

Rensselaer Physics Department Activities

July 2006 – September 2006

(Rensselaer Students are underlined)

HONORS AND AWARDS

G.-C. WANG

- Chaired a session in Advanced Functional Materials 2006, Chinese Academy of Science, Shenyang, China, July 4th, 2006.

X.-C ZHANG

- US patent 7,091,506, "Semiconductor surface-field emitter for T-ray generation," issued on August 15, 2006.
- US patent 7,087,902, "Fresnel lens tomographic imaging," issued on August 8, 2006.
- Director, NATO Advanced Research Workshop on Terahertz Frequency Detection and Identification of Materials and Objects.
- Chair for four sessions in NATO Advanced Research Workshop on Terahertz Frequency Detection and Identification of Materials and Objects.
- Honorary Professor in the China Institute of Metrology, China, August 24, 2006.
- Chair for 2nd NATO SET THz Exploratory Team Business Meeting, Paris, September 4-6, 2006.
- Conference co-chair, 3rd International Symposium of Ultrafast Phenomena and THz waves, Nanjing, September 25-27, 2006.

INVITED TALKS

T.-M. LU

- "Choices for future interconnect materials and processing", seminar, Chartered Semiconductor, Singapore, August 3, 2006. "
- "Physical self-assembly and 3D integrated nanostructures", seminar, Materials Science and Engineering Department, Nanyang Technological University, Singapore, August 4, 2006.

G.-C. WANG

- Shadowing growth of 2D nanostructures, Summer School of Advanced Functional Materials 2006, Chinese Academy of Science, Shenyang, China, 8:40 am, July 4th, 2006.
- Physical properties of oblique angle deposited 3D nanostructures, Summer School of Advanced Functional Materials 2006, Chinese Academy of Science, Shenyang, China, 2:50 PM, July 4th, 2006.
- Scaling behavior of texture evolution under oblique angle deposition, Summer School of Advanced Functional Materials 2006, Chinese Academy of Science, Shenyang, China, 8:30 am, July 5th, 2006.
- Terascale and terahertz research at Rensselaer, Department of Physics, Capital Normal University, Beijing, China, 10:30 am, July 7, 2006.
- Student centered learning: from studio physics to mobile studio, Department of Physics, Capital Normal University, Beijing, China, 9 am, July 7, 2006.
- Shadowing growth of 3D nanostructures and their physical properties, Physics Department, Wuhan University, Wuhan, China, 4 PM, July 10, 2006.

X.-C ZHANG

- “THz photonics in ambient air,” New Scientific Opportunities with High Power THz Source, Runcorn, England, June 30, 2006.
- “Security in mind” NATO Advanced Research Workshop on Terahertz Frequency Detection and Identification of Materials and Objects, July 11, 2006.
- “THz wave photonics in ambient air: generation, manipulation amplification, detection,” J. Dai, X. Xie, H. Zhong, N. Karpowicz, and X.-C. Zhang, Plenary presentation, IRMMW-THz 2006, Shanghai, September 21, 2006.
- “THz science, technology, and application,” Zhejiang University, Hangzhou, September 22, 2006.
- “Current status of terahertz technology & application,” 3rd International Symposium of Ultrafast Phenomena and THz waves, Nanjing, September 25, 2006.

MEETING ATTENDANCE

G.-C. WANG

- Advanced Functional Materials 2006, Chinese Academy of Science, Shenyang, China, July 4th – 6th, 2006.

OTHER PROFESSIONAL TRAVEL

G.-C. WANG

- Dept. of Energy, Germantown, MD, Sept. 7, 2006. Met with program directors

PRESENTATIONS

F. SCHUBERT

- E. Fred Schubert and Jong Kyu Kim “Solid-state lighting – Opportunities for fundamental innovation” *International Symposium on Compound Semiconductors* (ISCS), Vancouver, Canada, August 14–17 (2006)
- E. Fred Schubert and Jong Kyu Kim “Solid-state lighting – Opportunities for fundamental innovation” *International Symposium on Compound Semiconductors* (ISCS), Vancouver, Canada, August 14–17 (2006)
- E. Fred Schubert and Jong Kyu Kim “Solid-state lighting – Opportunities for fundamental innovation” *Asia-Pacific Optical Communications Conference* (APOC), Gwangju, Korea, September 3–7 (2006)
- E. Fred Schubert and Jong Kyu Kim “Solid-state lighting – Opportunities for fundamental innovation” *13th International Workshop on Inorganic and Organic Electroluminescence and 2006 International Conference on the Science and Technology of Emissive Displays and Lighting* (EL2006), Jeju Island, Korea, September 18–22 (2006)

G.-C. WANG

- Path through graduate study, G.-C. Wang, Invited speaker, NSF-AGEP/IGERT Graduate/Faculty Seminar Series, Sept. 6, 2006, Rensselaer
- Graduate program at Rensselaer, G.-C. Wang, Summer School of Advanced Functional Materials 2006, Chinese Academy of Science, Shenyang, China, 6:20 PM, July 4th, 2006.
- Graduate program at Rensselaer physics, G.-C. Wang for students at the Physics Department, Wuhan University, Wuhan, China, 4 PM, July 8, 2006.
- Undergraduate and graduate curriculum at Rensselaer physics, G.-C. Wang for faculty at the Physics Department, Wuhan University, Wuhan, China, 10 am, July 10, 2006.

M. YAMAGUCHI

- “THz Wave Technology for BomDetec” , Xi-Cheng Zhang and Masashi Yamaguchi, CenSSIS Northeastern university BomDetec program kick-off meeting”, Boston, August 16 (2006).
- “THz Wave Generation through third order nonlinear optical process”, NSF program monitor-Dr.Rao’s visit, Masashi Yamaguchi, Aug.25, RPI.
- “THz center”, School of Science retreat, Masashi Yamaguchi and Xi-Cheng Zhang, Sep.27 at RPI.
- “THz technology and THz center at RPI”, meeting with representatives from Harris&Harris company, office of technology commercialization, and president’s office at RPI, Masashi Yamaguchi, Sep.29 at RPI.

PAPERS PUBLISHED

T.-M. LU

- "Atomic Layer Deposition of Pd on an Oxidized Metal Substrate" G. A. Ten Eyck, S. Pimanpang, H. Bakhru, T.-M. Lu, G.-C. Wang, *Chemical Vapor Deposition* 12, Issue 5, 290 (2006)
- "Water electrolysis activated by Ru nanorod array electrodes," S.-Y. Kim, T. Karabacak, T.-M. Lu, and Nikhil Koratkar, *Appl. Phys. Lett.* 88, 263106 (2006), has been selected for the July 11, 2006 issue of *Virtual Journal of Nanoscale Science & Technology*.
- "Low Temperature Physical-Chemical Vapor Deposition of Ti-Si-N-O Barrier Films", Y. C. Ee, Z. Chen, T.-M. Lu, Z. L. Dong, and S. B. Law, *Electrochemical and Solid-State Letters*, 9 (3), G100-G103 (2006)
- "Mound Formation in Surface Growth under Shadowing," M. Pelliccione, T. Karabacak, C. Gaire, and G.-C. Wang, *Phys. Rev. B* 74, 12 (2006).
- "Achieving a photonic band edge near visible wavelengths by metallic coatings", S.Y. Lin, D.-X. Ye, T.-M. Lu, J. Bur, Y.S. Kim, and K.M. Ho, *J. Appl. Phys.* 99, 083104 (2006).
- "Onset of thermal degradation in poly(p-phenylene vinylene) films deposited by chemical vapor deposition", Cynthia A. Gedelian, Gregory A. Ten Eyck, and Toh-Ming Lu, *Synthetic Metals*, submitted.

A. REDO-SANCHEZ

- H. Zhong, A. Redo-Sanchez, and X.-C. Zhang, "Identification and classification of chemicals using terahertz reflective spectroscopy focal-plane imaging system", *Optics Express*, 14, 20, pp. 9130-9141 (2006)
- A. Redo-Sanchez, J. Tejada, and X. Bohigas, "Bubble Detector in Polyurethane Applications Based on a Microwave System", *IEEE Sensors Journal*, 6, 4, pp. 939-944 (2006)
- A. Redo-Sanchez, N. Karpowicz, J. Xu, and X.-C. Zhang, "Damage and defect inspection with terahertz waves", *The 4th International Workshop on Ultrasonic and Advanced Methods for Nondestructive Testing and Material Characterization*, June 19 2006, Dartmouth (MA, USA)

G.-C. WANG

- "Mound Formation in Surface Growth under Shadowing", M. Pelliccione, T. Karabacak, C. Gaire, G.-C. Wang, and T.-M. Lu, *Phys. Rev. B* 74, 125420 (2006).

X.-C. ZHANG

- Jianming Dai, Xu Xie, and X.-C. Zhang, "Detection of broadband terahertz waves with laser-induced plasma in gases," *Physics Review Letters*, 97, 103903 (2006).

- Hua Zhong, Albert Redo-Sanchez, and X.-C. Zhang, "Identification and classification of chemicals using terahertz reflective spectroscopic focal-plane imaging system," *Optical Express*, (2006). In press.
- Hua Zhong, Nicholas Karpowicz, and X.-C. Zhang, "Terahertz emission profile from laser-induced air plasma," *Applied Physics Letters* 88, 261103 (2006)
- Haibo Liu and X.-C. Zhang, "THz spectroscopy for explosive, pharmaceutical, and biological sensing applications" submitted to the book chapter for NATO Springer series. (2006).
- Haibo Liu and X.-C. Zhang, "Dehydration kinetics of D-glucose monohydrate studied using THz time-domain spectroscopy", *Chemical Physics Letters* 429, 229–233 (2006).
- Y.S. Jeon, X.-C. Zhang, H.-S. Kang, "Generation of THz beams from CdZnTe single crystals by wavelength matching of an optical pumping beam," *Sae Mulli (The Korean Physics Society)*, 52, 425, (2006).
- Hai-Bo Liu, Xi-Cheng Zhang, "Terahertz spectroscopy for explosive, pharmaceutical, and biological sensing applications," a book chapter in *Terahertz Frequency Detection and Identification of Materials and Objects (NATO Advanced Research Workshop 2006)*, to be published by Springer, Netherlands.
- Hai-Bo Liu, Yunqing Chen, and X.-C. Zhang, "Characterization of anhydrous and hydrated pharmaceutical materials with THz time-domain spectroscopy," in press, *Journal of Pharmaceutical Science* (2006).
- Hai-Bo Liu, George Plopper, Sarah Earley, Yunqing Chen, Bradley Ferguson, and X.-C. Zhang, "Sensing the change of biological cell monolayers by THz differential time-domain spectroscopy," in press, *Biosensors and Bioelectronics* (2006).
- Hai-Bo Liu, Yunqing Chen, Glenn J. Bastiaans, and X.-C. Zhang, "Detection and identification of explosive RDX by THz diffuse reflection spectroscopy," *Optics Express*, 14, 415 (2006).
- Hai-Bo Liu, Hua Zhong, Nick Karpowicz, Yunqing Chen, and X.-C. Zhang, "Terahertz spectroscopy and imaging for defense and security applications," in press, a special THz issue of *Proceedings of the IEEE* (2006).

PROPOSALS (SUBMITTED or GRANTED)

G.-C. WANG

- In situ Study of Growth Front Texture Evolution of Polycrystalline Films Using a Novel Reflection High-Energy Electron Diffraction Pole Figure Technique, \$600 K/3 yrs, submitted to DOE on July 26, 2006.
- Microdiffraction study of the structure of a single isolated metallic nanorod, Brookhaven National Lab beam time, approved.
- Clinical Methods for Detection and Measurement of Microscopic Quanta of Prostate Cancer: Modeling and Acquisition of Clinical Samples: Gwo-

Ching Wang, PhD (RPI)/Derek Raghavan, MD PhD; Eric Klein, MD (LRI), Lerner Research Institute, The Cleveland Clinic Foundation, granted Sept. 2006.

M. YAMAGUCHI

- “NER: Nanoscale Acoustics and Thermal Transport in Nanorod/Nanotube Arrays”, NSF-NER, PI- Masashi Yamaguchi, co-PIs Pulickel M. Ajayan, and Toh-Ming Lu, Aug.9 funded, \$120K for one year.
- “THz wave standoff distance detection of explosives (>100m) using the air as an emitter & sensor”, BAA 05-024-ONR, PI-Xi-Cheng Zhang, co-PIs Masashi Yamaguchi, and Jamming Dai, Aug. funded, \$900K for three years.
- “MRI: Development of Backward Wave Oscillator Tunable Broadband THz Source for THz Electronics Research, THz-Materials Research and THz-Imaging”, NSF-MRI, PI-Ingrid Wilke, co-PIs Masashi Yamaguchi, Xi-Chen Zhang, Gwo-Ching Wang, and Michael Shur, 13 Sep. funded \$400K for three years.
- “Nanoscale thermal conduction and electron phonon coupling in Advanced Electrical Systems”, MURI-ONR, PI-Masashi Yamaguchi, co-PI Toh-Ming Lu, white paper submitted.
- “Sensing of chemical and biological agents and intense terahertz wave generation in micro-plasma from chemical vapors”, BAA W9113M-05-0009-DARPA, PI-Masashi Yamaguchi, co-PI Xi-Cheng Zhang, Sep.9 White paper submitted.

X.-C. ZHANG

- AFOSR, “THz fiber laser,” \$101,725, one year (2006). Granted.
- ONR, “THz wave standoff distance detection of explosives (>100m) using the air as an emitter & sensor,” \$900k, with co-PI Yamaguchi and Dai, three years (2006-2009). Granted.
- ONR, “Understanding phonon signatures of explosives,” \$750k, with co-PI Nayak and Chen, three years (2006-2009). Granted.
- ONR, “THz detection of improvised explosive devices,” \$1M, with PI Shur, three years (2006-2009). Granted.
- NSF EPDT: THz wave photonics. \$270k. Three years. (2006-2009). Granted.
- Cash gift, IMRA America Inc. Fellow: \$50k (2006). Received.
- Cash gift, Zomega THz Corp. \$20k (2006). Received.
- “Terahertz Wave Technology,” Lawrence Livermore National Laboratories. \$25,000, one month, 2006. Granted.

SIGNIFICANT RESULTS OBTAINED OR NEW RESEARCH AFFILIATES

VISITORS TO RENSSELAER

G.-C. WANG

- Prof. Willie Rockward from physics department, Morehouse College spent three weeks learning THz imaging at RPI physics under NSF IGERT program.

X.-C. ZHANG

- 7/24 to 8/11 Prof. Wille Rockward from Morehouse College visited
- 8/7 to 8/17 Prof. Kang and Prof. Jeon from Korea visited
- 8/7 – 8 / 14 Prof. Cunlin Zhang from China visited
- 8/5 Dr. M. Troffer from Navy visited
- 8/7 Dr. M. Troffer (Navy) and Dr. David McDarby (DTRA) visited
- 8/14 Dr. S. Ostows & Dr. R. Skibo from SC&A and PNTS visited
- 9/11-9/15 Laurence Lebon from Belgium Royal Military Academy visited
- 9/12 Bell Labs group: Dr. Oleg Mitrofanov, Dr. Lothar Moeller, Dr. Randy Giles, and Dr. John Lertola. Possible Bell Lab and RPI collaboration.
- 9/13 Dr. Michael Fitch, Applied Physics Laboratory, John Hopkins University, visited

NON-PROFESSIONAL ACTIVITIES

IMPORTANT ACTIVITIES OF STUDENTS

G.-C. WANG

- REU students presented their summer research in poster presentations on August 8.
- Fu Tang defended his PhD work “Study of texture evolution under oblique angle deposition by reflection high energy electron diffraction” on July 24, 2006.

OTHER