Fraunhofer ITWM

FRAUNHOFER INSTITUTE FOR INDUSTRIAL MATHEMATICS ITWM

# PROGRAM

# 9TH INTERNATIONAL WORKSHOP ON TERAHERTZ TECHNOLOGY AND APPLICATIONS

**March 3rd – 4th, 2020, Fraunhofer-Center, Fraunhofer-Platz 1, Kaiserslautern**

In cooperation with

DGZfP DEUTSCHE GESELLSCHAFT FÜR ZERSTÖRUNGSFREIE PRÜFUNG e.V.

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Photonics HUB

# 9TH INTERNATIONAL WORKSHOP ON TERAHERTZ TECHNOLOGY AND APPLICATIONS

Terahertz technology has proven to be a valuable tool for applications in diagnostics, measurement, and testing. The industrial use of this technology, however, raises a lot of challenging questions. The "International Workshop on Terahertz Technology and Applications" fosters the exchange of knowledge and experience between academics and industry in this exciting and rapidly developing field. The following renowned experts have confirmed their participation and will give invited lectures to the forum:

- Martina Havenith-Newen, Ruhr-Universität Bochum, Germany
- Peter Uhd Jepsen, Technical University of Denmark, Denmark
- Christoph Lange, Universität Regensburg, Germany
- Tadao Nagatsuma, Osaka University, Japan

The ninth workshop will address primarily the topics:
- Industrial Applications
- Homeland Security
- Communications
- New Terahertz System Technologies

**Chairmen**
Georg von Freymann, Technische Universität Kaiserslautern, Germany
Joachim Jonuscheit, Fraunhofer Institute for Industrial Mathematics ITWM, Germany

# PROGRAM
## Tuesday, March 3rd, 2020

11:00 Registration and laboratory tour at Fraunhofer ITWM

12:00 Snack

13:00 Welcome and opening remarks, Georg von Freymann, Fraunhofer ITWM

### SESSION 1: NEW TECHNOLOGIES I

13:10 **Physics and Applications of Terahertz-driven Electrons – from Thin-film Conductivity Characterization to THz Photomultipliers** (invited)
Peter Uhd Jepsen,Technical University of Denmark, Kgs. Lyngby, DK

13:40 **THz Fourier Imaging Based on Heterodyne Detection**
Hui Yuan, Goethe-Universität Frankfurt am Main, DE

14:00 **THz Pulse Detection with Graphene and Related Materials**
Petr A. Obraztsov, Russian Academy of Sciences, Moscow, RU

14:20 **Palmtop, Tunable Backward Terahertz-wave Parametric Oscillator**
Kouji Nawata, Riken, Sendai, JP

14:40 **Lithium Niobate based Single-cycle THz Source with 66 mW of Average Power at MHz-repetition Rate**
Tim Vogel, Ruhr-Universität Bochum, DE

15:00 Coffee break

### SESSION 2: NEW TECHNOLOGIES II

15:30 **Subcycle THz Dynamics in Extreme Settings of Light-matter Interaction: From Atomically Strong Fields to Vacuum Fields** (invited)
Christoph Lange, University of Regensburg, DE

16:00 **Coherent Sampling of Injection-locked Resonant Tunneling Diode Terahertz Oscillators**
Takashi Arikawa, Kyoto University, JP

16:20 **Coherent Lensless Imaging Techniques Using Terahertz Radiation**
Erwin Hack, Empa, Dübendorf, CHE

16:40 **Broadband Infrared Field-resolved Spectroscopy**
Christina Hofer, Max-Planck-Institute of Quantum Optics, Garching, DE

17:00 **Probing Surface States on Topological Insulators Using Mid-infrared Nano-tomography**
Martin Zizlsperger, University of Regensburg, DE

17:20 Poster session

19:00 Bus transfer to hotels

20:00 Evening reception at the “Fruchthalle”

# PROGRAM
## Wednesday, March 4th, 2020

8:30 Bus transfer to Fraunhofer ITWM

**SESSION 3: COMMUNICATION**

9:00 **Recent Progress and Future Prospect of THz Communications Research enabled by Photonics** (invited)
Tadao Nagatsuma, Osaka University, JP

9:30 **Photonic Sampling for the Metrology of THz Wireless Communications**
Ranjan Das, Technische Universität Braunschweig, DE

9:50 **High Capacity Terahertz Communication Links Combining Photonic and Electronic Technologies in the Transmit-Receive Frontend**
Ingmar Kallfass, University of Stuttgart, DE

10:10 **True Time Delay Beamforming for THz Wireless Communications based on Photonic Chip and Photoconductive Antennas**
Alvaro Morales, Eindhoven University of Technology, NL

10:30 Coffee Break

**SESSION 4: SPECTROSCOPY**

10:50 **Ultrasensitive Marker-free Biomolecular THz Detection for Tumor Related Analytics**
Peter Haríng Bolivar, University of Siegen, DE

11:10 **All-electronic THz Nanoscopy: Local Permittivity Mapping of Bacteria**
Peter Haríng Bolivar, University of Siegen, DE

11:30 **Application of Terahertz-/Millimeter-Wave Gas Spectroscopy for Detection of Volatile Organic Compounds in Gases**
Nick Rothbart, German Aerospace Center (DLR), Berlin, DE

11:50 **Ultra-long Carrier Recombination Processes for Hot Carriers in Undoped Graphene/hBN Heterostructures**
Panhui Huang, Sorbonne Université, FR; East China Normal University, Shanghai, CN

12:10 Lunch

**SESSION 5: APPLICATION**

13:00 **Comparison of optoelectronic Time and Frequency Domain Systems for Multilayer Thickness Determination**
Lars Liebermeister, Fraunhofer Institute for Telecommunications, Heinrich Hertz Institute, Berlin, DE

13:20 **Layer-thickness Measurements with Incoherent Terahertz Light**
Daniel Molter, Fraunhofer Institute for Industrial Mathematics ITWM, Kaiserslautern, DE

13:40 **Examination of Wax-resin lining Condition of Oil Paintings by using THz time-domain Imaging**
Kaori Fukunaga, National Institute of ICT, Tokyo, JP

14:00 **Sensor Fusion of Ultrasound Excitation and Terahertz Detection to Image Concealed Impact Damage within Carbon Fiber Composites**
David Zimdars, TeraMetrix, Ann Arbor, Michigan, USA

14:20 **Analysis of Pore Structure in Pharmaceutical Tablets using THz TDS**
Mira Naftaly, National Physical Laboratory, Teddington, UK

14:40 **Mobile Handheld Imaging System for Nondestructive Testing with Millimeter Waves**
Fabian Friederich, Fraunhofer Institute for Industrial Mathematics ITWM, Kaiserslautern, DE

15:00 Closing remarks, Georg von Freymann, Fraunhofer ITWM

15:15 Coffee Break

15:15 Laboratory tour at Fraunhofer ITWM

17:00 End of workshop

# POSTER SESSION

**P1 THz- and Mid IR Fourier Transform Spectroscopy on Photolytically and Thermally Destructed High Molecular Polyethylene**
J. Beckmann, BAM Federal Institute for Materials Research and Testing, Berlin, DE

**P2 Injection Locked Electronic Sources for Efficient THz Generation**
K. Arzi, University of Duisburg-Essen, DE

**P3 Unique Absorbers for THz Microbolometers**
B. Atik, METU MEMS Center, Ankara, TR

**P4 High-power MM/SubMM-wave Sources**
O. Cojocari, ACST GmbH, Hanau, DE

**P5 Comparisons of the Main Hollow-core Terahertz Waveguides and Best Waveguide Improvement towards Effective Single Mode Propagation**
G. Humbert, XLIM Research Institute, UMR CNRS Université de Limoges, FR

**P6 THz Computed Tomography in NDT – Improving Image Reconstruction**
P. Fosodeder, Research Center for Non-Destructive Testing GmbH, Linz, AT

**P7 Signal to Noise Improvement for THz Imaging System Comparing Amplitude and Frequency Modulation**
T. Krmac, University of Ljubljana, SI

**P8 Bayesian Optimisation of THz Quantum Cascade Laser Operating above 200 K**
M. Franckie, ETH Zürich, CHE

**P9 THz Pulsed Time-Domain and Frequency Modulated Continuous Wave Imaging of "The Last Supper"**
K. Fukunaga, National Institute of ICT, Tokyo, JP

**P10 Comparison of PTB's Power Scales of Free-space and Waveguide-based Electro-Magnetic Waves**
M. Kehrt, Physikalisch-Technische Bundesanstalt (PTB), Braunschweig und Berlin, DE

**P11 Initial Estimation for Fast Layer Thickness Determination Based on Terahertz Time-domain Spectroscopy**
I. Busboom, Düsseldorf University of Applied Sciences, DE

**P12 Ge Based Photoconductive Terahertz Emitters**
A. Singh, Helmholtz-Zentrum Dresden-Rossendorf, Dresden, DE

**P13 Electro-optical Generation of Terahertz Dual-combs with ErAs:In(Al)GaAs Photoconductors and its Application to Noncontact Thickness Measurement**
A. D. J. Fernandez Olvera, Technische Universität Darmstadt, DE

**P14 Homodyne Spectroscopy with Broadband Terahertz Power Detector Based on 90-nm Silicon CMOS Transistor**
K. Ikamas, Vilnius University and General Jonas Žemaitis Military Academy of Lithuania, Vilnius, LT

**P15 Fully Automated Terahertz Sensor System for Industrial Non-contact Layer Thickness Measurements**
B. Globisch, Technische Universität Berlin and Fraunhofer Institute for Telecommunications, Heinrich Hertz Institute, Berlin, DE

**P16 Guided Terahertz FMCW Radars for Reflectometry Probing Purposes**
A. Chopard, Bordeaux University Talence and Lytid SAS, Montrouge, FR

**P17 A Fast and Homogeneous Lighting for Full-Field Terahertz Imaging**
J-B. Perraud, Bordeaux University, Talence, FR

**P18 Multilayer Thickness Evaluation on Non-metallic Substrate using TDS Spectroscopy: Specificity of Anisotropic Aeronautic Composite Materials**
J-B. Perraud, Bordeaux University, Talence, FR

**P19 Two-colour Y-branch Laser for THz Applications**
J. O'Gorman, Sensor Photonics GmbH, Marburg, DE

**P20 Terahertz Generation using Two-Colour Plasma Filaments**
T. Kawde, Friedrich-Schiller University, Jena, DE

**P21 Generation and Application of THz Radiation from Organic BNA-Crystals**
F. Roeder. Friedrich-Schiller University, Jena, DE

**P22 Thin Metal Film Conductance Measurement using Reflection Mode Terahertz Time-Domain Spectroscopy**
R. Kelner, Technical University of Denmark, Kongens Lyngby, DK

**P23 Bi-aspheric Singlet THz Lenses Free of Spherical Aberration**
D. Madhi, Technical University of Denmark, Kongens Lyngby, DK

**P24 Matched-filter-bank Approach to Terahertz Thickness Measurement of Thick Plastic Sheeting**
M. Zhai, Georgia Tech-CNRS IRL2958, Georgia Tech Lorraine, Metz, FR

**P25 Nondestructive Multilayer Coating Terahertz Thickness Measurement Based on Autoregressive Extrapolation**
M. Zhai, Georgia Tech-CNRS IRL2958, Georgia Tech Lorraine, Metz, FR

**P26 THz Excitation Spectroscopy of Photoexcited Semiconductor Surfaces and Heterointerfaces**
R. Norkus, Center for Physical Sciences and Technology, Vilnius, LT

**P27 3D Printing of Cyclic Olefin Copolymer for THz Transparent Devices**
E. Mavrona, Empa, Dübendorf, CHE

**P28 Polarized THz Time Domain Spectroscopy for the Analysis of Anisotropic Properties of Wood and Artificial Cellulose Materials**
P. Zolliker, Empa, Dübendorf, CHE

## POSTER SESSION

**P29 Quasi-instantaneous Switch-off of Deep-Strong Light-matter Coupling**
J. Mornhinweg, University of Regensburg, DE

**P30 Terahertz Signal and Image Processing for Enhancement of Air Voids Detection**
N. Palka, Military University of Technology, Warsaw, PL

**P31 Permittivity Determination by Polarimetric MMW Radiometry**
M. Peichl, DLR, Oberpfaffenhofen, DE

**P32 An Efficient Terahertz Rectifier on the SiC/Graphene Platform**
M. Schlecht, FAU Erlangen-Nürnberg, DE

**P33 Photonic Sources and Beam Steering Techniques for Mobile THz Imaging and Spectroscopy**
A. Stöhr, University of Duisburg-Essen, Duisburg, DE

**P34 Foreign Body Detection in Food Enabled by a 4096 Pixel Terahertz Camera**
S. C. Tonder, University of Duisburg-Essen, Duisburg, DE

**P35 Design and Simulation of a Metasurface Enhanced THz Sensor**
H. Tugay, Middle East Technical University, Ankara, TR

**P36 Function of Human Fingerprint as Capillary Channel to Prevent Slipping when Gripping**
S.-M. Yuma, Seoul National University, KR

**P37 Terahertz Sensing with Visible Light**
M. Kutas, Fraunhofer Institute for Industrial Mathematics ITWM, Kaiserslautern, DE

**P38 Design of a Mobile Scanning System for Imaging with Frequency-Modulated Continuous-Wave Terahertz Radiation**
S. Mohammadzadeh, Fraunhofer Institute for Industrial Mathematics ITWM, Kaiserslautern, DE

**P39 Multilayer Thickness Inspection with W FrequencyBand FMCW Radar**
N. S. Schreiner, Fraunhofer Institute for Industrial Mathematics ITWM, Kaiserslautern, DE

**P40 Iterative Algorithms in the Context of Terahertz Tomographic Imaging**
F. Friederich, Fraunhofer Institute for Industrial Mathematics ITWM, Kaiserslautern, DE

**P41 New Series of Standards VDI/VDE 5590 on Terahertz Systems**
Technical Committee VDI/VDE-GMA FA 8.17 TERAHERTZ SYSTEMS, Düsseldorf, DE

## EXHIBITORS AND SPONSORS

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