European Optical Society

Coherence for Europe ®

3rd EOS Topical Meeting on Terahertz Science & Technology (TST 2012)

17 - 20 June 2012, Kaiserstejnsky Palace, Prague, Czech Republic

ADVANCE PROGRAMME

Sponsors:

ALPES LASERS

AMERICAN ELEMENTS

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Czech & Slovak Society for Photonics

European Optical Society

Annual Meeting

EOSAM 2012 moves to Aberdeen

Aberdeen Exhibition and Conference Centre, Scotland (UK) | 25 - 28 September 2012

Present your research in the energy capital of Europe!

Topical Meetings

TOM 1 Biophotonics
TOM 2 Silicon Photonics
TOM 3 Nanophotonics & Metamaterials
TOM 4 Micro-Optics
TOM 5 Organic Photonics & Electronics
TOM 6 Nonlinear Photonics
TOM 7 Optical Systems for Energy & Production Industries

Workshop

Continuing education: Short courses for industry

Exhibition with special focus on:

- Photonics for offshore applications: blue photonics®
- Biomedical photonics
- Organic optoelectronics
- Micro-optical components and systems

Sign up for updates at www.myeos.org/events/eosam2012

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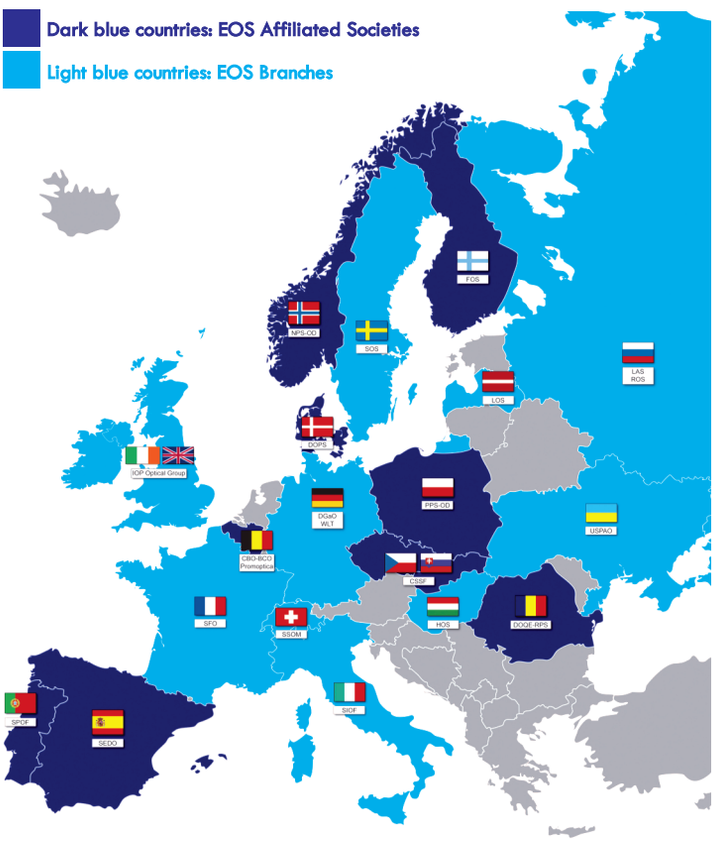
Phone: +49 (0)511 277 2673 · Fax: +49 (0)511 277 2699 · Email: **tst2012@myeos.org** · **www.myeos.org/events/tst2012**

ABOUT EOS

History

The European Optical Society (EOS) was founded in 1991. The purpose of the society is to contribute to progress in optics and related sciences, and to promote their applications at the European and international levels, by bringing together individuals and legal entities involved in these disciplines and their applications. EOS is a not for profit organisation and serves as the joint forum for all individuals, companies, organisations, educational institutions, and learned and professional societies, who recognise the opportunity and challenge that a common European base provides for the development of optics in its broadest sense. EOS organises recognized topical meetings, conferences, workshops and other events, publishes journals and is an important player on the European level. 22 national optical societies and a great number of individuals and companies are currently members of EOS (www.myeos.org).



EOS membership - Join us and...

- Be a part of the umbrella organisation of the national optical societies in Europe
- Connect with colleagues from all over Europe and beyond
- Contribute to strengthening Europe's future in optics and photonics
- Stay up-to-date about European Research Funding
- Benefit from discounts on EOS events and publications in the EOS online journal JEOS:RP
- Receive the Annual EOS Member Directory - your guide to the European optics and photonics community

Activities

- Organisation of topical meetings, workshops and conferences, and endorsement of other scientific events
- Operation of a virtual platform for the European optics and photonics community at www.myeos.org
- Focus Groups and Student Clubs (as of 2011)
- Publication of JEOS:RP, the electronic Journal of the European Optical Society - Rapid Publications (www.jeos.org)
- Bi-monthly electronic member newsletter
- Representation of the optics and photonics community on the European level (Photonics21 Technology Platform)
- Annual award of the EOS Prize

Membership modes and fees

Individual membership

Annual fee: 50 €

Individual membership through an EOS Branch

Every member of an EOS Branch is automatically an individual member of the EOS, too, with all benefits.

Annual fee: included in the Branch membership fee

Student membership

Annual fee: 10 €

Associate membership through an EOS Affiliated Society

Every member of an EOS Affiliated Society is automatically an associate member of the EOS, too, but with limited benefits.

Annual fee: included in the Affiliated Society membership fee

Upgrade for associate members

Upgrade to an individual EOS membership with full benefits.
Annual fee: 12.50 €

Corporate membership through an EOS Branch or Affiliated Society

Annual fee: 200 €

Direct corporate membership

Annual fee: 300 €

How to join?

To join the EOS as an individual, student or corporate member, please see our website at www.myeos.org/members.

Questions?

Please contact the EOS office at info@myeos.org.

VENUE

Prague, the capital of the Czech Republic, is a most valuable historical city reserve. In 1992, the historical core of the city covering 866 hectares was listed in the UNESCO World Cultural and Natural Heritage Register. Prague represents a unique collection of historical monuments dominated by the Prague Castle which towers high above the city. It is a display of all artistic styles and movements.

The historical core of the city is situated on both banks of the Vltava river and consists of 6 parts - formerly independent urban units unified in the 18th century: Stare Mesto (Old Town), Josefov (the preserved part of the former Jewish Town - today a part of the Old Town), Nove Mesto (New Town), Mala Strana (Lesser Town), Hradcany and Vysehrad. Naturally, most of the historical monuments, museums and galleries are concentrated right there. [Source: www.praguewelcome.cz]

TST 2012 will take place at Kaiserstejnsky Palace which is located in the Prague Lesser Town and has been hosting events for more than three centuries.

Its total reconstruction begins under the architects Zdeněk Pokorný and Jaroslav Bělský in 1977, and it was registered a UNESCO heritage site in 1981. Restitution procedures were completed and the palace returned to its original owners in 1997.

Venue address: **Kaiserstejnsky Palace**
Malostranské namesti 23/37, Prague 1
110 00 Czech Republic
www.kaiserstejnskypalac.cz/Text/homepage?MenuItemId=2

GETTING THERE

By plane

The Airport *Letiště Praha-Ruzyně* links Prague with about 130 destinations worldwide. It is served by approx. 50 airlines, among them also some budget airlines offering direct flights to Prague. The airport is located about 15 km away from the city centre and the meeting venue.

Directions to the venue/city centre:

- to the main railway station *Hlavní nádraží* and the city centre the most direct way is taking the *Airport Express* (travelling time: ~ 35 min.)
- alternatively: take the bus line 119 (direction *Dejvická*) and exit at the final stop
- from there take the metro line A (direction *Depo Hostivař*)
  - to get directly to the **venue**: exit at the stop *Malostranská* (walking time to the venue: ~ 10 min.)
  - to get to the **city centre**: exit at the stop *Muzeum*, situated about 2 km away from the main railway station
- further information on getting around is described on the next page in paragraph "by public transport"

Useful links:

- Destinations & airlines: www.prg.aero/en/flight-info/destination-and-airlines/destinations
- Plan the journey to your hotel (stations are indicated on the hotel list): www.dpp.cz/en/

By train

The main railway station *Hlavní Nádraží* is located in the heart of the city centre and is connected to a number of European cities.

From the main railway station *Hlavní nádraží* to the venue:

- take the tramway line 9 (direction *Sídliště Řepy*)
- change at the stop *Újezd* into tramway line 12 (direction *Palmovka*) or 20 (direction *Divoká Šárka*) and exit at the stop *Malostranské náměstí*

You may also arrive at the centrally located station *Masarykovo nadrazi* which is considered to be the oldest Railway Station of Prague.

From the railway station *Masarykovo nadrazi* to the venue:

- take the tramway line 30 (direction: *Výstaviště*)
- change at the stop *Strossmayerovo náměstí* into line 12 (direction: *Sídliště Barrandov*) and exit at the station *Malostranské náměstí*

Walking time to the venue: ~ 1 min.

Useful link:

- Journey planner: www.dpp.cz/en

GETTING THERE (continued)

By car

Prague can be reached by motorways and main roads from several European cities (www.praguewelcome.cz/en/services/transportation/prague-by-car/road-distances-from-prague.shtml) and the major boarder crossings.

Important information:

- drivers need an international driving permit
- the international certificate of insurance "green card" is an obligation for entering the Czech Republic
- the car headlights have to be switched on also in day-time
- you have to purchase toll stickers and place them on the front window when driving all motorways and selected high speed routes
  ⇒ the appropriate toll stickers can be purchased at border crossings, post offices or fuel stations

Useful links:

- Prague by car: www.praguewelcome.cz/en/services/transportation/prague-by-car/basic-information.shtml
- Toll system: www.mytocz.cz/index.php?id=1521

GETTING AROUND IN PRAGUE

By public transport

Prague offers a large and efficient public transportation network including bus, tram and metro linking.

Daily operating times:

- **Metro:** from 5 a.m. to 12 p.m. (on Fridays and Saturdays about one hour longer)
  During the rush hours a train is running every 2-3 min. and in off-peak hours every 4-10 min.
- **Trams & busses:** from 4:30 a.m. to midnight, on Fridays and Saturdays about one hour longer)

Useful links:

- More information & a journey planner (incl. fares) is available at the website of the operating company: www.dpp.cz/en
- Network maps: www.ropid.cz/info/maps__s219x901.html
- Overview of public transport: www.praguewelcome.cz/en/services/transportation/public-mass-transit/basic-information.shtml

General information about Prague is available at:

- www.praha.eu/jnp/en
- www.praguewelcome.cz/en

Prague on Foot

Exploring the historic city centre of Prague which is listed in the UNESCO World Cultural and Natural Heritage Register since 1992 is definite a must.
The city centre offers a number of attractions, e.g. the Hradčany with Prague Castle and the Old Town including the Charles Bridge. The historic centre is moreover characterised by winding alleys and almost invites to a journey through the history of architectural styles with its inter alia Romanesque rotundas, Gothic cathedrals, Baroque and Renaissance palaces.

Useful link:

- Plan your trip through the city centre at: www.praguewelcome.cz/srv/www/en/monuments/prague.x?form=

By taxi

Prague has established the so-called "fair place taxi" stations that can be found throughout the city. Alternatively, you may call a taxi directly, e.g. at:

- AAA RADIOTAXI | Phone: +420 2 - 140 14
- Halotaxi | Phone: +420 244 114 411

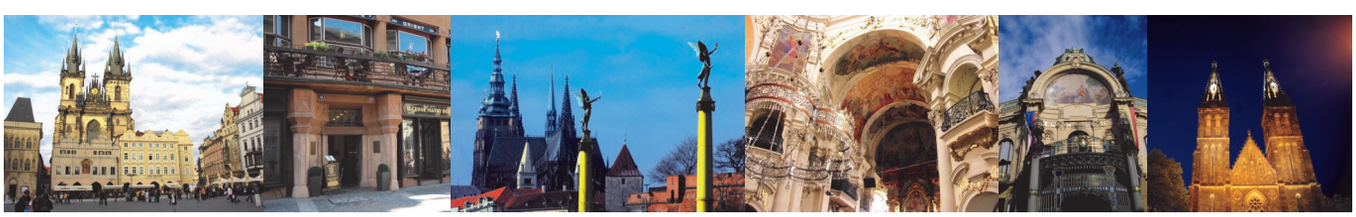
Further taxi companies:

www.praguewelcome.cz/srv/www/en/addresses/list.x?keyIds=42802&pagedPlace=Praha

SIGHTSEEING PROPOSALS

Besides the 3rd EOS Topical Meeting on Terahertz Science & Technology, Prague has much to offer. If you decide to extend your stay to experience the touristic sides of the "Golden City" you may be interested in sightseeing recommendations. *Prague Information Services* has provided trips for a one-, two- and three-day visit to Prague that are available at the *Capital City of Prague Tourism Portal* (www.praguewelcome.cz).

- **"Prague in a nutshell":** www.praguewelcome.cz/en/visit/prague-fit-to-your-tastes/prague-in-a-nutshell/



HOTEL LIST

Please note that the room rates as well as the information on internet facilities (internet plugs, Wi-fi etc.) are taken from the homepages of the listed hotels.
Rates may vary from the prices listed below (e.g. during fairs or depending on the season) according to room availability and reservation date. Please contact the hotel directly to make your reservation.

Hotel Malostranska Residence****

Rates: from 114 Euro/night/person (breakfast: price not specified)
Address: Malostranské náměstí 24, 110 00 Prague 01 (CZ)
URL: www.booking.com/hotel/cz/malostranska-24-palace-residence.html?label=gog235jc;sid=138676551d51965958a67a1aa24a0261;dcid=1;dva=0&lang=en-gb
Internet: WiFi available
Distance to the meeting venue: 0.1 km
Station: Malostranské náměstí (tram: 12, 20, 22, 91)

Hotel U Schnellů***

Rates: 55 Euro/night/single room (breakfast incl.)
Address: Tomášská 2/21, 11800 Prague 1 - Malá Strana (CZ)
E-Mail: uschnellu@centrum.cz
URL: www.uschnellu.cz/en.html
Phone: +420 257 531 037
Fax: +420 257 532 038
Internet: Free Wi-fi in all rooms
Distance to the meeting venue: 0.1 km
Station: Malostranské náměstí (tram: 12, 20, 22, 91)

The Charles Hotel****

Rates: from 89 Euro/night/single room (breakfast incl.)
Address: Josefská 1, 118 00 Prague 1 - Malá Strana (CZ)
E-Mail: reservation@hotel-charles.eu
URL: www.hotel-charles.cz/default.aspx
Phone: +420 257 532 914
Fax: +420 257 532 910
Internet: Free Wi-fi available
Distance to the meeting venue: 0.25 km
Station: Malostranské náměstí (tram: 12, 20, 22, 91)

Hotel Pod Věží****

Rates: from 98 Euro/night/single room (breakfast incl.)
Address: Mostecká 58/2, 118 00 Praha 1 - Malá Strana (CZ)
Email: hotel@podvezi.com
URL: http://podvezi.com
Phone: +420 257 532 041
Fax: +420 257 532 069
Internet: Wi-Fi available
Distance to the meeting venue: 0.25 km
Station: Malostranské náměstí (tram: 12, 20, 22, 91)

Hotel Residence U černého orla***

Rates: 119 Euro/night/person (breakfast incl.)
Address: Mostecká 11, 118 00 Praha 1 (CZ)
E-Mail: reception@residenceprague.cz
URL: www.residenceprague.cz/index.php
Phone: +420 257 535 061
Fax: +420 257 535 066
Internet: not specified
Distance to the meeting venue: 0.3 km
Station: Malostranské náměstí (tram: 12, 20, 22, 91)

Domus Balthasar Design Hotel****

Rates: 180 Euro/night/person (breakfast incl.)
Address: Mostecká 5, Malá Strana - 118 00 Prague 1 (CZ)
E-Mail: balthasar@hidden-places.com
URL: www.domus-balthasar.cz
Phone: +420 257 199 499
Fax: +420 257 199 490
Internet: Internet connection in all rooms
Distance to the meeting venue: 0.3 km
Station: Malostranské náměstí (tram: 12, 20, 22, 91)

Best Western Premier Hotel Royal Palace Prague*****

Rates: 149 Euro/night/single room (breakfast incl.)
Address: Letenská 11, Prague 1, 118 00 (CZ)
E-Mail: hotel@hotelroyalpalace.cz
URL: www.royalpalacehotel.cz/en/
Phone: +420 224 811 281
Fax: +420 224 811 287
Internet: Internet connection available
Distance to the meeting venue: 0.5 km
Station: Malostranská (Metro: A; Tram: 1, 8, 12, 18, 20, 22, 91)

HOTELS LIST (continued)

Hotel Three Storks (U Tří čápů)*****
Rates: from 79/Euro/night/single room (breakfast incl.)
Address: Valdstejnske nam. 8
11800 Praha 1 (CZ)
E-Mail: utricapu@avehotels.cz
URL: www.hotelthreestorks.cz/index.php
Phone: +420-2572 10779
Fax: +420- 2572 12967
Internet: Free Wi-fi available
Distance to the meeting venue: 0.5 km
Station: Malostranské náměstí (tram: 12, 20, 22, 91)

Hotel Čertovka****
Rates: from 124 Euro/night/single room (breakfast incl.)
Address: U lužického semináře 85/2
118 00 Praha-Malá Strana (CZ)
E-Mail: reservations@certovka.cz
URL: www.certovka.cz/?lang=en&1323869828
Phone: +420 257 011 500
Fax: +420 257 534 392
Internet: not specified
Distance to the meeting venue: 0.9 km
Station: Malostranská (tram: 1, 8, 12, 18, 20, 22, 91)

Hotel Constans****
Rates: from 75 Euro/night/single room (breakfast incl.)
Address: Břetislavova 309
118 00 Praha 1 - Malá Strana (CZ)
E-Mail: reservation@hotelconstans.cz
URL: www.hotelconstans.cz/en
Phone: +420 234 091 818
Fax: +420 234 091 860
Internet: Wi-Fi available
Distance to the meeting venue: 1.3 km
Station: Malostranské náměstí (tram: 12, 20, 22, 91)

Aparthotel City 5***
Rates: 65 Euro/night/person/studio (breakfast: CZK 100/day (4 Euro/day))
Address: Vltavská 11/667
150 00 Praha 5 - Smíchov (CZ)
E-Mail: office@appartamento.cz
URL: www.aparthotelprague.com
Phone: +420 602 495 529
Fax: +420 257 217 066
Internet: Free Wi-fi available
Distance to the meeting venue: ~ 3.5 km
Station: Na Knížecí (Tram: 6, 12, 14, 20)

Hotel Arcadia Old Town***
Rates: 75 Euro/night/single studio (breakfast incl.)
Address: Hostivítova 3
128 00 Prague 2 (CZ)
E-Mail: info@arcadiaresidence.com
URL: www.arcadiaresidence.com/?lang=en
Phone: +420 2249 22040
Fax: +420 2249 22042
Internet: Internet connection available
Distance to the meeting venue: ~ 4 km
Station: Albertov (tram: 7, 18, 24)
Important: To stay close to the venue: please indicate that you would like to book a room at the Arcadia Old Town in the centre and not in the Arcadia Residence situated outside the centre.

⇒ An extensive overview of hotels arranged by category is available at: www.praguewelcome.cz/en/services/accommodation.shtml

HOSTELS

Charles Bridge Economic Hostel
Rates: from 24 Euro/night/Deluxe 3 bed (breakfast: not specified)
Address: Mostecka 4/53, 118 00 Praha 1 - Mala Strana (CZ)
Contact form: www.charlesbridgehostel.cz/contactform
URL: www.charlesbridgehostel.cz
Phone: +420 257 213 420
Internet: Wi-Fi available
Distance to the meeting venue: 0.3 km
Station: Malostranské náměstí (tram: 12, 20, 22, 91)

Little Town Budget Hostel
Rates: 68 Euro/night/single room (breakfast: 6 Euro/day)
Address: Malostranske namesti 11/260
118 00 Prague 1 (CZ)
E-Mail: info@littletownhotel.cz
URL: www.littletownhotel.cz
Phone: +420 242 406-964/-965
Fax: +420 255 729 689
Internet: Free Wi-Fi available
Distance to the meeting venue: 0.4 km
Station: Malostranské náměstí (tram: 12, 20, 22, 91)

⇒ Further hostels are available at: www.hostelworld.com

INFORMATION FOR AUTHORS AND ATTENDEES

ORAL PRESENTATIONS

Time slots: Presenting authors are allotted 15 minutes (12 minutes presentation plus 3 minutes for discussion). Please plan your presentation accordingly to meet the 15 minute maximum.

Presentation upload: Speakers are requested to upload their presentation to the computer in the meeting room well in advance to their talk.

Presentation format: Please bring your presentation on a USB mass storage, CD-ROM or DVD and include all video files. File formats: ppt, pptx and pdf. A Windows-based presentation computer will be provided.

For Mac users: To make sure your presentation is displayed correctly, please:

- bring your presentation as pdf-file with fonts embedded or
- restrict yourself to Arial/Times New Roman (not Times)/Courier New (not Courier)/Symbol/Wingdings when creating your ppt- or pptx-file.

Technical equipment: All technical equipment (presentation computer, video projector, sound system, laser pointer) will be available on-site. It is not possible to use your personal laptop.

POSTER PRESENTATIONS

Poster authors are requested to be present at their posters during the official poster session. Please **prepare and print** your poster in advance to the conference. Poster set-up and removal is in the responsibility of the authors. Any posters left on the boards at the close of the poster session will be discarded. Poster numbers will be displayed on the poster boards to show authors where to place their poster.

Required poster size: The posters should have a size of DIN A1 (594 x 841 mm) or DIN A0 (841 x 1189 mm) preferably in a portrait format (not landscape format). Double sided tape and similar pads will be provided by the organizer. The size of the poster boards is 90 cm (width) x 200 cm (height).

The official poster session will be held on Tuesday, 19 June, from 13:00 - 15:15.

EOS REGISTRATION DESK

Please collect your material on **Sunday afternoon or on Monday morning.**

On-site registration hours		**Information / Receipts / Confirmation of attendance / Cash payment**
Sunday, 17 June	18:00-19:00	Attendees requiring a payment receipt or confirmation of attendance
Monday, 18 June	08:00-18:15	may obtain these documents onsite at the EOS registration desk.
Tuesday, 19 June	08:30-18:15	Attendees paying by cash are requested to have the exact change ready in
Wednesday, 20 June	08:30-18:00	Euro.

REGISTRATION & FEES

At least one author of an accepted presentation is requested to register properly in advance to the conference.

Early-bird deadline: 20 April 2012.

The full-time-registration fee includes the participation in all three meeting days, the Welcome Reception on Sunday evening, one copy of the Topical Meeting digest CD-ROM (ISBN numbered), snacks and drinks during the official poster session as well as all coffee breaks and lunches. The participation in the conference dinner is optional (additional costs tba).

Registration category	**Early-bird fee** (until 20 April)		**Late/On-site fee (**after 20 April**)**	
	incl. 19 % VAT	**excl. VAT***	**incl. 19 % VAT**	**excl. VAT***
Registration for members	571.20 €	480.00 €	642.60 €	540.00 €
Registration for non-members	654.50 €	550.00 €	725.90 €	610.00 €
Registration for student members	297.50 €	250.00 €	368.90 €	310.00 €
Registration for student non-members	333.20 €	280.00 €	404.60 €	340.00 €
Registration for invited speakers	464.10 €	390.00 €	463.10 €	390.00 €

* PLEASE NOTE: Registrations from companies and non-university research institutes registered in EU countries (except Germany) are exempted from VAT, **if VAT no. is given**.

WELCOME RECEPTION

The Welcome Reception will be taking place on **Sunday, 17 June, from 18:30 to 20:00** in the Foyer & Saloons on the 1st floor of Kaiserstejnsky Palace.

EOS CONFERENCE DIGEST

The registration fee includes a CD-ROM with the complete volume of accepted abstracts (plenary, invited and contributed) of the topical meeting (ISBN 978-3-9815022-1-3).
Please note that the EOS does not publish conference proceedings with extensive papers. Authors who wish to publish in-depth papers are welcome to take advantage of the special publication offer from JEOS:RP (see the next paragraph). This publication offer is an option but no obligation.

JEOS:RP - SPECIAL SPECIAL PUBLICATION OFFER

EOS European Optical Society
www.jeos.org

Attendees of TST 2012 are welcome to submit a paper to the Journal of the European Optical Society - Rapid Publications (JEOS:RP). JEOS:RP is a peer-reviewed open-access journal which is listed with ISI Journal Citation Reports. 2010 Impact Factor: 1.044.
The paper must be an original high-quality contribution connected to this Topical Meeting and will be reviewed according to the normal procedure of the journal. In case of acceptance authors will **receive a 20% discount on the publication rate**. The paper must be submitted no later than 30 September 2012 (www.jeos.org).

Special publication fee for standard papers of EOS attendees

- 280 € (instead of 350 €) for full EOS members
- 320 € (instead of 400 €) for non EOS members

For further information please see: www.jeos.org/forms/AuthorGuide.pdf

BEST STUDENT PRESENTATION AWARD

Sponsored by Springer science+business media

The best student oral contribution and the best student poster presentation of TST 2012 will be awarded a diploma, an EOS student membership for 2012 and a prize sponsored by Springer.
All student oral and poster contributions are eligible to the prize. The criteria for the award are relevance, originality, scientific merit and clarity.

WIFI ACCESS

Free WIFI access will be available at the conference location. Please ask at the registration desk for the password.

CONFERENCE DINNER

The conference dinner will be taking place on Monday, 18 June from 19:30 – 22:00 CEST at the conference venue. The registration fee includes an International style buffet with cold & warm food as well as beverages. Spirits must be paid separately.

Where: Kaiserstejnsky Palace (1st floor)
When: Monday, 18 June, 19:30 – 22.00 CEST
Costs per person: 28.00 Euro (+ 19% VAT)

The participation in the dinner is optional and required separate registration until 11 June 2012.

SYNOPSIS

The field of THz Science and Technology is growing at a tremendous speed, as evidenced by the exponentially growing number of publications in this field and by the rapidly increasing number of patents and applications. This topical meeting provides a platform on which the latest results in the generation, detection and use of THz radiation in science and technology will be presented and discussed. The meeting is for senior scientists and (under)graduate students alike. There will be two 45 minute-long Master Class Talks, especially aimed at the undergraduate and graduate student level.

This meeting is the 3rd of the EOS Topical Meeting Series on THz Science & Technology. Former meetings took place in Paris in 2008 and 2010 under the umbrella of the EOS Annual Meetings 2008 and 2010.

TOPICS

- Emission of THz radiation (QCLs, HEMTs, FELs, synchrotrons, nonlinear optics etc.)
- Detection of THz radiation (quantum dots, single photon detectors, time-Gate, HEMTs etc.)
- THz integrated optics, waveguiding, plasmonics, metamaterials, photonic crystals
- Interaction of THz radiation with matter (dielectrics, semiconductors, nanostructured materials, liquid-state dynamics, chemistry, biology, ultrafast spectroscopy etc.)
- Nonlinear phenomena induced by THz radiation
- THz far-field and near-field imaging, THz microscopy and microspectroscop
- Remote sensing of gases and chemical/biological agents
- THz applications (security, telecom, remote detection etc.)

GENERAL CHAIRS

Petr Kužel
Institute of Physics
Academy of Sciences of the
Czech Republic (CZ)

Peter Uhd Jepsen
DTU Fotonik
Technical University of Denmark (DK)

PROGRAMME COMMITTEE

- **Richard Averitt**
  Boston University (US)
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  Ecole Polytechnique (FR)
- **Rupert Huber**
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- **Martin Koch**
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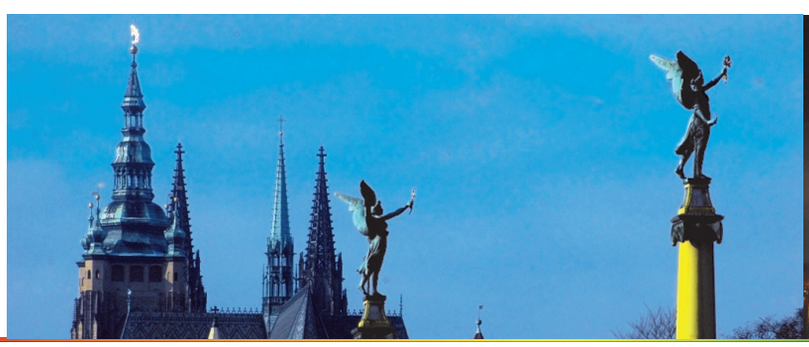

Keynote, Masterclass & Invited Speakers

KEYNOTE SPEAKER

Monday 18 June

09:15-10:00

Xi-Cheng Zhang, The Institute of Optics, University of Rochester (US).

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

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]

MASTERCLASS SPEAKERS

Monday 18 June

10:00-10:45

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

High-field THz pulse generation and nonlinear THz spectroscopy

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]

Tuesday, 19 June

09:00-09:45

Edmund H. Linfield, School of Electronic and Electrical Engineering, University of Leeds (GB)

Terahertz Quantum Cascade Lasers

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]

INVITED SPEAKERS

Monday, 18 June

14:30-15:00

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

Metamaterial Terahertz Transmission Optics and Surface Waves

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]

16:45-17:15

Oleg Mitrofanov, University College London (GB)

Progress in development of waveguides for terahertz applications

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]

Tuesday, 19 June

15:15-15:45

Kodo Kawase, Nagoya University, Ecotopia Science Institute (JP) & RIKEN, Advanced Science Institute (JP)

Nonlinear optical THz sources and applications

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]

INVITED SPEAKERS (continued)

Wednesday, 20 June

09:00-09:30

Miriam 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)

Quantum Cascade Lasers as versatile, narrow-linewidth sources in the Terahertz range

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 (>100mW), 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]

10:30-11:00

Giacomo Scalari, Institute of Quantum Electronics, ETH Zürich (CH)

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

We present here recent progress in the design and realization of THz devices based on subwavelength 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]

11:30-12:00

Hynek Němec, Institute of Physics, Academy of Sciences of the Czech Republic (CZ)

What can we learn about charge transport from terahertz spectra?

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]

12:30-13:00

Alexej Pashkin, University of Konstanz, Department of Physics and Center for Applied Photonics (DE)

Unconventional superconductors studied by ultrafast multi-terahertz spectroscopy

We present a review of our recent ultrafast multi-THz spectroscopy studies of the cuprate superconductor $YBa_2Cu_3O_7$ and the parent pnictide system $BaFe_2As_2$. A substantial electron-phonon scattering is observed in the former material, while the latter system demonstrates a strong spin-phonon coupling. [5306]

16:15-16:45

David G. Cooke, Department of Physics, McGill University (CA)

Sub-picosecond THz spectroscopy of polymer bulk heterojunction films

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]

Daily overview

SUNDAY, 17 JUNE	
18:00-19:00	Pre-Registration
18:30-20:00	Welcome Reception
MONDAY, 18 JUNE	
08:00-09:00	Registration
09:00-09:15	Welcome by the Chairs
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)
10:00-11:30	Session: Terahertz nonlinear **Masterclass talk: High-field THz pulse generation and nonlinear THz spectroscopy** Keith A. Nelson, Massachusetts Institute of Technology (US)
11:30-12:00	Coffee break
12:00-13:15	Session: THz spectroscopy: technique & methodology
13:15-14:30	Lunch break
14:30-16:15	Session: Metamaterials, waveguides and near-fields
16:15-16:45	Coffee break
16:45-18:15	Session: Metamaterials, waveguides and near-fields (continued)
19:30-22:00	Conference dinner
TUESDAY, 19 JUNE	
09:00-09:45	**Masterclass talk: Terahertz Quantum Cascade Lasers** Edmund H. Linfield, School of Electronic and Electrical Engineering, University of Leeds (GB)
09:45-10:45	Session: Spectroscopy: phonons & vibrations
10:45-11:15	Coffee break
11:15-13:00	Session: THz imaging
13:00-15:15	Lunch break & Poster session
15:15-16:30	Session: Sources & detection
16:30-17:00	Coffee break
17:00-18:15	Session: Sources & detection (continued)
WEDNESDAY, 20 JUNE	
09:00-11:00	Session: Quantum Cascade Laser (QCL)
11:00-11:30	Coffee break
11:30-13:15	Session: Electron localization, electron-phonon coupling and graphene
13:15-15:00	Lunch break
15:00-15:45	Session: Electron localization, electron-phonon coupling and graphene (continued)
15:45-16:15	Coffee break
16:15-17:45	Session: Polymers: charge transport and vibration modes
17:45	EOS Student Awards
18:00	End of EOS Topical Meeting

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]

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
Keith 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]

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. Tani[1,2], Y. Kadoya[2,4], K. Tanaka[1,2,3]; [1]Kyoto University, Department of Physics (JP); [2]CREST, Japan Science and Technology Agency (JP); [3]Kyoto University, WPI-iCeMS (JP); [4]Hiroshima 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]

11:00-11:15 **STUDENT PRESENTATION**
Terahertz Electric Field Induced Tunnel Ionization of *p*-type Germanium
Y. Mukai[1], H. Hirori[2,3], K. Tanaka[1,2,3]; [1]Kyoto University, Department of Physics (JP); [2]CREST, Japan Science and Technology Agency, (JP); [3]Kyoto 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]

11:15-11:30
THz field induced pair-breaking in YBCO thin films
C. Zhang[1], A. Glossner[1,2], S. Kikuta[1], I. Kawayama[1], H. Murakami[1], P. Müller[2], M. Tonouchi[1]; [1]Osaka University, Institute of Laser Engineering (JP); [2]Universität 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]

11:30-12:00 Coffee break

NOTES

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. Molter[1,2], G. Torosyan[1], J. Klier[1], C. Matheis[1], C. Petermann[1], S. Weber[1,2], F. Ellrich[1], J. Jonuscheit[1], R. Beigang[1,2]; [1]Fraunhofer Institute for Physical Measurement Techniques IPM, Kaiserslautern (DE); [2]Department 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]

12:15-12:30 STUDENT PRESENTATION
Interpolation of frequency gaps between THz comb modes by precise tuning of laser mode-locked frequency
Y.-D. Hsieh[1], Y. Iyonaga[1], Y. Sakaguchi[1], S. Yokoyama[1], H. Inaba[2], K. Minoshima[2], T. Iwata[3], T. Yasui[1,3], T. Araki[1]; [1]Osaka University, Graduate School of Engineering Science (JP); [2]National Institute of Advanced Industrial Science and Technology, National Metrology Inst. Japan (JP); [3]University 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 possiblity to enhance the spectral resolution in THz spectroscopy up to the linewidth of each comb mode. [5279]

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]

12:45-13:00
Step-scan terahertz time-domain magneto-optics
D. Molter[1,2], G. Torosyan[1], G. Ballon[3], L. Drigo[3], J. Léotin[3], R. Beigang[1,2]; [1]Fraunhofer Institute for Physical Measurement Techniques IPM (DE); [2]Department of Physics and Research Center OPTIMAS, University of Kaiserslautern (DE); [3]Laboratoire 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]

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 $TlInS_2$ superionic crystals. [5405]

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

NOTES

Room: Emmy Destinn hall (2nd floor)

14:30-16:15
METAMATERIALS, WAVEGUIDES AND NEAR-FIELDS
Chair: O. Mitrofanov, University College London (GB)

NOTES

14:30-15:00 **Invited talk**

Metamaterial Terahertz Transmission Optics and Surface Waves

B. Reinhard[1], T. Fip[1,2], M. Volk[1,2], K. Schmitt[1,2], J. Neu[1], M. Höh[1,2], M. Rahm[1,2]; [1]Department of Physics and Research Center OPTIMAS, University of Kaiserslautern (DE); [2]Fraunhofer 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]

15:00-15:15 **STUDENT PRESENTATION**

THz near-field Faraday imaging in hybrid metamaterials

N. Kumar[1], A. Strikwerda[2], K. Fan[3], X. Zhang[3], R. Averitt[2],P. Planken[1], A. Adam[1]; [1]Delft University of Technology, Faculty of Applied Sciences (NL); [2]Boston University, Department of Physics (US); [3]Boston 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 timedomain 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]

15:15-15:30

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

F. Blanchard[1,2], K. Ooi[3], T. Tanaka[1,2], A. Doi[4], K. Tanaka[1,2,3]; [1]Institute for Integrated Cell-Material Sciences (WPI-iCeMS), Kyoto University (JP); [2]CREST, Japan Science and Technology Agency (JP); [3]Department of Physics Graduate School of Science, Kyoto University (JP); [4]Olympus 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]

15:30-15:45

Resonant magnetic response of TiO2 microspheres at terahertz frequencies

C. Kadlec[1], H. Němec[1], F. Kadlec[1], F. Dominec[1], R. Yahiaoui[2], U.-C. Chung[3], C. Elissalde[3], M. Maglione[3], P. Mounaix[2], P. Kužel[1]; [1]Institute of Physics, Academy of Sciences of the Czech Republic (CZ); [2]LOMA, Univ. Bordeaux 1, CNRS, UMR 5798 (FR); [3]ICMCB, 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]

15:45-16:00 **STUDENT PRESENTATION**

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

M. Zalkovskij[1], R. Malureanu[1], A. Novitsky[1], P. U. Jepsen[1], A. V. Lavrinenko[1], C. Kremers[2], D.N. Chigrin[2]; [1]Technical University of Denmark, Department of Photonics Engineering (DK); [2]University 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]

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. Waselikowski[1], P. Bollgruen[2], D. Mager[2], J. Korvink[2,3], M. Walther[1]; [1]Freiburg Materials Research Center, University of Freiburg (DE); [2]Laboratory for Simulation, Department of Microsystems Eng. IMTEK, University of Freiburg (DE); [3]School 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]

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. Mitrofanov[1], J.A. Harrington[2]; [1]University College London (GB); [2]Rutgers 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]

17:15-17:30 STUDENT PRESENTATION

Enhanced THz transmission through a single plasmonic nano slot antenna

J. Flock[1], T. Rybka[1], H. Park[2], D.S. Kim[2], T. Dekorsy[1]; [1]University of Konstanz, Dep. of Physics (DE); [2]Center 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]

17:30-17:45

Sample-probe interactions in terahertz near field imaging

S.R. Andrews[1], M. Misra[1], S.A. Maier[2]; [1]Dept. of Physics, University of Bath (GB); [2]Centre 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]

17:45-18:00

Improving homogenization and spatial dispersion in THz-metamaterial fibres

B.T. Kuhlmey[1], A. Tuniz[1], N. Singh[1], R. Lwin[1], B. Pope[1], A. Argyros[1], S. Fleming[1], A. Wang[1], M.C.J. Large[1], E.M. Pogson[2], R.A. Lewis[2], A. Bendavid[3]; [1]Institute of Photonics and Optical Science (IPOS), School of Physics, University of Sydney (AU); [2]Institute for Superconducting and Electronic Materials, University of Wollongong (AU); [3]Commonwealth 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]

18:00-18:15 STUDENT PRESENTATION

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

S. Miyamoto[1], H. Tanaka[1], D. Armand[2], J. Kitagawa[1,2], Y. Kadoya[1,2], [1]Hiroshima Univ. ADSM (JP); [2]Japan 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]

19:30-22:00 **CONFERENCE DINNER**

Location: Kaiserstejnsky Palace, 1st floor

NOTES

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

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]

10:00-10:15 **STUDENT PRESENTATION**

Glassy dynamics in concentraced 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]

10:15-10:30 **STUDENT PRESENTATION**

Electric field tuning of dielectric properties of $SrTiO_3$ 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 $SrTiO_3$ 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 $SrTiO_3$ dielectric properties in the terahertz frequency range. [5324]

10:30-10:45

Strain-induced ferroelectricity of a $SrTiO_3$ 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 $SrTiO_3$ (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]

10:45-11:15 Coffee break

NOTES

Room: Emmy Destinn hall (2nd floor)

11:15-13:00
THZ IMAGING
Chair: G. Scalari, Institute of Quantum Electronics, ETH Zürich (CH)

NOTES

11:15-11:30 STUDENT PRESENTATION
Terahertz and micro four point probe conductivity mapping of large area CVD grown graphene films
J.D. Buron[1,2], D.H. Petersen[2], P. Bøggild[2], D. Cooke[3], J. Sun[4], M. Hilke[3], E. Whiteway[3], P.F. Nielsen[5], A. Yurgens[4], P.U. Jepsen[1]; [1]Technical University of Denmark, Department of Photonics Engineering (DK); [2]Technical University of Denmark, Department of micro- and nanotechnology (DK); [3]McGill University, Physics Department (CA); [4]Chalmers University, Quantum device physics laboratory (SE); 5Capres A/S, Diplomvej (DK).
Summary tba [5376]

11:30-11:45
Large aberration-free diffractive lenses for the THz range
M. Sypek[1], M. Makowski[1], J. Suszek[1], Ag. Siemion[1], A. Siemion[1], E. Hérault[2], F. Garet[2], J.-L. Coutaz[2], M. Bernier; [1]Faculty of Physics, Warsaw University of Technology (PL); [2]IMEP-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
J.P. Guillet[1], B. Recur[2], I. Manek-Hönninger[1], J.C. Delagnes[1], W. Benharbone[1], P. Desbarats[2], J.P. Domenger[2], L. Canioni[1], P. Mounaix[1]; [1]Univ. Bordeaux, LOMA, UMR 5798 (FR) & CNRS, LOMA, UMR 5798 (FR); [2]LaBRI, 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
T. Yasui[1,2], Y. Ohgi[1], M. Minami[1], M. Jewariya[3], M. Nagai[1], T. Araki[1], E. Abraham[4]; [1]Osaka Univ., Grad. Sch. Eng. Sci. (JP); [2]Univ. of Tokushima, Inst. Tech. and Sci. (JP); [3]Osaka Univ., Renovation Center of Instrum. for Sci. Ed. Tech. (JP); [4]Univ. 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
M. Bessou[2], H. Duday[2], J-P. Caumes[1], S. Salort[1], B. Chassagne[1], C. Pradère[4], A. Ziéglé[6], A. Dautant[3], E. Abraham[5]; [1]ALPhANOV (FR); [2]PACEA, Univ. of Bordeaux/CNRS (FR); [3]IBGC, Univ. of Bordeaux/CNRS (FR); [4]TREFLE, Univ. of Bordeaux/CNRS (FR); [5]LOMA, Univ. of Bordeaux/CNRS (FR); [6]Museum 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 been 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
J.B. Jackson[1], J, Labaune[1], G. Walker[2], M. Menu[3], G.A. Mourou[1]; [1]ENSTA-École Polytechnique, Institute Lumière Extrême (FR); [2]School of Systems Engineering, University of Reading (GB); [3]Centre 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
T. Tanaka[1,2], T. Matsui[1], F. Blanchard[1,2], A. Doi[2,4], A. Kubo[5], M. Amagai[5], K. Tanaka[1,2,3]; [1]Kyoto University, WPI-iCeMS (JP); [2]Japan Science and Technology Agency, CREST (JP); [3]Kyoto University, Department of Physics (JP); [4]Olympus Corporation (JP); [5]Keio 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
K. Kawase[1,2], S. Hayashi[2], S.R. Tripathi[1,2]; [1]Nagoya University, Ecotopia Science Institute (JP); [2]RIKEN, 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
J.A. Fülöp[1], Z. Ollmann[1], L. Pálfalvi[1], G. Almási[2], J. Hebling[1]; [1]University of Pécs, Department of Experimental Physics (HU); [2]University of Pécs, Department of Physical Information Technology (HU).
The so far highest THz pulse energy (125 μJ) 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]

NOTES

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
S. Hayashi[1], K. Nawata[1], K. Kawase[1,2], H. Minamide[1]; [1]RIKEN ASI (JP); [2]Nagoya 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 $MgO:LiNbO_3$, 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
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
M.S. Vitiello[1], D. Coquillat[2], L. Vicarelli[1], L. Viti[1], A. Pitanti[1], D. Ercolani[1], F. Teppe[2], A.C. Ferrari[3], G. Scalari[4], J. Faist[4], M. Polini[1], F. Beltram[1], L. Sorba[1], V. Pellegrini[1], W. Knap[2], A. Tredicucci[1]; [1]NEST, Istituto Nanoscienze-CNR and Scuola Normale Superiore (IT); [2]Université Montpellier 2 and CNRS, TERALAB-GIS, L2C UMR 5221 (FR); [3]Engineering Department, Cambridge University (GB); [4]Institute 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/Hz1/2, 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
J. Börner[1], G. Pillet[1], L. Morvan[1], D. Dolfi[1], A. Beck[2], P. Latzel[2], F. Pavanello[2], G. Ducournau[2], J.-F. Lampin[2]; [1]Thales Research & Technology (FR); [2]Université 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 unitravelling 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
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
C. Zhang[1], Y. Avetisyan[2], I. Kawayama[1], H. Murakami[1], M. Tonouchi[1]; [1]Osaka University, Institute of Laser Engineering (JP); [2]Yerevan 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]

NOTES

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]; [1]CNR- Istituto Nazionale di Ottica and LENS (European Laboratory for Nonlinear Spectroscopy) (IT); [2]NEST, 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 (>100mW), 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]

09:30-09:45

Mode-locking of a terahertz laser by direct phase synchronization

K. Maussang[1], J. Maysonnave[1], N. Jukam[1], J.R. Freeman[1], P. Cavalié[1], S.P. Khanna[2], E.H. Linfield[2], A.G. Davies[2], H.E. Beere[3], D.A. Ritchie[3], S.S. Dhillon[1], J. Tignon[1]; [1]Laboratoire Pierre Aigrain, Ecole Normale Supérieure, CNRS (UMR 8551) & Université Paris P. et M. Curie, Université D. Diderot (FR); [2] School of Electronic and Electrical Engineering, University of Leeds (GB);[3] University 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]

09:45-10:00 **STUDENT PRESENTATION**

Operating direction of terahertz quantum cascade lasers

C. Deutsch[1], H. Detz[2], T. Zederbauer[2], A.M. Andrews[2], W. Schrenk[2], A. Benz[1], G. Strasser[2], K. Unterrainer[1]; [1]Vienna University of Technology, Photonics Institute and Center for Micro- and Nanostructures (AT); [2]Vienna 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 growthinduced 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]

10:00-10:15 **STUDENT PRESENTATION**

Coupled microdisk THz quantum cascade lasers

M. Brandstetter[1], M. Janits[1], C. Deutsch[1], M. Martl[1], A. Benz[1], H. Detz[2], T. Zederbauer[2], A.M. Andrews[2], W. Schrenk[2], G. Strasser[2], K. Unterrainer[1]; [1]Photonics Institute and Center for Micro- and Nanostructures, Vienna University of Technology (AT); [2]Institute 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]

10:15-10:30 **STUDENT PRESENTATION**

THz quantum cascade laser absorption studies with coupled cavities

M. Martl[1], M. Krall[1], C. Deutsch[1], A. M. Andrews[2], W. Schrenk[3], G. Strasser[2,3], K. Unterrainer[1,3], J. Darmo[1]; [1]Vienna University of Technology, Photonics Institute (AT); [2]Vienna Univ. of Technology, Institute of Solid State Electronics (AT); [3]Vienna 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]

NOTES

Room: Emmy Destinn hall (2nd floor)

10:30-11:00 **Invited talk**

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

G. Scalari[1], C. Maissen[1], M. Geiser[1], C. Walther[1], D. Turčinková[1], D. Hagenmüller[2], S. De Liberato[2], C. Ciuti[2], C. Reichl[3], D. Schuh[4], W. Wegscheider[3], M. Beck[1], J. Faist[1]; [1]Institute of Quantum Electronics, ETH Zürich (CH); [2]Laboratoire Matériaux et Phénomènes Quantiques, Université Paris Diderot-Paris 7 and CNRS (FR); [3]Laboratory for Solid State Physics, ETH Zürich (CH); [4]Institut 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 GRAPHEME

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?

H. Němec[1], Z. Mics[2], P. Kužel[1]; [1]Institute of Physics, Academy of Sciences of the Czech Republic (CZ); [2]Max 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

Z. Mics[1,2], H. Němec[2], M. Kempa[2], P. Kužel[2], O. Hayden[3], Y. Liu[4], T. Bein[4], D. Fattakhova-Rohlfing[4]; [1]Max Planck Institute for Polymer Research (DE); [2]Academy of Sciences of the Czech Republic, Institute of Physics (CZ); [3]Corporate Technology, Siemens AG (DE); [4]Department 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

H. Nakanishi[1], K.A. Salek[2], S. Fujiwara[2], K. Takayama[2], I. Kawayama[2], H. Murakami[2], M. Tonouchi[2]; [1]Dainippon Screen Mfg. (JP); [2]Institute of Laser Engineering, Osaka University (JP).

We have succeeded in detecting the terahertz waves generated from the solar cell exited 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

A. Pashkin[1], K.W. Kim[1,2,3], M. Porer[1,4], M. Beyer[1], H. Schäfer[1], A. Dubroka[2], C. Bernhard[2], X. Yao[5], T. Wolf[6], J. Demsar[1,7], R. Huber[1,4], A. Leitenstorfer[1]; [1]University of Konstanz, Department of Physics and Center for Applied Photonics (DE); [2]University of Fribourg, Department of Physics and Center for Nanomaterials (CH); [3]Chungbuk National University, Department of Physics (KR); [4]University of Regensburg, Department of Physics (DE); [5]Shanghai Jiao Tong University, Department of Physics (CN); [6]Karlsruhe Institute of Technology, Institute for Solid State Physics (DE); [7]Jozef Stefan Institute, Complex Matter Department (SI).

We present a review of our recent ultrafast multi-THz spectroscopy studies of the cuprate superconductor $YBa_2Cu_3O_7$ and the parent pnictide system $BaFe_2As_2$. A substantial electron-phonon scattering is observed in the former material, while the latter system demonstrates a strong spin-phonon coupling. [5306]

NOTES

Room: Emmy Destinn hall (2nd floor)

13:00-13:15
Multi-THz-Photon-Induced Ionization of Coherent Excitons
S. Chatterjee[1], B. Ewers[1], N.S. Köster[1], M. Koch[1], H.M. Gibbs[2], G. Khitrova[2], A.C. Klettke[1], M. Kira[1], S.W. Koch[1]; [1]Faculty of Physics and Materials Science Center, Philipps-Universität Marburg (DE); [2]College 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]

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

15:00-15:45
ELECTRON LOCALIZATION, ELECTRON-PHONON COUPLING AND GRAPHEME (continued)
Chair: M. Johnston, University of Oxford (GB)

15:00-15:15 STUDENT PRESENTATION
Ultrafast Carrier Transport in *Graphene under High Electric Field*
S. Tani[1,2], F. Blanchard[2,3], H. Hirori[2,3], K. Shinokita[1,2], G. Asai[1], M. Shirai[1,2,3], K. Tanaka[1,2,3]; [1]Kyoto University, Department of Physics (JP); [2]CREST, Japan Science and Technology Agency (JP); [3]Kyoto 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]

15:15-15:30
Investigation of THz photoConductivity and carriers lifetime in narrow-gap $Hg_yCd_{1-y}Te/Cd_{1-x}Hg_xTe$ QW and bulk structures with graphene-like energy-momentum law
S.V. Morozov[1], V.V. Rumyantsev[1], V.Ya. Aleshkin[1], A.V. Antonov[1], M.S. Joludev[1], K.E. Kudryavtsev[1], V.I. Gavrilenko[1], N.N. Michailov[2], O.Drachenko[3], S.Winnerl[3], H.Schneider[3], M.Helm[3]; [1]Institute for Physics of Microstructures RAS (RU); [2]A.V. Rzhanov Institute of Semiconductor Physics SBRAS (JP); [3]Forschungszentrum 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]

15:30-15:45 STUDENT PRESENTATION
Environmental Impact on the Photoconductivity of Graphene Observed by Terahertz Spectroscopy
C.J. Docherty[1], C.-T. Lin[2], H.J. Joyce[1], R.J. Nicholas[1], L.-J. Li[2], M.B. Johnston[1]; [1]Clarendon Laboratory, Department of Physics, University of Oxford (BG); [2]Institute 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 photoinducedterahertz conductivity of graphene in different atmospheres. [5386]

15:45-16:15 Coffee break

NOTES

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. Cooke[1], F.C. Krebs[2], P. Uhd Jepsen[3]; [1]Department of Physics, McGill University (CA); [2]Department of Energy Conversion and Storage, Technical University of Denmark (DK); [3]Department 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]

16:45-17:00

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

C.S. Ponseca Jr.[1], A. Yartsev[1], E. Wang[2], M. Andersson[2], V. Sundström[1]; [1]Lund University, Division of Chemical Physics (SE); [2]Chalmers 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]

17:00-17:15

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

M. Yamashita[1], Y. Yamada[1,2], T. Sasaki[3], H. Okuzaki[4], C. Otani[1,2]; [1]RIKEN, ASI THz sensing and imaging laboratory (JP); [2]Tohoku University, Grad. Sch. of Sci. (JP); [3]Tohoku University, Institute of Material Research (JP); [4]University 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]

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. Morisawa[1], S. Yamamoto[1], H. Hoshina[2], H. Sato[1], Y. Ozaki[1]; [1]Department of Chemistry, School of Science and Technology, Kwansei Gakuin University (JP); [2]RIKEN (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]

17:30-17:45

Terahertz Vibrational Spectroscopy of Polymers with Hydrogen Bonds

H. Hoshina[1], S. Ishii[1,2], Y. Morisawa[3], S. Yamamoto[3], H. Sato[3], Y. Ozaki[3], I. Noda[4], T. Uchiyama[2], C. Otani[1]; [1]RIKEN ASI (JP); [2]Miyagi University of Education (JP); [3]Kwansei Gakuin University (JP); [4]The 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]

17:45 EOS Student Awards

18:00 End of EOS Topical Meeting

NOTES

Poster session: Tuesday, 19 June | 13:00-15:15 | **Room:** Kaiserstejnsky Palace

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.

TST2012_5269_002
3D terahertz computed tomography of human bones
M. Bessou[2], H. Duday[2], J-P. Caumes[1], S. Salort[1], B. Chassagne[1], M. Tondusson[3], E. Abraham[3]; [1]ALPhANOV (FR); [2]PACEA, Univ. of Bordeaux/CNRS (FR); [3]LOMA, 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 spongious bone whereas compact bone exhibits stronger terahertz absorption, as shown by additional terahertz time-domain spectroscopy.

TST2012_5275_003 STUDENT PRESENTATION
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.

TST2012_5281_004 STUDENT PRESENTATION
Improvement of spectral accuracy in asynchronous-optical-sampling THz time-domain spectroscopy by sweeping of mode-locked frequency in dual fiber lasers
Y. Iyonaga[1], Y. Sakaguchi[1], S. Yokoyama[1], H. Inaba[2], K. Minoshima[2], T. Iwata[3], T. Yasui[1,3], T. Araki[1]; [1]Osaka University, Graduate School of of Engineering Science (JP); [2]National Institute of Advanced Industrial Science and Technology (AIST), National Metrology Institute of Japan (JP); [3]Univiversity 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.

TST2012_5283_005 STUDENT PRESENTATION
Linear Characterization of THz DFG Emitters
S. Mariani[1], F. Ghiglieno[1], A. Andronico[1], I. Favero[1], S. Ducci[1], Y. Todorov1, C. Sirtori[1], M. Kamp[2], M. Munsch[3], J. Claudon[3], J. M. Gérard[3], G. Leo[1]; [1]Univ. Paris Diderot, Sorbonne Paris Cité, Laboratoire MPQ (FR); [2]Technische 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.

TST2012_5284_006
Six-wave mixing in terahertz wave generation from laser-induced air plasma
V. Vaičaitis, 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.

TST2012_5285_007 STUDENT PRESENTATION
Ultrabroad Dual-Mode Spectral Control of a Quantum Dot Laser Gain Medium
R. Leyman[1], N. Bazieva[1], D. Carnegie[1], K.A. Fedorova[1], D.A. Livshits[2], E.U. Rafailov[1]; [1]Photonics & Nanoscience Group, School of Engineering, Physics and Mathematics, University of Dundee (GB); [2]Innolume 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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Poster session: Tuesday, 19 June | 13:00-15:15 | **Room:** Kaiserstejnsky Palace

TST2012_5287_008
THz Spectroscopic Image Processing for Extracting Multiple Samples
K. Kitagishi[1], M. Akagi[1], Y. Oishi[1,2], Y. Izutani[1]; [1]Otsuka Electronics Co.Ltd. (JP); [2]Hokkaido 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.

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).
e 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.

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.

TST2012_5329_011
Ultrashort optical pulse system using MZM-based comb generator and fine tuning system
I. Morohashi[1], T. Sakamoto[1], T. Kawanishi[1], I. Hosako[1], Y. Tamura[2], M. Oikawa[2], S. Aoki[2]; [1]National Institute of Information and Communications Technology (JP); [2]Optohub 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.

TST2012_5293_012 STUDENT PRESENTATION
Photonic crystal between metallic parallel plates, effect of air gap on band structure
D. Armand[1,2], S. Kouya[1], M. Kodama[1], J. Kitagawa[1,2], Kadoya[1,2]; [1]Hiroshima University (JP); [2]Japan 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.

TST2012_5295_013
Horn antenna in THz regime
D. Armand[1,2], Y. Nishifuji[2], J. Kitagawa[1,2], Y. Kadoya[1,2]; [1]Japan science and technology agency, CREST (JP); [2]Hiroshima University ADSM (JP).
We built horn antennas and characterized them on THz-TDS setup. The smallest horn antenna's aperture is 50 μm × 200 μm but exhibits a quite high transmission value, and dispersion of incident pulse is in good agreement with waveguide dispersion model.

TST2012_5297_014 STUDENT PRESENTATION
Monitoring Phase-change of Poly(N-*isopropylacrylamide*) with Attenuated Total Reflectance Terahertz Spectroscopy
H. Naito, Y. Ogawa, S. Sultan[1], 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 accessary of attenuated total reflectance (ATR) to monitor phase-change of P-NIPAAM.

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Poster session: Tuesday, 19 June | 13:00-15:15 | **Room:** Kaiserstejnsky Palace

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. Niemela[2], A. Vacchi[1]; [1]INFN, Sezione di Trieste (IT); [2]International 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.

TST2012_5303_016
Traceable THz Power Measurement by Suitable Detectors
A. Steiger[1], W. Bohmeyer[2], K. Lange[2], R. Müller[1]; [1]Physikalisch-Technische Bundesanstalt (PTB) (DE); [2]Sensor- und Lasertechnik (SLT) (DE).
To pave the way for accurate and reliable THz power measurements, PTB and SLTcompany joined their expertise in THz radiometry and pyroelectric detector technology. A common R&D project is dedicated to develop a novel "calibratable THz-Detector".

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.

TST2012_5314_018 STUDENT PRESENTATION
Theoretical demonstration of high efficient cw THz generation by using composite photonic structure element
A. Oyamada[1], H. Kitaguchi[1], K. Ebata[2], H. Ishihara[1]; [1]Department of Physics and Electronics, Osaka Prefecture University (JP); [2]Industrial 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.

TST2012_5315_019
Surface-plasmon enhanced terahertz emission
G. Ramakrishnan[1], N. Kumar[1], P. Planken[1], D. Tanaka[2], K. Kajikawa[2]; [1]Optics Research Group, Department of Imaging Science and Technology,Delft University of Technology (NL); [2]Department 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 monomolecular layer of hemicyanine deposited at the gold surface further increases the terahertz amplitude by a factor of 3.

TST2012_5320_020 STUDENT PRESENTATION
Using the terahertz spectroscopy for observing the kinetics of recrystallisation of polybutenes
V. Křesálek, T. Gavenda; Tomas Bata University in Zlin, Department of Electronics and Measurements (CZ).
This article contains information about measured data, which have been obtained using terahertz spectroscope method. The measurement was focused on the kinetics of recrystallisation of polybutenes, described by the dependency of refractive index on time.

TST2012_5321_021 STUDENT PRESENTATION
Vibrational spectra of four different types of nylons studied by terahertz spectroscopy
S. Ishii[1,2], Y. Morisawa[3], H. Sato[3], Y. Ozaki[3], C. Otani[2], T. Uchiyama[1], H. Hoshina[2]; [1]Miyagi University of Education (JP); [2]RIKEN ASI (JP); [3]Kwansei 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.

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Poster session: Tuesday, 19 June | 13:00-15:15 | **Room:** Kaiserstejnsky Palace

TST2012_5327_023 STUDENT PRESENTATION

A compact, low-temperature THz time domain waveguide spectrometer

W. Qiao[1], D. Stephan[1], M. Hasselbeck[2], Q. Liang[1], T. Dekorsy[1]; [1]University of Konstanz, Department of Physics and Center for Applied Photonics (DE); [2]University of New Mexico, epartment 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.

TST2012_5344_024 STUDENT PRESENTATION

Loss characteristics of hollow metallic THz waveguide with inner dielectric coatings

Y. Li[1], X. Zhang[1], W. Qiao[2]; [1]Xi'an University of Technology, Applied Physics Department (CN); [2]ShanDong 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.

TST2012_5340_025

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

J. Petzelt, 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.

TST2012_5343_026 STUDENT PRESENTATION

Near infrared laser down conversion due to the resonance polariton effect in THz region based on MgO:$LiNbO_3$

X. Zhang[1], W. Shi[1], W. Qiao[2]; [1]Xi'an University of Technology, Applied Physics Department (CN); [2]ShanDong 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:$LiNbO_3$. 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

THz time-domain spectroscopy study of free-standing films of doped helical polyacetylene graphite

A.V. Andrianov[1], A.N. Aleshin[1], P.E. Gusakov[1], A.V. Bobylev[1], S. Matsushita[2], K Akagi[2], V. Trukhin[1]; [1]A.F. Ioffe Physical Technical Institute of RAS (RU); [2]Kyoto 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

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 splitring 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.

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Poster session: Tuesday, 19 June | 13:00-15:15 | **Room:** Kaiserstejnsky Palace

TST2012_5356_029 STUDENT PRESENTATION

Temperature effects on cw terahertz photomixer

S. Campbell[1], T. Ackemann[1], H. Fraser[1], M. Missous[2]; [1]SUPA and Department of Physics, University of Strathclyde (GB); [2]School 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

T. Ackemann[1], M. Alduraibi[2,3], S. Campbell[1], M. Missous[2], H. Fraser[1], A. S. Arnold[1], E. Riis[1]; [1]SUPA and Department of Physics, University of Strathclyde (GB); [2]School of Electrical and Electronic Engineering, The University of Manchester (GB); [3]Now 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

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 TiO_2 microspheres

F. Dominec[1], H. Němec[1], F. Kadlec[1], C. Kadlec[1], R. Yahiaoui[2], P. Mounaix[2], U-C. Chung[3], P. Kužel[1]; [1]Institute of Physics, Academy of Sciences of the Czech Republic (CZ); [2]Centre de Physique Mol´eculaire, Optique et Hertzienne, Université Bordeaux I, CNRS UMR 5798 (FR); [3]Institut de Chimie de la Mati`ere Condens´ee de Bordeaux (CMCB), CNRS–UPR9048 (FR).

We study metamaterials composed of high-ε TiO_2 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.

TST2012_5375_033

Graphene hyperlens for terahertz radiation

A. Andryieuski, D. Chigrin, A. Novitsky, A. Lavrinenko; [1]Technical University of Denmark, DTU Fotonik – Department of Photonics Engineering (DK); [2]University 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.

TST2012_5378_034 STUDENT PRESENTATION

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

N. Rothbart[1], H. Richter[1], M. Wienold[2], L. Schrottke[2], M. Giehler[2], R. Hey[2], H.T. Grahn[2], H.-W. Hübers[1,3]; [1]Institute of Planetary Research, German Aerospace Center (DLR) (DE); [2]Paul-Drude-Institut für Festkörperelektronik (DE); [3]Institut 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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Poster session: Tuesday, 19 June | 13:00-15:15 | **Room:** Kaiserstejnsky Palace

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]; [1]Department of Photonics and Optoinformatics, NRU ITMO (RU); [2]Ioffe 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.

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.

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.

TST2012_5383_038 STUDENT PRESENTATION
Broad-band molecular spectroscopy with a multimode terahertz quantum-cascade laser
R. Eichholz[1], H. Richter[1], S.G. Pavlov[1], M. Wienold[2], L. Schrottke[2], M. Giehler[2], R. Hey[2], H.T. Grahn[2], H.-W. Hübers[1,3]; [1]Institute of Planetary Research, German Aerospace Center (DLR) (DE); [2]Paul-Drude-Institut für Festkörperelektronik, (DE); [3]Institut 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.

TST2012_5384_039
Intensity modulation of terahertz quantum cascade lasers using femtosecond optical pulses
Y. Sakasegawa[1], S. Saito[1], N. Sekine[1], M. Ashida[2], I. Hosako[1]; [1]National Institute for Information and Communications Technology (JP); [2]Graduate School of Engineering Science, Osaka University (JP).
We have investigated the emission intensity of teraherthz 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.

TST2012_5385_040
Emitters and detectors for a THz time domain material inspection system pumped at 1560 nm
F. Ospald[1,2], W. Zouaghi[1,2], J.-M. Rämer[1], 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.

TST2012_5388_041
Bi-directional terahertz emission from gold-coated nanogratings
K. Weber[1,2], F. Garwe[2], U. Hübner[2], D. Cialla[1,2], K. Wynne[3], T. May[2]; [1]Institute of Physical Chemistry and Abbe Center of Photonics, Friedrich-Schiller-University Jena (DE); [2]Institute of Photonic Technology (IPHT) (DE); [3]Department 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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Poster session: Tuesday, 19 June | 13:00-15:15 | **Room:** Kaiserstejnsky Palace

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.

TST2012_5393_043

Ultrafast Tunable THz Metamaterial Devices

M. Massaouti[1], N.-H. Shen[2], T. Koschny[2], M. Kafesaki[1,3], C. M. Soukoulis[1,2], S. Tzortzakis[1,3]; [1]Institute of Electronic Structure and Laser, Foundation for Research and Technology (GR); [2]Ames Laboratory and Department of Physics and Astronomy, Iowa State University (US); [3]Department 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.

TST2012_5394_044

Towards an efficient THz image-processing-based inspection framework

E. Baccaglini[1], M. Gavelli[1], N. Raimondo[1], R. Scopigno[1], F. Palma[2]; [1]Istituto Superiore Mario Boella (IT); [2]NTT 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.

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.

TST2012_5398_046 STUDENT PRESENTATION

Metal aperture arrays for operation in the THz region

C.K.A. Hill[1], M.C. Rosamond[1], D. Dai[1], D. Wood[1], A.J. Gallant[1]; [1]Durham 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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Poster session: Tuesday, 19 June | 13:00-15:15 | **Room:** Kaiserstejnsky Palace

TST2012_5401_047
Feasible study of safety inspection of building walls using pulsed THz wave
T. Ikari[1], D. Yamada[1], R. Fukasawa[1], K. Fukunaga[2]; [1]Spectra Design Ltd. (JP); [2]National Institute of Informatino 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.

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.

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. THzrange frequency spacing of the narrow-linewidth phase-locked modes, enabling efficient THz difference-frequency generation, has been demonstrated.

TST2012_5408_050 STUDENT PRESENTATION
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. Schrenk[3], G. Strasser[2,3]; [1]Photonics Institute, Vienna University of Technology (AT); [2]Institute of Solid State Electronics, Vienna University of Technology (AT); [3]Center 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
Design of strained-layer InAs/GaInSb 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.

NOTES

Poster session: Tuesday, 19 June | 13:00-15:15 | **Room:** Kaiserstejnsky Palace

TST2012_5459_052

Terahertz lasing from boron centers embedded in silicon

H.-W. Hübers[1,2], S.G. Pavlov[1], R. Eichholz[1], N. Deßmann[1], N.V. Abrosimov[3], H. Riemann[3], B. Redlich[4], A.F.G. van der Meer[4], R.Kh. Zhukavin[5], V.N. Shastin[5]; [1]Institute of Planetary Research, German Aerospace Center (DLR) (DE); [2]Institut für Optik und Atomare Physik, Technische Universität Berlin (DE); [3]Leibniz Institute of Crystal Growth (DE); [4]FOM-Institute for Plasma Physics (NL); [5]Institute 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

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

L. Fekete[1], H. Němec[1], Z. Mics[1], F. Kadlec[1], P. Kužel[1], V. Novák[2], J. Lorinčík[3,4], M. Martin[5], J. Mangeney[5], J.C. Delagnes[6], P. Mounaix[6]; [1]Institute of Physics, ASCR (Prague 8) (CZ);[2]Institute of Physics ASCR (Prague 6) (CZ); [3]Institute of Photonics and Electronics ASCR (CZ); [4]Department of Physics, Faculty of Science, J.E. Purkinje University (CZ); [5]Institut d'Electronique Fondamentale, CNRS Université Paris XI, UMR8622 (FR); [6]Laboratoire 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 In0.53Ga0.47As and InP. Sub-picosecond lifetimes and good electron mobilities were observed for the highest irradiation dose.

TST2012_5464_054

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

J-P. Caumes[2], E. Abraham[1], J-C. Batsale[2], C. Pradère[2]; [1]LOMA, Univ. of Bordeaux/CNRS (FR); [2]I2M/TREFLE, ENSAM/CNRS (FR).

A full-field real-time room temperature bolometer principle will be described as a MMW/THz to thermal converters for wide band electromagnetic radiations. Quantitative multi-spectral (0.1-30THz), sensitive (<25nW/Hz1/2) and fast (1-10Hz) 2D THz and MMW imaging measurement is presented on a large optical field of view (>50x50mm²).

NOTES

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