

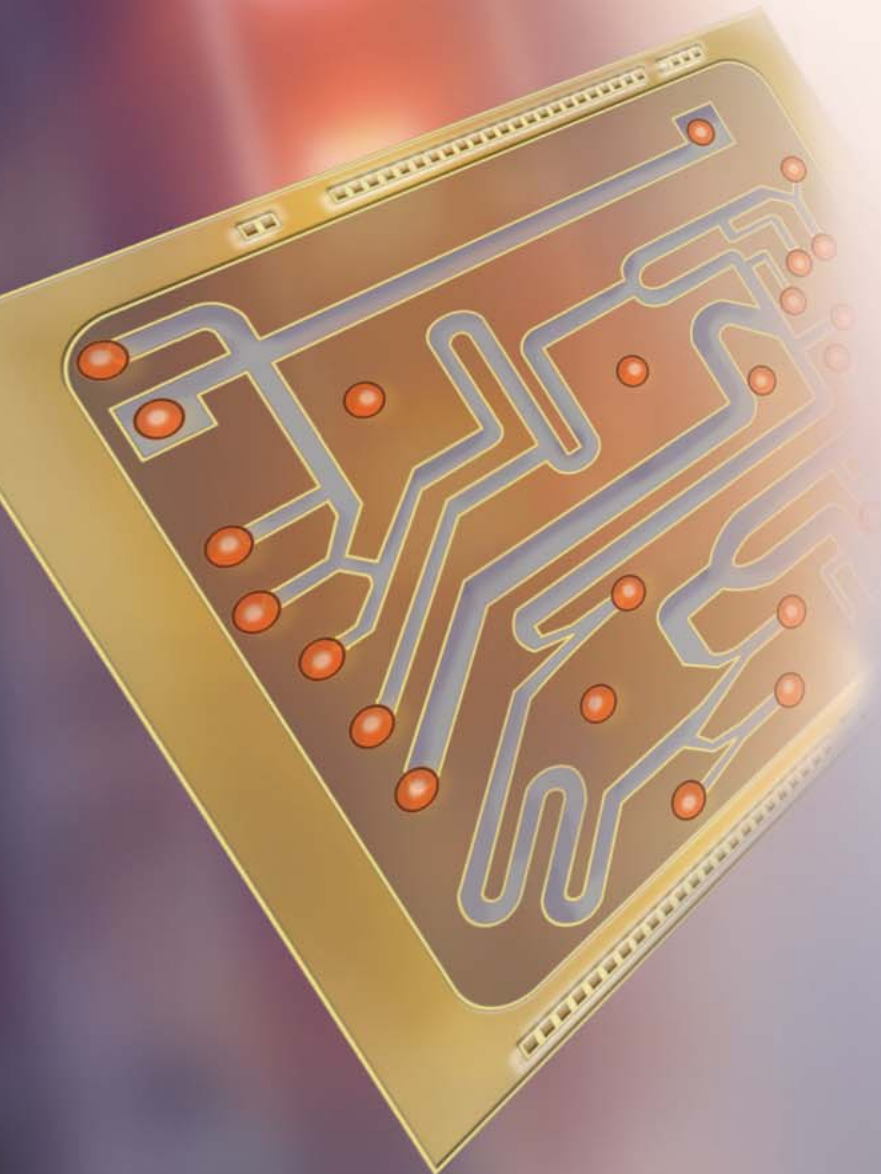
Technical Program


SPIE
OpticsEast

*Photonics for Applications in Industry,
Life Sciences, and Communications*

1–4 October 2006

Hynes Convention Center, Boston, Massachusetts USA



 The International Society
for Optical Engineering

Conference 6373 • Hynes Conv. Ctr. Room 108

Monday-Wednesday 2-4 October 2006 • Proceedings of SPIE Vol. 6373

Terahertz Physics, Devices, and Systems

Conference Chairs: Mehdi Anwar, Univ. of Connecticut; Anthony J. DeMaria, Coherent DEOS; Michael S. Shur, Rensselaer Polytechnic Institute

Program Committee: Alexander G. Davies, Univ. of Leeds (United Kingdom); Frank C. De Lucia, The Ohio State Univ.; Gottfried H. Döhler, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); Achyut K. Dutta, Banpil Photonics; John F. Federici, New Jersey Institute of Technology; Qing Hu, Massachusetts Institute of Technology; M. Saif Islam, Univ. of California/Davis; Hiroshi Ito, Nippon Telegraph and Telephone Corp. (Japan); Peter U. Jepsen, Danmarks Tekniske Univ. (Denmark); James Kolodzey, Univ. of Delaware; Edmund H. Linfield, Univ. of Leeds (United Kingdom); Yalin Lu, Univ. of Colorado at Colorado Springs; Robert Magnusson, Univ. of Connecticut; Amir Hamed Majedi, Univ. of Waterloo (Canada); Richard A. Soref, Air Force Research Lab.; Geoff W. Taylor, Univ. of Connecticut; Simon Verghese, MIT Lincoln Lab.; Richard T. Webster, Air Force Research Lab.; Sigfrid K. Yngvesson, Univ. of Massachusetts/Amherst; Weili Zhang, Oklahoma State Univ.

Monday 2 October

SESSION 1

Hynes Conv. Ctr. Room 108 Mon. 1:00 to 3:00 pm

THz Spectroscopy

Chairs: Robert Magnusson, Univ. of Connecticut;
Richard T. Webster, Air Force Research Lab.

1:00 pm: **Signature science in the terahertz** (*Invited Paper*), F. C. De Lucia, The Ohio State Univ. [6373-01]

1:30 pm: **THz dynamics of the metal-insulator transition in vanadium dioxide** (*Invited Paper*), P. U. Jepsen, Danmarks Tekniske Univ. (Denmark); B. M. Fischer, Univ. of Adelaide (Australia); A. Thoman, H. Helm, Albert-Ludwigs-Univ. Freiburg (Germany); R. Lopez, R. F. Haglund, Jr., Vanderbilt Univ. [6373-02]

2:00 pm: **Ab-initio prediction of terahertz vibrational modes in crystalline systems**, P. U. Jepsen, Danmarks Tekniske Univ. (Denmark); S. J. Clark, Univ. of Durham (United Kingdom) [6373-03]

2:15 pm: **Terahertz spectroscopy of molten sulfur using a tunable THz source**, M. Mross, T. Lowell, Vermont Photonics, Inc.; G. C. Vezzoli, New Hampshire Community Technical College [6373-04]

2:30 pm: **Broadband terahertz spectroscopy** (*Invited Paper*), A. G. Davies, E. H. Linfield, Univ. of Leeds (United Kingdom) [6373-05]

Coffee Break 3:00 to 3:30 pm

SESSION 2

Hynes Conv. Ctr. Room 108 Mon. 3:30 to 6:00 pm

THz Sources I: Advanced Material

Chairs: M. Saif Islam, Univ. of California/Davis;
Frank C. De Lucia, The Ohio State Univ.

3:30 pm: **Fabrication and characterization of GaN/AlGaIn multilayer structure for terahertz quantum cascade laser** (*Invited Paper*), S. C. Wang, National Chiao Tung Univ. (Taiwan); R. A. Soref, Air Force Research Lab.; G. Sun, Univ. of Massachusetts [6373-06]

4:00 pm: **A 200-GHz low phase noise photonic local oscillator module**, R. S. Kimberk, T. R. Hunter, E. Tong, R. Blundell, Harvard-Smithsonian Ctr. for Astrophysics [6373-07]

4:20 pm: **The properties of terahertz sources based on dopant transitions in semiconductors** (*Invited Paper*), J. Kolodzey, P. Lv, S. Kim, Univ. of Delaware [6373-08]

4:50 pm: **Continuous-wave submillimeter-wave gyrotrons**, S. Han, Massachusetts Institute of Technology [6373-09]

5:10 pm: **Electrical domains and submillimeter signal generation in AlGaIn/GaN superlattices** (*Invited Paper*), V. I. Litvinov, I. Gordion, WaveBand Corp.; A. Manasson, Univ. of Maryland/College Park [6373-10]

5:40 pm: **Spectral properties of very deep zero-order metallic gratings with subwavelength slits at THz frequency region**, Z. Tian, Q. Xing, D. Liang, N. Zhang, S. Li, J. Gu, L. Chai, Q. Wang, Tianjin Univ. (China) [6373-11]

Tuesday 3 October

SESSION 3

Hynes Conv. Ctr. Room 108 Tues. 8:30 to 10:00 am

THz Propagation and Detection I: Advanced Concepts

Chairs: Peter U. Jepsen, Danmarks Tekniske Univ. (Denmark);
Simon Verghese, MIT Lincoln Lab.

8:30 am: **Subwavelength plastic fiber for terahertz wave guiding** (*Invited Paper*), C. Sun, L. Chen, H. Chen, J. Lu, National Taiwan Univ. (Taiwan) [6373-12]

9:00 am: **Terahertz sources, sensors, and components: performance and capabilities** (*Invited Paper*), G. Chattopadhyay, J. S. Ward, I. Mehdi, P. H. Siegel, Jet Propulsion Lab. [6373-14]

9:30 am: **Toward the modulation of negative index materials by photoconductive coupling**, V. J. Logeeswaran, M. S. Islam, Univ. of California/Davis; E. Ponizovskaya, A. Bratkovsky, W. Wu, S. Wang, R. S. Williams, Hewlett Packard Labs. [6373-15]

9:45 am: **Tailoring quaternary buffer/channel/barrier metamorphic HEMTs for THz operation**, R. T. Webster, Air Force Research Lab.; M. Anwar, Univ. of Connecticut [6373-16]

Coffee Break 10:00 to 10:30 am

SESSION 4

Hynes Conv. Ctr. Room 108 Tues. 10:30 am to 12:20 pm

THz Imaging

Chairs: James Kolodzey, Univ. of Delaware;
Alexander G. Davies, Univ. of Leeds (United Kingdom)

10:30 am: **Terahertz interferometric imaging of a concealed object** (*Invited Paper*), A. M. Sinyukov, A. Bandyopadhyay, A. Sengupta, R. B. Barat, D. E. Gary, Z. Michalopoulos, J. F. Federici, New Jersey Institute of Technology [6373-17]

11:00 am: **Imaging and spectroscopy at terahertz frequencies using hot electron bolometer technology** (*Invited Paper*), E. Gerecht, D. Gu, National Institute of Standards and Technology; K. S. Yngvesson, F. Rodriguez, Univ. of Massachusetts/Amherst [6373-18]

11:30 am: **Scene simulation of terahertz images**, M. R. Fetterman, W. Kiser, Jr., The Pennsylvania State Univ. [6373-19]

11:50 am: **Si-based tunnel junction devices for sub-terahertz communication and imaging** (*Invited Paper*), P. R. Berger, The Ohio State Univ.; P. E. Thompson, Naval Research Lab. [6373-20]

Lunch/Exhibition Break 12:20 to 1:50 pm

SESSION 5

Hynes Conv. Ctr. Room 108 Tues. 1:50 to 3:30 pm

Keynote Session

Chairs: **Anthony J. DeMaria**, Coherent DEOS;
Michael S. Shur, Rensselaer Polytechnic Institute

Keynote

1:50 pm: **Quantum cascade lasers from quantum design to a high performance technology for mid-infrared and THz photonics** (*Invited Paper*), F. Capasso, Harvard Univ. [6373-21]

2:30 pm: **THz-photomixer based on vertical quasi-ballistic transport** (*Invited Paper*), G. H. Döhler, S. Preu, F. Renner, M. Eckardt, A. Schwanhäusser, S. Malzer, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); M. P. Hanson, A. C. Gossard, J. Chan, E. R. Brown, Univ. of California/Santa Barbara; L. J. Wang, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); G. Loata, T. Löffler, H. G. Roskos, Johann Wolfgang Goethe-Univ. (Germany) .. [6373-22]

3:00 pm: **Photonic terahertz-wave generation using uni-traveling-carrier photodiodes** (*Invited Paper*), H. Ito, Nippon Telegraph and Telephone Corp. (Japan) [6373-23]

Coffee Break 3:30 to 4:00 pm

SESSION 6

Hynes Conv. Ctr. Room 108 Tues. 4:00 to 5:50 pm

THz Propagation and Detection II

Chairs: **Richard T. Webster**, Air Force Research Lab.;;
Amir H. Majedi, Univ. of Waterloo (Canada)

4:00 pm: **Coherent CW THz transceivers** (*Invited Paper*), E. Mueller, Coherent, Inc. [6373-24]

4:30 pm: **Extraordinary terahertz transmission of subwavelength plasmonic structures** (*Invited Paper*), W. Zhang, A. K. Azad, Oklahoma State Univ. [6373-25]

5:00 pm: **Surface plasmon modes for metal-clad optical and terahertz waveguides** (*Invited Paper*), A. B. M. Rahman, City Univ. (United Kingdom); C. Themistos, Frederick Institute of Technology (Cyprus); M. Rajarajan, K. T. V. Grattan, City Univ. (United Kingdom) [6373-26]

5:30 pm: **Research progress of terahertz wave technology in food safety**, Z. Yan, Y. Ying, H. Zhang, Zhejiang Univ. (China) [6373-27]

✓ Posters-Tuesday

A poster reception, with authors present at their posters, will be held Tuesday evening from 6:00 to 7:30 pm in the Hynes Convention Center Exhibit Hall A. Light refreshments will be served. Poster authors may begin displaying their posters after Noon on Monday and will be asked to leave their posters up until 7:30 pm on Tuesday. All posters must be posted by 5:00 pm on Tuesday. Poster authors, see p. 76 for setup instructions.

✓ **Effect of microwave radiation on the stability of terahertz hot-electron bolometer mixers**, S. Ryabchun, Harvard-Smithsonian Ctr. for Astrophysics [6373-39]

Wednesday 4 October

SESSION 7

Hynes Conv. Ctr. Room 108 Wed. 8:00 to 10:15 am

Superconducting THz Devices and Systems

Chairs: **Hiroshi Ito**, Nippon Telegraph and Telephone Corp. (Japan);
Mehdi Anwar, Univ. of Connecticut

8:00 am: **Microwave generation by Josephson vortex motion in stacked high-Tc intrinsic junctions** (*Invited Paper*), H. Lee, M. Bae, Pohang Univ. of Science and Technology (South Korea) [6373-28]

8:30 am: **Ultrafast kinetic inductance samplers** (*Invited Paper*), C. J. Stevens, Univ. of Oxford (United Kingdom) [6373-29]

9:00 am: **A 1.5-THz hot electron bolometer receiver for ground-based terahertz astronomy in northern Chile** (*Invited Paper*), E. Tong, Harvard-Smithsonian Ctr. for Astrophysics; J. H. Kawamura, Jet Propulsion Lab.; D. P. Marrone, R. Blundell, S. N. Paine, Harvard-Smithsonian Ctr. for Astrophysics [6373-30]

9:30 am: **THz signal generation/propagation in an integrated traveling-wave superconductive/photoconductive heterodyne photodetector** (*Invited Paper*), A. H. Majedi, Univ. of Waterloo (Canada) [6373-31]

10:00 am: **THz radiation from intrinsic Josephson junctions of Bi-2212 single crystals**, K. Kadowaki, K. Kawamata, M. Kohri, Y. Kubo, T. Yamamoto, I. Kakeya, Univ. of Tsukuba (Japan) [6373-32]

Coffee Break 10:15 to 10:35 am

SESSION 8

Hynes Conv. Ctr. Room 108 Wed. 10:35 am to 12:25 pm

THz Sources II: Advanced Concepts

Chairs: **Gottfried H. Döhler**, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); **Weili Zhang**, Oklahoma State Univ.

10:35 am: **Terahertz comb radio frequency generation in nonlinear optical devices** (*Invited Paper*), E. J. Donkor, Univ. of Connecticut [6373-33]

11:05 am: **Terahertz quantum cascade lasers** (*Invited Paper*), E. H. Linfield, A. G. Davies, Univ. of Leeds (United Kingdom) [6373-34]

11:35 am: **Development of double negative metamaterials in the THz regime** (*Invited Paper*), A. Akyurtlu, N. Wongkasem, K. A. Marx, Univ. of Massachusetts/Lowell [6373-35]

12:05 pm: **Mask repair using layout based pattern copy for the 65-nm node and beyond**, V. A. Boegli, NaWoTec GmbH (Germany) [6373-36]