonics Engineering, Technical University of Denmark (DK).

The formation of mobile charges following 400 nm photoexcitation in a roll-to-roll processed conjugated polymer bulk heterojunction film is monitored directly using transient terahertz spectroscopy with sub-100 fs temporal resolution. [5336]

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16:45-17:00

Excitation dependence measurement of the ultrafast THz photoconductivity decay of bulk heterojunction materials

C.S. Ponseca Jr.¹, A. Yartsev², E. Wang², M. Andersson², V. Sundström¹; ¹Lund University, Division of Chemical Physics (SE); ²Chalmers University of Technology, Department of Chemical and Biological Engineering/Polymer Technology (SE).

By lowering the excitation density of two polymer:PCBM blends by a factor of a hundred, the ultrafast THz photoconductivity decay was almost eliminated. This is the first report on such bulk heterojunction systems and was explained as due to charge pair annihilation. [5355]

112

17:00-17:15

pH dependence of carrier transport in PEDOT:PSS films investigated by THz and IR-UV spectroscopy

M. Yamashita¹, Y. Yamada^{1,2}, T. Sasaki³, H. Okuzaki⁴, C. Otani^{1,2}; ¹RIKEN, ASI THz sensing and imaging laboratory (JP); ²Tohoku University, Grad. Sch. of Sci. (JP); ³Tohoku University, Institute of Material Research (JP); ⁴University of Yamanashi, Inter. Grad. Sch. of Med. and Eng. (JP).

We investigated the pH effect on the carrier transport in conducting polymer PEDOT:PSS by the combination of terahertz and infrared-ultraviolet spectroscopy, which revealed that the increase of the pH decreased the DC conductivity resulting from the decrease of carrier density and mobility due to the weak carrier localization. [5309]

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17:15-17:30

Assignments and analyses of vibrational bands in THz and low-frequency Raman spectra of poly-(R)-3-hydroxybutyrate (PHB) based on the DFT calculation with Cartesian coordinate tensor transfer method

Y. Morisawa¹, S. Yamamoto¹, H. Hoshina², H. Sato¹, Y. Ozaki¹; ¹Department of Chemistry, School of Science and Technology, Kwansai Gakuin University (JP); ²RIKEN (JP).

Terahertz (THz) and low-frequency Raman spectra of poly(3-hydroxybutyrate) were compared with the DFT calculations with Cartesian coordinate tensor transfer method. Result of the calculation agreed with both the THz and Raman spectra. Assignments of inter- and intramolecular vibrational bands have been carried out. [5286]

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17:30-17:45

Terahertz Vibrational Spectroscopy of Polymers with Hydrogen Bonds

H. Hoshina¹, S. Ishii^{1,2}, Y. Morisawa³, S. Yamamoto³, H. Sato³, Y. Ozaki³, I. Noda⁴, T. Uchiyama², C. Otani¹; ¹RIKEN ASI (JP); ²Miyagi University of Education (JP); ³Kwansai Gakuin University (JP); ⁴The Procter & Gamble Company (US).

Vibrational spectra of poly-(3-hydroxybutyrate) (PHB) and nylon were studied by terahertz (THz) spectroscopy. The vibrational peaks of hydrogen bonds, which control the intermolecular structure, were observed. The correlation between THz spectra and higher order conformation of polymer was studied. [5316]

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17:45

EOS Student Awards

18:00

End of EOS Topical Meeting

Poster session: Tuesday, 19 June | 13:00-15:15 | Room: Kaiserstejnsky Palace, 1st floor

TST2012_5267_001

Array of serially connected silicon CMOS sub-terahertz detectors per pixel architecture

P. Földesy; The Computer and Automation Research Institute, Hungarian Academy of Sciences Cellular Sensory and Optical Wave Computing Laboratory (HU).

Integrated silicon detector pixel is presented in 90 nm CMOS technology with 52 kV/W@0.47 THz response. In a pixel, four antenna coupled detector FETs are connected in series to improve SNR. The response is amplified, digitalized and filtered by integrated lock-in amplifier. Motivations are discussed of multiple detectors per pixel.

120

TST2012_5269_002

3D terahertz computed tomography of human bones

M. Bessou², H. Duda², J.-P. Caumes¹, S. Salort¹, B. Chassagne¹, M. Tondusson³, E. Abraham³;
¹ALPHANOV (FR); ²PACEA, Univ. of Bordeaux/CNRS (FR); ³LOMA, Univ. of Bordeaux/CNRS (FR).

3D millimeter wave computed tomography has been used to investigate dried human bones. In spite of lower spatial resolution compared with conventional X-ray, THz tomography clearly reveals internal structures in spongy bone whereas compact bone exhibits stronger terahertz absorption, as shown by additional terahertz time-domain spectroscopy.

122

TST2012_5275_003

Towards filling the high-power THz gap

D. Dietze, D. Bachmann, K. Unterrainer, J. Darmo; Vienna University of Technology, Photonics Institute (AT).

In this contribution, we present our results on the generation of intense and broadband THz pulses using table-top laser systems. THz peak fields on the order of 100 kV/cm and bandwidths above 5 THz are achieved with several different types of emitters.

STUDENT PRESENTATION

124

TST2012_5281_004

Improvement of spectral accuracy in asynchronous-optical-sampling THz time-domain spectroscopy by sweeping of mode-locked frequency in dual fiber lasers

Y. Iyona¹, Y. Sakaguchi¹, S. Yokoyama¹, H. Inaba², K. Minoshima², T. Iwata³, T. Yasui^{1,3}, T. Araki¹; ¹Osaka University, Graduate School of Engineering Science (JP); ²National Institute of Advanced Industrial Science and Technology (AIST), National Metrology Institute of Japan (JP); ³University of Tokushima, Institute of Technology and Science (JP).

We improved the spectral accuracy in asynchronous-optical-sampling THz-TDS (ASOPS-THz-TDS) by sweeping the mode-locked frequency in dual fiber lasers. Experimental results of THz spectroscopy of low-pressure water vapor indicated that the achieved accuracy largely exceed the spectral resolution in ASOPS-THz-TDS.

STUDENT PRESENTATION

126

TST2012_5283_005

Linear Characterization of THz DFG Emitters

S. Mariani¹, F. Ghiglieno¹, A. Andronico¹, I. Favero¹, S. Ducci¹, Y. Todorov¹, C. Sirtori¹, M. Kamp², M. Munsch³, J. Claudon³, J. M. Gérard³, G. Leo¹; ¹Univ. Paris Diderot, Sorbonne Paris Cité, Laboratoire MPQ (FR); ²Technische Physik, Universität Würzburg (DE); ³CEA-CNRS-UJF, CEA, INAC, SP2M (FR).

We report on the optical characterization of AlGaAs nonlinear THz emitters based on triply resonant microcylindrical cavities. Reflectivity spectra measured from 2D arrays of pillars showing the excitation of THz whispering gallery modes are presented.

STUDENT PRESENTATION

128

TST2012_5284_006

Six-wave mixing in terahertz wave generation from laser-induced air plasma

V. Vaičiūtis, V. Smilgevičius, E. Gaižauskas, V. Jarutis, D. Chomčik; Vilnius university Laser Research Center (LT).

Terahertz emission from air excited by tightly focused bichromatic femtosecond laser pulses has been analysed. It was shown that the properties of generated terahertz radiation can be well described taking into account both the third-order and quintic optical nonlinearities of the laser induced gas plasma volume.

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Poster session: Tuesday, 19 June | 13:00-15:15 | Room: Kaiserstejnsky Palace, 1st floor

TST2012_5285_007

STUDENT PRESENTATION

Ultrabroad Dual-Mode Spectral Control of a Quantum Dot Laser Gain Medium

R. Leyman¹, N. Bazieva¹, D. Carnegie¹, K.A. Fedorova¹, D.A. Livshits², E.U. Rafailov¹; ¹Photonics & Nanoscience Group, School of Engineering, Physics and Mathematics, University of Dundee (GB); ²Innolume GmbH (DE).

The generation of stable continuous wave (CW) optical beams comprising two simultaneous longitudinal modes which are tunable over an ultrabroad infrared (IR) spectral range is demonstrated. This is achieved using a "chirped" multi-layer InAs quantum dot (QD) laser gain medium. This result may be employed as a highly tunable optical pump setup for terahertz (THz) difference frequency-driven photomixer devices.

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TST2012_5287_008

THz Spectroscopic Image Processing for Extracting Multiple Samples

K. Kitagishi¹, M. Akagi¹, Y. Oishi^{1,2}, Y. Izutani¹; ¹Otsuka Electronics Co.Ltd. (JP); ²Hokkaido University, School of Engineering (JP).

The THz spectroscopic imaging was held for the tablets containing the chemical constituents of drugs. The data processing based on cross-correlation analysis was applied for the time waveforms. The images by this method successfully reflect the distribution of the ingredients of the tablets.

134

TST2012_5288_009

Prediction of a thickness of a paint film by applying a PLS1 method to data obtained in terahertz reflectometry

T. Iwata, S. Yoshioka, S. Nakamura, Y. Mizutani, T. Yasui; The University of Tokushima, Department of Mechanical Engineering (JP).

We have applied a modified partial-least-squares-1 (PLS1) method to time-domain (TD) data obtained in terahertz (THz) reflectometry for predicting the thickness of a paint film on a substrate. The proposed procedure can be carried out effectively for a moderately-thin film rather than a thick one.

136

TST2012_5290_010

Generation of Multi-frequency millimeter-wave using MZM-based flat comb generator

I. Morohashi, T. Sakamoto, T. Kawanishi, I. Hosako; National Institute of Information and Communications Technology (JP).

We report on generation of multi-frequency signals in 100 GHz-bands. The millimeter waves (MMWs) were generated by spectral synthesis of optical comb signals generated by a Mach-Zehnder-modulator-based flat comb generator. Simultaneous generation of 10 GHz-spaced MMW signals was successfully demonstrated.

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TST2012_5329_011

Ultrashort optical pulse system using MZM-based comb generator and fine tuning system

I. Morohashi¹, T. Sakamoto¹, T. Kawanishi¹, I. Hosako¹, Y. Tamura², M. Oikawa², S. Aoki²; ¹National Institute of Information and Communications Technology (JP); ²Optohub Co. (JP).

We report on a femtosecond optical pulse system using Mach-Zehnder-modulatorbased flat comb generator (MZ-FCG) with a fine tuning system. The pulsewidth of optical pulses generated by the MZ-FCG was precisely tuned by using a variable dispersion compensator and a peak power monitor.

140

TST2012_5293_012

STUDENT PRESENTATION

Photonic crystal between metallic parallel plates, effect of air gap on band structure

D. Armand^{1,2}, S. Kouya¹, M. Kodama¹, J. Kitagawa^{1,2}, Kadoya^{1,2}; ¹Hiroshima University (JP); ²Japan science and technology agency, CREST (JP).

We present theoretical and experimental results on a photonic band gap device design around 1 THz. The 2D photonic crystal is made of metallic rod in square lattice arrangement. The crystal is sandwiched by metallic parallel plates; we study the band gap width depending on the air gap modification.

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Poster session: Tuesday, 19 June | 13:00-15:15 | Room: Kaiserstejnky Palace, 1st floor

TST2012_5295_013

Horn antenna in THz regime

D. Armand^{1,2}, Y. Nishifuji², J. Kitagawa^{1,2}, Y. Kadoya^{1,2}; ¹Japan science and technology agency, CREST (JP); ²Hiroshima University ADSM (JP).

We built horn antennas and characterized them on THz-TDS setup. The smallest horn antenna's aperture is $50 \mu\text{m} \times 200 \mu\text{m}$ but exhibits a quite high transmission value, and dispersion of incident pulse is in good agreement with waveguide dispersion model.

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TST2012_5297_014

STUDENT PRESENTATION

Monitoring Phase-change of Poly(N-isopropylacrylamide) with Attenuated Total Reflectance Terahertz Spectroscopy

H. Naito, Y. Ogawa, S. Sultan¹, N. Kondo; Kyoto University, Agricultural Process Engineering (JP). Absorbance spectra in the terahertz (THz) region of Poly(N-isopropylacrylamide) (P-NIPAAm) solutions from 26.5 to 47.3 degrees Celsius were measured by a Fourier transform spectrometer (FTS) with measurement accessory of attenuated total reflectance (ATR) to monitor phase-change of P-NIPAAm.

146

TST2012_5302_015

Characterization of a laser source suitable for a muonic-hydrogen experiment: a DFB-QCL emitting at 6,8 μm

L. Stoychev^{1,2}, M.M. Dzagli^{1,2}, K. Gadedjisso-Tossou^{1,2}, J. Niemela², A. Vacchi¹; ¹INFN, Sezione di Trieste (IT); ²International Centre for Theoretical Physics (IT).

Quantum Cascade Lasers (QCLs) are characterized as a potential source for the measurement of the hyperfine splitting of the muonic-hydrogen atom. For the needs of the experiment a pulsed laser source with tunable emission in the 6,8 μm spectral region is required.

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TST2012_5303_016

Traceable THz Power Measurement by Suitable Detectors

A. Steiger¹, W. Bohmeyer², K. Lange², R. Müller¹; ¹Physikalisch-Technische Bundesanstalt (PTB) (DE); ²Sensor- und Lasertechnik (SLT) (DE).

To pave the way for accurate and reliable THz power measurements, PTB and SLT company joined their expertise in THz radiometry and pyroelectric detector technology. A common R&D project is dedicated to develop a novel "calibratable THz-Detector".

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TST2012_5305_017

STUDENT PRESENTATION

Single mode microstructured silica waveguide for broadband THz transmission

Y. Pan, S. Andrews, F. Yu, J.C. Knight; Department of Physics, University of Bath (GB).

We demonstrate broadband 'anti-resonant' THz guiding in a thin-walled silica capillary and an even thinner wall capillary supported inside a microstructured cladding tube. The later approach allows the fabrication and handling of structures with walls as thin as 30 μm , which support THz guiding with bandwidth up to 1.5 THz. Time domain field mapping show single-mode propagation and good confinement to the central 2 mm diameter air core.

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TST2012_5314_018

STUDENT PRESENTATION

Theoretical demonstration of high efficient cw THz generation by using composite photonic structure element

A. Oyamada¹, H. Kitaguchi¹, K. Ebata², H. Ishihara¹; ¹Department of Physics and Electronics, Osaka Prefecture University (JP); ²Industrial Materials and Process Technology R&D Laboratories, Sumitomo Electric Industries, Ltd. (JP).

We theoretically propose the composite photonic structure that allows us to control photonic modes with a high degree of freedom by flexible structure design. By using this structure for terahertz emission through the difference-frequency generation, we can greatly improve the performance of conversion efficiency and tunable frequency range.

154

TST2012_5315_019

Surface-plasmon enhanced terahertz emission

G. Ramakrishnan¹, N. Kumar¹, P. Planken¹, D. Tanaka², K. Kajikawa²; ¹Optics Research Group, Department of Imaging Science and Technology, Delft University of Technology (NL); ²Department of Electronics and Applied Physics, Tokyo Institute of Technology (JP).

Surface plasmon-enhanced terahertz emission by second-order optical rectification is reported for the first time from plain gold surfaces excited using femtosecond laser pulses. A mono-molecular layer of hemicyanine deposited at the gold surface further increases the terahertz amplitude by a factor of 3.

156

TST2012_5320_020

STUDENT PRESENTATION

Using the terahertz spectroscopy for observing the kinetics of recrystallisation of polybutenes

V. Křesálek, J. Gavenda; Tomas Bata University in Zlín, Department of Electronics and Measurements (CZ).

This article contains information about measured data, which have been obtained using terahertz spectroscopy method. The measurement was focused on the kinetics of recrystallisation of polybutenes, described by the dependency of refractive index on time.

158

TST2012_5321_021

STUDENT PRESENTATION

Vibrational spectra of four different types of nylons studied by terahertz spectroscopy

S. Ishii^{1,2}, Y. Morisawa³, H. Sato³, Y. Ozaki³, C. Otani², T. Uchiyama¹, H. Hoshina²; ¹Miyagi University of Education (JP); ²RIKEN ASI (JP); ³Kwansei Gakuin University (JP).

Terahertz absorption spectra of four different types of Nylons (Nylon-6/6, Nylon-6, Nylon-11, Nylon-12) were measured by Fourier transform far-infrared spectrometer (FT-FIR). The absorption spectra show different features due to the difference of higher order conformations of Nylons.

160

TST2012_5327_023

STUDENT PRESENTATION

A compact, low-temperature THz time domain waveguide spectrometer

W. Qiao¹, D. Stephan¹, M. Hasselbeck², Q. Liang¹, T. Dekorsy¹; ¹University of Konstanz, Department of Physics and Center for Applied Photonics (DE); ²University of New Mexico, Department of Physics & Astronomy (US).

The THz emission from a photo-Dember emitter and the absorption spectrum of 1,2-dicyanobenzene are measured as a function of temperature in a compact, high-resolution THz time domain waveguide spectrometer.

162

TST2012_5344_024

STUDENT PRESENTATION

Loss characteristics of hollow metallic THz waveguide with inner dielectric coatings

Y. Li¹, X. Zhang¹, W. Qiao²; ¹Xi'an University of Technology, Applied Physics Department (CN); ²ShanDong University, Information Science and Engineering Department (CN).

Terahertz transmission characteristic in the dielectric/metal hollow waveguide was studied. The absorption tolerance of dielectric film was analyzed when considering such factors as transmission wavelength, inner radius, refractive index and multilayer dielectric films.

164

TST2012_5340_025

Time-domain THz spectroscopy of central modes in displacive ferroelectrics and related materials

J. Perzelt, E. Buixaderas, D. Nuzhnyy, T. Ostapchuk, F. Kadlec, S. Kamba, P. Kuzel, J. Hlinka; Institute of Physics ASCR (CZ).

Problem of central modes (CM), which are coexisting with soft phonon modes (SM) close to ferroelectric phase transitions typically in the 10^{10} - 10^{12} Hz range, is rather old, and was first studied mostly by inelastic neutron and light spectroscopies (see e.g. P. A. Fleury and K. B. Lyons, *Light Scattering Near Phase Transitions*, Modern Problems in Condensed Matter Science 5, p. 449, Amsterdam: North-Holland, 1983). Some of us have reviewed the earlier results obtained by THz and FIR spectroscopies in. It was shown that in many displacive ferroelectrics their appearance in the paraelectric phase can be evidenced by comparing the low-frequency dielectric data with those extrapolated from the dielectric spectra of the SM even without explicit knowledge of the dielectric spectra in the 10^{10} - 10^{12} Hz range. However, BWO and, more recently, time domain THz spectroscopy in the 3-80 cm^{-1} range enabled to study the CM quantitatively in a number of classical ferroelectrics, as well as in relaxor ferroelectrics, antiferroelectrics and dipolar glasses. Here we will briefly review the more recent data obtained after our review in 2004.

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Poster session: Tuesday, 19 June | 13:00-15:15 | Room: Kaiserstejnsky Palace, 1st floor

- TST2012_5343_026** STUDENT PRESENTATION
Near infrared laser down conversion due to the resonance polariton effect in THz region based on MgO:LiNbO₃ 167
X. Zhang¹, W. Shi¹, W. Qiao²; ¹Xi'an University of Technology, Applied Physics Department (CN); ²ShanDong University, Information Science and Engineering Department (CN).
 Using tunable THz system, the second order near infrared laser down conversion can be observed by mixing the laser and monochromatic THz wave in MgO:LiNbO₃. The results indicated the THz polariton can resonated with the monochromatic THz field in LN crystal, and make the possible to modulate the optics-excited THz polariton.
- TST2012_5348_027** 169
THz time-domain spectroscopy study of free-standing films of doped helical polyacetylene graphite
A.V. Andrianov¹, A.N. Aleshin¹, P.E. Gusakov¹, A.V. Bobylev¹, S. Matsushita², K Akagi², V. Trukhin¹; ¹A.F. Ioffe Physical Technical Institute of RAS (RU); ²Kyoto University, Department of Polymer Chemistry (JP).
 We report on electrical and optical properties of the helical polyacetylene (H-PA) graphite films in the 0.1-2.5 THz frequency ranges studied by the transmission THz time-domain spectroscopy. It is found out that the characteristics of H-PA graphite films in the THz spectral range can be reasonably well described by Drude model.
- TST2012_5349_028** STUDENT PRESENTATION
Tuning Fano resonances in a SRR based metamaterial 171
J. Wallauer, S. Waselikowski, C. Testud, M. Walther; University of Freiburg, Materials Research Center (FMF) (DE).
 Narrow Fano resonances are generated in a metamaterial consisting of coupled splitting resonators (SRRs). We show that their asymmetric lineshape can be tuned dramatically by controlling the coupling between the symmetric and antisymmetric eigenmode of the metamaterial.
- TST2012_5356_029** STUDENT PRESENTATION
Temperature effects on cw terahertz photomixer 173
S. Campbell¹, T. Ackemann¹, H. Fraser¹, M. Missous²; ¹SUPA and Department of Physics, University of Strathclyde (GB); ²School of Electrical and Electronic Engineering, The University of Manchester (GB).
 It is demonstrated that the photocurrent and THz emission from cw photomixers is enhanced at elevated temperatures. This enhancement can reach 25% and 80%, respectively at 60°C compared to 20°C for LT-GaAs driven at 780 nm.
- TST2012_5358_030** STUDENT PRESENTATION
Diamond heat sinking of cw terahertz photomixer 175
T. Ackemann¹, M. Alduraib^{2,3}, S. Campbell¹, M. Missous², H. Fraser¹, A. S. Arnold¹, E. Riis¹; ¹SUPA and Department of Physics, University of Strathclyde (GB); ²School of Electrical and Electronic Engineering, The University of Manchester (GB); ³Now at: Department of Physics and Astronomy, King Saud University (SA).
 The generation of cw Terahertz radiation from photomixing in low-temperature grown GaAs is limited by the thermal load for single emitters. We propose a new diamondbased heat sinking scheme and demonstrate a first working device.
- TST2012_5363_031** 177
Calibration of terahertz-wave detectors: comparison procedure and error estimation
A. Dobroiu, C. Otani; RIKEN ASI (JP).
 A comparison of terahertz-wave detectors was performed in view of establishing an accurate calibration procedure. The measurement conditions were carefully designed and applied to the comparison of two previously calibrated detectors, as well as to the calibration of another detector.

TST2012_5374_032

STUDENT PRESENTATION

Terahertz metamaterials based on resonance in TiO₂ microspheres

F. Domíneq¹, H. Němec¹, F. Kadlec¹, C. Kadlec¹, R. Yahiaoui², P. Mounaix², U.-C. Chung³, P. Kužel¹;
¹Institute of Physics, Academy of Sciences of the Czech Republic (CZ); ²Centre de Physique Moléculaire, Optique et Hertzienne, Université Bordeaux I, CNRS UMR 5798 (FR); ³Institut de Chimie de la Matière Condensée de Bordeaux (CMCB), CNRS-UPR9048 (FR).

We study metamaterials composed of high- ϵ TiO₂ microparticles of nearly spherical shapes with diameters of 30-100 μm showing a magnetic resonance in the THz range. The observed resonances in the terahertz spectral range were broadened by nonuniform sizes of microspheres and match those predicted by numerical simulations.

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TST2012_5375_033

Graphene hyperlens for terahertz radiation

A. Andryieuski, D. Chigrin, A. Novitsky, A. Lavrinenko; ¹Technical University of Denmark, DTU Fotonik - Department of Photonics Engineering (DK); ²University of Wuppertal, Institute of High-Frequency and Communication Technology (DE).

We propose the structured graphene terahertz hyperlens that allows overcoming natural diffraction limit and resolving subwavelength features. The proposed hyperlens can have applications in terahertz spectroscopy and imaging.

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TST2012_5378_034

STUDENT PRESENTATION

Fast terahertz imaging with a quantum-cascade laser and a scanning mirror

N. Rothbart¹, H. Richter¹, M. Wienold², L. Schrottke², M. Giehler², R. Hey², H.T. Grahn², H.-W. Hübers^{1,3};
¹Institute of Planetary Research, German Aerospace Center (DLR) (DE); ²Paul-Drude-Institut für Festkörperelektronik (DE); ³Institut für Optik und Atomare Physik, Technische Universität Berlin (DE).

A terahertz imaging system based on a quantum-cascade laser, a fast scanning mirror, and a sensitive Ge:Ga detector is demonstrated. Transmission images are obtained by scanning the beam of the QCL across an object. Images with a diameter of approximately 45 mm and a signal-to-noise ratio of approximately 25 dB were obtained within 1.1 s. The system was also used to obtain three dimensional images by computed tomography.

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TST2012_5380_035

Edge diffraction in the scattering of focused terahertz radiation by a probe of the terahertz near-field microscope

V.N. Trukhin^{1,2}, D.P. Hor'kov^{1,2}, L.L. Samoilov^{1,2}; ¹Department of Photonics and Optoinformatics, NRU ITMO (RU); ²Ioffe Physical Technical Institute (RU).

In this work we report the results of the investigations of the terahertz (THz) radiation scattering mechanism by a metal conical probe and a thin metal cylinder. The experimental results are explained assuming the diffraction edge waves occurrence on the excited region-shadow region transition boundary.

185

TST2012_5381_036

Passive sub-terahertz video imaging for security application

T. May, E. Heinz, D. Born, G. Zieger, S. Anders, V. Zakosarenko, G. Thorwirth, H.G. Meyer;
 Institute of Photonic Technology (IPHT) (DE).

"THz-Videocam" is a German project to build a passive security camera which visualizes sub-terahertz waves using superconducting bolometer arrays. Against the background of existing solutions, our camera will be analyzed in terms of achieved performance and its practical use.

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TST2012_5382_037

STUDENT PRESENTATION

Spectral measurements of the picosecond photoconductivity in semiconductors by THz radiation pulses

A. Arlauskas, R. Adomavičius, J. Adamonis, A. Krotkus; Center for Physical Sciences and Technology (LT).

A technique for measuring the electron transport characteristics during the first phase after their photoexcitation was proposed. Picosecond photoconductivity of low-temperature-grown GaAs and GaAsBi was measured and explained in terms of the band structure and scattering mechanisms in these materials.

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Poster session: Tuesday, 19 June | 13:00-15:15 | Room: Kaiserstejnsky Palace, 1st floor

TST2012_5383_038

STUDENT PRESENTATION

Broad-band molecular spectroscopy with a multimode terahertz quantum-cascade laser

R. Eichholz¹, H. Richter¹, S.G. Pavlov¹, M. Wienold², L. Schrottke², M. Giehler², R. Hey², H.T. Grahn², H.-W. Hübers^{1,3}; ¹Institute of Planetary Research, German Aerospace Center (DLR) (DE); ²Paul-Drude-Institut für Festkörperelektronik, (DE); ³Institut für Optik und Atomare Physik, Technische Universität Berlin (DE)

A terahertz absorption spectrometer for high-resolution molecular spectroscopy is realized. The spectrometer is based on a multimode quantum-cascade laser. The design and performance of the spectrometer are presented.

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TST2012_5384_039

Intensity modulation of terahertz quantum cascade lasers using femtosecond optical pulses

Y. Sakasegawa¹, S. Saito¹, N. Sekine¹, M. Ashida², I. Hosako¹; ¹National Institute for Information and Communications Technology (JP); ²Graduate School of Engineering Science, Osaka University (JP).

We have investigated the emission intensity of terahertz quantum cascade lasers under the injection of femtosecond optical pulses. The photo-excited plasmas built-up at a facet can directly reduce the output intensity and completely suppressed the THz emission.

193

TST2012_5385_040

Emitters and detectors for a THz time domain material inspection system pumped at 1560 nm

E. Ospald^{1,2}, W. Zouaghi^{1,2}, J.-M. Rämmer¹, R. Beigang^{1,2}; ¹University of Kaiserslautern, Department of Physics and Research Center OPTIMAS (DE); ²Fraunhofer Institute for Physical Measurement Techniques, Department of Terahertz Measurement and Systems (DE).

A fiber-integrated terahertz time-domain sensor is developed within an EU-funded collaborative project for defect detection in aeronautics composite materials. The laser for the device is a commercial twin fiber laser system with ECOPS functionality, while emitter and detector utilize its fundamental wavelength centered at 1560 nm.

195

TST2012_5388_041

Bi-directional terahertz emission from gold-coated nanogratings

K. Weber^{1,2}, F. Garwe², U. Hübner², D. Ciolla^{1,2}, K. Wynne³, T. May²; ¹Institute of Physical Chemistry and Abbe Center of Photonics, Friedrich-Schiller-University Jena (DE); ²Institute of Photonic Technology (IPHT) (DE); ³Department of Physics, University Strathclyde (GB).

Within this contribution, experimental findings on the bi-directional terahertz (THz) emission of gold-coated nanogratings irradiated by a NIR fs laser are presented. Using a superconducting transition edge sensor (TES), the THz emission and its emission angular distribution were recorded.

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TST2012_5411_042

STUDENT PRESENTATION

Cell Measurement using ATR-THz Spectroscopy

K. Shiraga, Y. Ogawa, H. Naito, S. Tomita, T. Suzuki, N. Kondo; Kyoto University, Graduate School of Agriculture (JP).

Attenuated total reflection (ATR) spectroscopy in the terahertz (THz) region was applied to measure the living adhered cells (DLD-1) in medium between 1 and 13 THz. Probably because of the phospholipid cell membrane, the cell presence proved to be distinguished from the medium through its absorbance spectrum.

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TST2012_5393_043

Ultrafast Tunable THz Metamaterial Devices

M. Massoufi¹, N.-H. Shen², T. Koschny², M. Kafesaki^{1,3}, C. M. Soukoulis^{1,2}, S. Tzortzakis^{1,3}; ¹Institute of Electronic Structure and Laser, Foundation for Research and Technology (GR); ²Ames Laboratory and Department of Physics and Astronomy, Iowa State University (US); ³Department of Materials Science and Technology, University of Crete (GR).

We discuss recent developments on tunable ultrafast THz metamaterials. Tunability is offered dynamically using femtosecond laser pulses. THz amplitude and phase modulators as well as ultrafast switches can be realized.

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Poster session: Tuesday, 19 June | 13:00-15:15 | Room: Kaiserstejnsky Palace, 1st floor

TST2012_5394_044

Towards an efficient THz image-processing-based inspection framework

E. Baccaglioni¹, M. Gavelli¹, N. Raimondo¹, R. Scopigno¹, E. Palma²; ¹Istituto Superiore Mario Boella (IT); ²NTT New Tera Technology s.r.l. (IT).

This work describes an on-going activity aimed at the development of an automated framework for the inspections of industrial components, addressing flaw detection and analysis of para-aramid synthetic fiber components, based on Terahertz 3D tomographies and CAD models. In particular, this paper is focused on the improvement of the model-to-object mapping, also introducing a flexible graphical user interface which enables the monitoring of operations and semi-automatic geometrical measurements.

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TST2012_5397_045

STUDENT PRESENTATION

Simulations of Charge Transport in Semiconductor Nanostructures for Interpretation of THz Conductivity Spectra

V. Zajac, H. Němec, P. Kužel; Institute of Physics, Academy of Sciences of the Czech Republic (CZ).

Classical simulations of charge carrier motion within interconnected semiconductor nanoparticles help to characterize the effect of the connectivity between neighbouring nanoparticles and of their size on the overall high-frequency photoconductivity spectrum of the nanostructure.

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TST2012_5398_046

STUDENT PRESENTATION

Metal aperture arrays for operation in the THz region

C.K.A. Hill¹, M.C. Rosamond¹, D. Dai¹, D. Wood¹, A.J. Gallant¹; ¹Durham University, School of Engineering and Computing Sciences (GB).

The THz transmission properties of metal aperture arrays are highly dependent on the shape and spacing of the sub-wavelength apertures. However, the precise design parameters for these arrays are not well established. Here, we present results showing the effect of changing the periodicity in shape-optimised arrays.

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TST2012_5401_047

Feasible study of safety inspection of building walls using pulsed THz wave

T. Ikari¹, D. Yamada¹, R. Fukasawa¹, K. Fukunaga²; ¹Spectra Design Ltd. (JP); ²National Institute of Informatics and Communications Technology (JP).

This presentation reports the use of a pulsed THz wave system for non-destructive inspection of building wall affected by an earthquake. The internal cracks and detachment of tiles from bonding layer were clearly visualized on subsurface THz image.

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TST2012_5402_048

ZnTe-based contact grating setup for high-energy THz pulse generation

Z. Ollmann, J.A. Fülöp, G. Almási, J. Hebling; Institute of Physics, University of Pécs (HU).

The feasibility of efficient generation of high-energy (up to mJ-level) THz pulses is discussed by using a contact grating setup with ZnTe and longer than 1.1 μm pump wavelength. It is shown by numerical calculations that more than 80% diffraction efficiency can be achieved.

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TST2012_5404_049

STUDENT PRESENTATION

Dual-Wavelength Lasers for Difference-Frequency Generation of THz Radiation

M. Dumitrescu, A. Laakso, J. Viheriälä, T. Uusitalo, O. Hyvärinen, L. Toikkanen; Tampere University of Technology, Optoelectronics Research Centre (FI).

Multi-section distributed feedback lasers with laterally-coupled ridge-waveguide surface gratings have been developed for dual-longitudinal-mode emission. THz-range frequency spacing of the narrow-linewidth phase-locked modes, enabling efficient THz difference-frequency generation, has been demonstrated.

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Poster session: Tuesday, 19 June | 13:00-15:15 | Room: Kaiserstejnky Palace, 1st floor

TST2012_5408_050

STUDENT PRESENTATION

215

THz emission from InGaAs/GaAsSb micropillar arrays

M. Krall^{1,3}, M. Brandstetter^{1,3}, C. Deutsch^{1,3}, A. Benz^{1,3}, K. Unterrainer^{1,3}, H. Detz^{2,3}, T. Zederbauer^{2,3}, A.M. Andrews^{2,3}, W. Schrenk³, G. Strasser^{2,3}; ¹Photonics Institute, Vienna University of Technology (AT); ²Institute of Solid State Electronics, Vienna University of Technology (AT); ³Center for Micro- and Nanostructures, Vienna University of Technology (AT).

We are presenting measurements of THz emission from arrays of micrometer-sized pillars in a double-metal waveguide. The micropillars are fabricated by structuring an InGaAs/GaAsSb heterostructure grown by molecular beam epitaxy using a highly anisotropic reactive ion etching process.

TST2012_5410_051

217

Design of strained-layer InAs/GaSb superlattices for photodetectors of THz radiation

M. Patrashin, I. Hosako; National Institute of Information and Communications Technology, Terahertz and Millimeter Waves ICT Laboratory (JP).

We calculated layer structure of InAs/Ga1-xInxSb superlattices that have SL energy gaps of 5-25 meV. These energy gaps enable absorption of THz radiation, which indicates a potential suitability of strained-layer InAs/Ga1-xInxSb superlattices for THz range photodetectors.

TST2012_5459_052

219

Terahertz lasing from boron centers embedded in silicon

H.-W. Hübers^{1,2}, S.G. Pavlov¹, R. Eichholz¹, N. Deßmann¹, N.V. Abrosimov³, H. Riemann³, B. Redlich⁴, A.F.G. van der Meer⁴, R.Kh. Zhukavin⁵, V.N. Shastin⁵; ¹Institute of Planetary Research, German Aerospace Center (DLR) (DE); ²Institut für Optik und Atomare Physik, Technische Universität Berlin (DE); ³Leibniz Institute of Crystal Growth (DE); ⁴FOM-Institute for Plasma Physics (NL); ⁵Institute for Physics of Microstructures, Russian Academy of Sciences (RU).

Stimulated emission in the terahertz frequency range has been realized on intra-center impurity transitions of boron acceptors embedded in monocrystalline silicon under mid-infrared optical pumping at low lattice temperature. This is the first time that laser action from p-type silicon has been obtained.

TST2012_5463_053

221

Pump-probe THz spectroscopy: Effect of dose on the carrier dynamics in Br⁺-bombarded semiconductors

L. Fekete¹, H. Němec¹, Z. Mics¹, F. Kadlec¹, P. Kužel¹, V. Novák², J. Lorinčík^{3,4}, M. Martín⁵, J. Mangeney⁶, J.C. Delagnes⁶, P. Mounaix⁶; ¹Institute of Physics, ASCR (Prague 8) (CZ); ²Institute of Physics ASCR (Prague 6) (CZ); ³Institute of Photonics and Electronics ASCR (CZ); ⁴Department of Physics, Faculty of Science, J.E. Purkinje University (CZ); ⁵Institut d'Electronique Fondamentale, CNRS Université Paris XI, UMR8622 (FR); ⁶Laboratoire Ondes et Matière d'Aquitaine, Université Bordeaux I, UMR5798 (FR).

We use Infrared Pump – Terahertz Probe spectroscopy to characterize the ultrafast carrier dynamics (including electron lifetime, mobility and intervalley scattering) in Br⁺-bombarded In_{0.53}Ga_{0.47}As and InP. Sub-picosecond lifetimes and good electron mobilities were observed for the highest irradiation dose.

TST2012_5464_054

223

MMW/THz thermal converters for 2D multi-spectral real-time imaging

J.-P. Caumes², E. Abraham¹, J.-C. Batsale², C. Pradère²; ¹LOMA, Univ. of Bordeaux/CNRS (FR); ²2M/TREFLE, ENSAM/CNRS (FR).

A full-field real-time room temperature bolometer principle will be described as a MMW/THz thermal converters for wide band electromagnetic radiations. Quantitative multi-spectral (0.1-30THz), sensitive (<25nW/Hz^{1/2}) and fast (1-10Hz) 2D THz and MMW imaging measurement is presented on a large optical field of view (>50x50mm²).