RENBO SONG, Ph.D.

208 Saucon View Dr. • Bethlehem, PA 18015 • USA

Information updated up to: ***April. 2011***

Contact Information

Renbo Song, Ph.D.
Postdoctoral Research Fellow
Center for Optical Technologies (COT)
Department of Electrical and Computer Engineering
Lehigh University
7 Asa Drive, Bethlehem, PA 18015, USA
Email: resd@Lehigh.Edu,
Phone: 484-767-7299 (cell), Fax: (610) 758-2605
Research Group: www.ece.lehigh.edu/~tansu
CV Link: www.ece.lehigh.edu/~tansu/pdf/Renbo_Song_CV.pdf

Birth Place and Date:

Laiyang, Shandong, P. R. China; November 29, 1975.

Education Background

Spring 2003 – Fall 2009, ***Lehigh University (Bethlehem, Pennsylvania, USA)***
Doctor of Philosophy (Ph.D.) in Electrical Engineering (Specialization area: Photonics & Optoelectronics)

- Research Assistant (ECE, Lehigh) (Cumulative GPA: 3.88/4.0)
- Packard fellowship of Lehigh University (2008-2009)
- Ph.D. Advisor: Prof. Yujie J. Ding, Research Areas: Optical sensor design and infrared spectroscopy.

Fall 2001 – Spring 2003, ***University of Arkansas (Fayetteville, Arkansas, USA)***
Ph.D candidate in Micro-Electronics-Photonics (MicroEP) Program

- Research Assistant (MicroEP, University of Arkansas)

Fall 1998 – Spring 2001, ***Shandong University (Jinan, China)***
Master of Sciences (M.S.) in Condensed Matter Physics (Specialization area: Nonlinear Optics)

- Research Assistant (Optics, Shandong University)
- Research Areas: optical frequency generation (SHG & THG) of nonlinear optical crystals

Fall 1994 – Spring 1998, ***Shandong University (Jinan, China)***
Bachelor of Science (B.S.) in Optics

- Best Students Award (Every semester, 1994-1998, to top 3 out of 62 students)

Professional Experiences

Spring. 2010 – present, ***Lehigh University (Bethlehem, PA, USA)***
Postdoctoral Research Fellow / Research Scientist
Department of Electrical and Computer Engineering (ECE)
& Center for Optical Technologies (COT)
P. C. Rossin College of Engineering and Applied Science
Postdoctoral Research Advisor: Prof. Nelson Tansu (ECE)

- MOCVD Epitaxy of InGaN semiconductors for light-emitting diodes (LEDs), micropyramids, and nanowires for solid state lighting; and device technologies for enhanced light extraction efficiency and white LEDs.
- High-efficiency III-Nitride solar cell and solar hydrogen projects

Spring 2011 ***Lehigh University (Bethlehem, PA, USA)***
Substitute Lecturer (Teaching Experience)
Department of Electrical and Computer Engineering (ECE)

- **ECE 203 "Introduction to Electromagnetic Waves"**
  - The ECE 203 is the second course of the engineering electromagnetic course for ECE junior students.

Spring. 2003 – Fall. 2009, ***Lehigh University (Bethlehem, PA, USA)***
Ph.D. Candidate and Research Assistant
Department of Electrical and Computer Engineering (ECE)
PhD Advisor: Prof. Yujie Ding (ECE)

- Optical sensor design based on planar glass waveguide.
- Infrared laser spectroscopy for bio-chemicals including DNA and proteins

Fall 2001 – Spring 2003 ***University of Arkansas (Fayetteville, AR, USA)***
Ph.D. Candidate and Research Assistant
Micro-Electronics-Photonics Department (MicroEP)

- Electro-optical (EO) effect of Nano-materials

Fall 1998 – Spring 2001 ***Shandong University (Jinan, China)***
Master Graduate Student and Research Assistant
State Key Laboratory of Crystal Materials (Solid State Laser Group)

- Nonlinear Optical Frequency Generation & solid state laser design

Research and Academic / Teaching Focus

My research and academic areas cover the photonics and optoelectronics (lasers and optical biosensors), semiconductor device technologies, electronics materials and device epitaxy with metalorganic chemical vapor deposition (MOCVD), and fabrication of semiconductor optoelectronics devices based on Group III-Nitride semiconductor nanostructures. My current research works focus on the applications for energy, including high-efficiency III-Nitride solar cell and solar hydrogen projects, and other novel light-emitting devices for solid state lighting.

My teaching interests are in the areas of photonics, semiconductor device technologies, optoelectronics, engineering electromagnetisms, and quantum mechanics, with equal emphasis on both class lectures and lab projects. In the Spring semester of 2011, I am a substitute lecturer for the course of "Introduction to Electromagnetic Waves" for the Department of Electrical and Computer Engineering at Lehigh University. I have published more than 20 journal and conference papers, and I also have served as a reviewer for leading journals in applied physics, quantum electronics, nanotechnology, photonics and optoelectronics areas.

Awards & Recognition

- Packard Fellowship of Lehigh University (2008-2009), Lehigh University
- Lehigh University Research Assistant (2003-2009), Lehigh University
- Best Student Award (Every semester, 1994-1998), Shandong University
- Vice President of Lehigh University Chinese Scholar and Student Association, 2006-2007

Professional Affiliations

Member of Optical Society of America (OSA), 2006-2009

Member of SPIE, 2006-2009

Member of American Physical Society, 2011-present

Technical Skills

- ***Materials Processing***
  - ✓ Metal Organic Chemical Vapor Deposition (MOCVD) for Nitride Semiconductors
  - ✓ PECVD for Silicon Dioxide (SiO_2) / Silicon Nitride (SiN)
  - ✓ Rapid Thermal Annealing (RTA)
  - ✓ Cleanroom Process for Semiconductor Devices
  - ✓ Photomask Design
  - ✓ E-beam lithography
- ***Analytical Tools / Techniques***
  - ✓ Scanning Electron Microscopy (SEM)
  - ✓ Atomic Force Microscopy (AFM)
  - ✓ Photoluminescence (PL)
  - ✓ Cathodoluminescence (CL)
  - ✓ Hall Measurement
  - ✓ X-Ray Diffraction (XRD)
  - ✓ Fourier Transform Infrared (FTIR) Spectroscopy
- ***Programming Language and Software Packages***
  - ✓ Labview
  - ✓ Matlab

Refereed Journal and Conference Publications

Total First Authorship Publications: 11; Total Refereed Journal Publications: 26

1. X. B. Hu, J. Y. Wang, W. H. Cui, Q. C. Guan, **R. B. Song**, J. Q. Wei, Y. G. Liu, J. H. Jiang, Y. L. Tian, "Growth defects in flux grown RbTiOAsO4 crystals observed with white-beam synchrotron radiation topography," *Journal of Crystal Growth*, 205(3), 323-327, 1999.
2. X. B. Hu, J. Y. Wang, J. Q. Wei, Y. G. Liu, **R. B. Song**, M. H. Jiang, Y. L. Tian, J. H. Jiang, "Growth twins in self-frequency doubling laser crystal $Yb_xY_{1-x}Al_3(BO_3)_4$," *Progress in Crystal Growth and Characterization of Materials*, 40(1-4), 57-61, 2000.
3. B. Teng, J. Y. Wang, Z. P. Wang, H. D. Jiang, X. B. Hu, **R. B. Song**, H. Liu, Y. G. Liu, J. Q. Wei, Z. S. Shao, "Growth and investigation of a new nonlinear optical crystal: bismuth borate BiB_3O_6," *Journal of Crystal Growth*, 224(3-4), 280-283, April 2001.
4. Z. P. Wang, J. H. Liu, **R. B. Song**, X. G. Xu, X. Sun, H. D. Jiang, K. Fu, J. Y. Wang, Y. G. Liu, J. Q. Wei, Z. S. Shao, "The second-harmonic-generation property of $GdCa_4O(BO_3)_3$ crystal with various phase-matching directions," *Optics Communications*, 187(4-6), 401-405, 2001.
5. Z. P. Wang, X. G. Xu, K. Fu, **R. B. Song**, J. Y. Wang, J. Q. Wei, Y. G. Liu, Z. S. Shao, "Non-critical phase matching of $Gd_xY_{1-x}Ca_4O(BO_3)_3$(Gd_xY_{1-x}COB) crystal," *Solid State Communications*, 120(9-10), 397-400, 2001.
6. Z. P. Wang, J. H. Liu, **R. B.Song**, H. D. Jiang, S. J. Zhang, K. Fu, C. Q. Wang, J. Y. Wang, Y. G. Liu, J. Q. Wei, H. C. Chen, Z. S. Shao, "Anisotropy of nonlinear-optical property of RCOB (R = Gd, Y) crystal," *Chinese Physics Letters*, 18(3), 385-387, 2001.
7. Z. P. Wang, X. G. Xu, X. Sun, K. Fu, **R. B. Song**, J. Y. Wang, Y. G. Liu, J. Q. Wei, Z. S. Shao, "Research on the non-critical phase-matching wavelength of $Gd_xY_{1-x}Ca_4O(BO_3)_3$ crystal," *Acta Physica Sinica*, 50(9), 1713-1716, Sep 2001.
8. J. Y. Wang, X. B. Hu, X. Yin, **R. B. Song**, J. Q. Wei, Z. S. Shao, Y. G. Liu, M. H. Jiang, Y. L. Tian, J. H. Jiang, W. X. Huang, "Growth, defects, and properties of $GdCa_4O(BO_3)_3$ and Nd:$GdCa_4O(BO_3)_3$ crystals," *Journal of Materials Research*, 16(3), 790-796, 2001.
9. B. Teng, J. Y. Wang, Z. P. Wang, H. D. Jiang, **R. B. Song**, H. Liu, X. B. Hu, Y. G. Liu, J. Q. Wei, Z. S. Shao, "Research on crystal growth and properties of a new nonlinear optical crystal: Bismuth borate BiB_3O_6," *Chinese Science Bulletin*, 46(21), 1783-1785, Nov 2001.

10. K. Fu, Z. P. Wang, Z. X. Cheng, J. H. Liu, **R. B. Song**, H. C. Chen, Z. S. Shao, "Effect of Nd^{3+} concentration on the laser performance of a new laser crystal: Nd : $NaY(WO_4)_2$," *Optics and Laser Technology*, 33(8),593-595,Nov 2001.
11. **R. B. Song,** Z. P. Wang, K. Fu, H. D. Jiang, "Growth, SHG and THG Non-critical Phase Match of GdYCOB Crystals," *Journal of Synthetic Crystals,* 30(3), 2001.
12. Z. P. Wang, B. Teng, K. Fu, X. G. Xu, **R. B. Song**, C. L. Du, H. D. Jiang, J. Y. Wang, Y. G. Liu, Z. S. Shao, "Efficient second harmonic generation of pulsed laser radiation in BiB_3O_6 (BIBO) crystal with different phase matching directions," *Optics Communications*, 202(1-3), 217-220, Feb 2002.
13. **R. B. Song,** S. Wei, Y. J. Ding, "Direct Measurements of Resonance Peaks of DNA's and Proteins Using Widely-Tunable Monochromatic THz Source," TuH3, *IEEE LEOS*, *The 16th Annual Meeting of IEEE*, 1, 238, Oct 2003.
14. A. Ganjoo, H. Jain, J. V. Ryan, **R. B. Song**, R. Chanda, J. Irudayaraj, Y. J. Ding, C. G. Pantano, "Fabrication of chalcogenide glass waveguide for IR evanescent wave sensors," *SPIE Proceedings of Integrated Chemical/Biological Nano-Sensor Devices*, 5593, 637-642, 2004.
15. **R. B. Song,** X. D. Mu, A. Ganjoo, Y. J. Ding, H. Jain, "Design, characterization, and optimization of waveguides based on chalcogenide glasses for biosensors," *SPIE Proceedings of Chemical and Biological Point Sensors for Homeland Defense II*, 5585, 58-64, 2004.
16. A. Ganjoo, H. Jain, C. Yu, **R. B. Song**, J. V. Ryan, J. Irudayaraj, Y. J. Ding, C. G. Pantano, "Planar chalcogenide glass waveguides for IR evanescent wave sensors," *Journal of Non-crystalline Solids*, 352(6-7), 584-588, 2006.
17. **R. B. Song,** Y. J. Ding, I. B. Zotova, "Fingerprinting Human Insulin and Insulin Lispro Based on Fourier Transform Infrared Spectroscopy in the Range from Mid-IR to THz," *Conference on Lasers and Electro-Optics (CLEO):* CTuO6, 1-2, May 2006.
18. **R. B. Song,** Y. J. Ding, I. B. Zotova, J. L. Jensen, "Spectroscopic study of simulant for VX nerve agent in a wide frequency range," *Conference on Lasers and Electro-Optics (CLEO)*, 84-5, 2007.
19. **R. B. Song,** Y. J. Ding, I. B. Zotova, "Fingerprinting insulins in the spectral region from mid-IR to THz," *International Journal of High Speed Electronics and Systems*, 17(2), 251-260, 2007.
20. **R. B. Song,** Y. J. Ding, I. B. Zotova, "Fingerprinting malathion vapor: A simulant for VX nerve agent," *Proceedings of SPIE* , v 6949, *Terahertz for Military and Security Applications VI*, 694903-694906, 2008.
21. **R. B. Song,** X. D. Mu, Y. J. Ding, A. Ganjoo, H. Jain, "Approach for determining the refractive-index profile of graded-index planar waveguides," *Applied Optics*, 47(33), 6226-6229, 2008.
22. **R. B. Song,** Y. J. Ding, P. N. Gupta, H. Jain "Investigation of vibrational modes from SiO_2 and $LaBGeO_5$ using a frequency-tunable terahertz source," *Journal of Non-Crystalline Solids,* 356(6-8), 419-421, 2010.
23. **R. B. Song,** Y. J. Ding, I. B. Zotova "Fingerprinting Ovalbumin - Simulant of Protein Toxins in extremely-Wide Frequency Range," *Conference on Lasers and Electro-Optics CLEO,* JWA57, May 2010.
24. X. H. Li, Y. K. Ee, **R. B. Song**, and N. Tansu, "Enhancement of Light Extraction Efficiency of InGaN Quantum Wells Light-Emitting Diodes Using TiO_2 Microsphere Arrays," in *Proc. of the SPIE Photonics West 2011, LEDs: Materials, Devices, and Applications for Solid State Lighting XV*, San Francisco, CA, Jan 2011.
25. (**Invited Conference Paper**) N. Tansu, H. P. Zhao, J. Zhang, G. Y. Liu, X. H. Li, Y. K. Ee, **R. B. Song**, T. Toma, L. Zhao, and G. S. Huang, "Novel Approaches for High-Efficiency InGaN Quantum Wells Light-Emitting Diodes – Device Physics and Epitaxy Engineering," in Proc. of the *SPIE Photonics West 2011*, *LEDs: Materials, Devices, and Applications for Solid State Lighting XV*, Paper 7954-42, San Francisco, CA, Jan 2011.
26. **R. B. Song**, L. Zhao, G. Y. Liu, J. Zhang, and N. Tansu, "Growths of InGaN Quantum Wells on GaN Micropyramids," in *Proc. of the American Physical Society (APS) Annual March Meeting 2011*, Dallas, Texas, March 2011.
27. X. H. Li, Y. K. Ee, **R. B. Song**, and N. Tansu, "Fabrication of Self-Assembled Silica / Polystyrene Microlens Arrays for Light Extraction Enhancement in Nitride Light-Emitting Diodes," in *Proc. of the IEEE/OSA Conference on Lasers and Electro-Optics (CLEO) 2011*, Paper CML4, Baltimore, MD, May 2011.

Submitted Refereed Journal and Conference Papers

28. X. H. Li, **R. B. Song**, and N. Tansu, "Enhancement of Light Extraction Efficiency of InGaN Quantum Wells Light-emitting Diodes using TiO_2 Microsphere Arrays," *IEEE Photonics Journal* (Accepted).
29. (**Invited Topical Review Article**) N. Tansu, H. P. Zhao, J. Zhang, , G. Y. Liu, X. H. Li, **R. B. Song**, L. Zhao, Y. K. Ee, and G. S. Huang, "Recent Progress on High Efficiency InGaN Quantum Wells and Quantum Dots Light Emitting Diodes for Solid State Lighting – A Review," *J. Phys. D: Appl. Phys.* (submitted).
30. X. H. Li, **R. B. Song**, Y. K. Ee, and N. Tansu, "Light Extraction Efficiency and Radiation Patterns of III-Nitride Light-Emitting Diodes with Colloidal Microlens Arrays with Various Aspect Ratios," *IEEE Photonics Journal* (Accepted).

Internal Scientific Lectures & Seminars (Non-Refereed)

1. **R. B. Song**, X. D. Mu, A. Ganjoo, Y. J. Ding, and H. Jain, "Characterization of chalcogenide-glass-based waveguide for biosensors," Poster in *Lehigh Center for Optical Technologies (COT) Open House 2005, **Lehigh University***, Bethlehem, Pennsylvania, USA, October 2005.
2. A. Ganjoo, **R. B. Song**, Y. J. Ding and H. Jain, Lehigh University; C. Yu, Y. Irudayaraj, J.V. Ryan and C.G. Pantano, "Design, characterization and functionalization of chalcogenide glass waveguides for infrared evanescent wave sensing," Poster in *Lehigh Center for Optical Technologies (COT) Open House 2005, **Lehigh University***, Bethlehem, Pennsylvania, USA, October 2005.

Professional and Synergistic Services

1. **Technical Program Committee Member** – American Physical Society (APS) Annual March Meeting 2011, Sub Committee 2: Semiconductor Physics, Dallas, Texas, March 2011.
2. **Session Chair / Presider** – American Physical Society (APS) Annual March Meeting 2011, Sub Committee 2: Semiconductor Physics, Dallas, Texas, March 2011.
3. **Journal Reviewer:**
   - *IEEE Journal of Selected Topics in Quantum Electronics*
   - *Nanoscale Research Letters*
   - *IEEE Photonics Journal*
   - *IEEE Journal of Quantum Electronics*
   - *Applied Optics (OSA)*

References

1. **Prof. Nelson Tansu** (Postdoctoral Advisor)
   Class of 1961 Associate Professor
   Department of Electrical and Computer Engineering
   Center for Optical Technologies
   Lehigh University, Bethlehem, PA 18015, USA
   Email: Tansu@Lehigh.Edu
   Phone: (484) 547-4818, Fax: (610) 758-2605
   Research Group: http://www.ece.lehigh.edu/~tansu
2. **Dr. Ronald A. Arif**
   Research Scientist, Optoelectronics Epitaxy R&D Group
   Cree, Inc
   Durham, NC, USA
   Email: Ronald_Arif@Cree.com Phone: (919) 313-5512
3. **Prof. Hongping Zhao**
   Assistant Professor
   Department of Electrical and Computer Engineering
   Case Western Reserve University
   Cleveland, OH 44106, USA
   Email: hoz207@lehigh.Edu Phone: (484) 350-0459

4. **Prof. Yujie J. Ding**
   Professor
   Department of Electrical and Computer Engineering
   Lehigh University
   Bethlehem, PA 18015, USA
   Email: yud2@Lehigh.Edu Phone: (610) 758-4582

5. **Prof. Filbert J. Bartoli**
   Chandler Weaver Chair Professor and ECE Department Chair
   Department of Electrical and Computer Engineering
   Lehigh University
   Bethlehem, PA 18015, USA
   Email: fjb205@Lehigh.Edu Phone: (610) 758-4069

6. **Dr. Wei Shi**
   Adjunct Associate Professor
   College of Optical Sciences
   University of Arizona
   Tucson, AZ, USA
   Email: weishi@email.arizona.edu Phone: 520-799-7413

7. **Dr. Xiaodong Mu**
   Manager – Research and Development
   Onyx Optics, Inc.
   Dublin, CA, USA
   Email: xmu@onyxoptics.com, Phone: 925- 833-1969 (ext. 143)