

Rui Q. Yang

RESEARCH INTERESTS

Semiconductor quantum structures and devices, applied physics, optoelectronics and applications, mid-infrared lasers and detectors, photovoltaic devices for energy conversion, particularly thermophotovoltaic (TPV) cells for conversion of mid-infrared light.

Group website: <http://QDL.ou.edu/>

BIOGRAPHY

Dr. Yang is a professor in the School of Electrical and Computer Engineering at the University of Oklahoma. He is the inventor of interband cascade (IC) lasers, detectors, and photovoltaic devices with research activities ranging from condensed matter physics to semiconductor quantum devices such as tunneling diodes, mid-infrared lasers and detectors, and photovoltaic devices for converting infrared light to electricity. Prior to joining the University of Oklahoma in 2007, he was a Principal Member of Engineering Staff and a Task Manager at the Jet Propulsion Laboratory (JPL), California Institute of Technology, Pasadena, California, where he led the development of advanced mid-infrared interband cascade lasers for applications in Earth sciences and planetary explorations. He received the Edward Stone Award in 2007 from JPL for outstanding research publication and the successful accelerated infusion of cutting-edge interband cascade semiconductor laser technology into flight mission readiness. The lasers that he invented and developed with his colleagues at JPL have been landed with Curiosity on Mars for NASA flight missions and successfully detected organic molecules CH_4 . He has authored/co-authored more than 140 refereed journal articles and two book chapters with 9 patents and over 200 conference contributions, invited seminars, and talks. He has been the principal investigator on many tasks and contracts from NASA, DoD, DoE funding agencies, and NSF.

Education

PhD, Solid State Physics
Nanjing University, China, 1987
MS, Solid State Physics
Nanjing University, China, 1984
BS, Physics
Zhejiang University, China, 1982

Experience

Professor
University of Oklahoma
Principal/Senior Member of
Engineering Staff, Task Manager
Jet Propulsion Laboratory,
California Institute of
Technology, Pasadena, CA

AWARDS, HONORS AND PROFESSIONAL ACTIVITIES

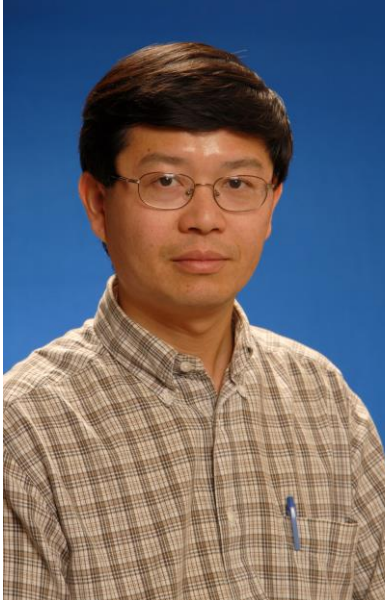
Aron Kressel Award in 2018 from IEEE Photonics Society
Fellow: IEEE, OSA.
Edward Stone Award in 2007 from JPL.
Best Technical Section Paper Award at 22nd Army Science
Conference (Baltimore, 2000)

SELECTED PROJECTS

- NSF, “Quantum Engineered Long-Wavelength Infrared Photodetectors”, 06/01/2012-05/31/2017.
- AFOSR, “Carrier Transport in Semiconductor Quantum Structures”, 02/01/2015-01/31/2018.
- NSF, “Advancement of interband cascade lasers”, 09/01/2016-08/31/2018.
- NSF, “Narrow Bandgap Multi-Stage Structures for Thermophotovoltaics”, 07/01/2016-06/30/2019.
- Department of Energy EPSCoR program, “Interband cascade photovoltaic cells”, 07/01/2010-06/30/2014.
- National Science Foundation (NSF), “Energy-efficient interband cascade lasers”, 06/01/2010-05/30/2013.

SELECTED PUBLICATIONS

- “Resonant tunneling and multiple negative differential conductance features in long wavelength interband cascade infrared photodetectors”, *Appl. Phys. Lett.* **111** (11), 113504, 2017 (with L. Lei, *et al.*)
- “Monolithically integrated mid-IR interband cascade laser and photodetector operating at room temperature,” *Appl. Phys. Lett.* **109**, 151111, 2016 (with H. Lotfi, *et al.*).
- “Long wavelength interband cascade infrared photodetectors operating at high temperatures,” *J. Appl. Phys.* **120**, 193102, 2016 (with L. Lei, *et al.*).
- “High-frequency operation of a mid-infrared interband cascade system at room temperature,” *Appl. Phys. Lett.* **108**, 201101, 2016 (with H. Lotfi, *et al.*).
- “Low-threshold InAs-based interband cascade lasers operating at high temperatures,” *Appl. Phys. Lett.* **106**, 251102, 2015 (with L. Li, *et al.*).
- “Type-I interband cascade lasers near 3.2 μm ”, *Appl. Phys. Lett.*, **106**, 041117, 2015 (with Y. Jiang *et al.*)
- “Theory of multiple-stage interband photovoltaic devices and ultimate performance limit comparison of multiple-stage and single-stage interband infrared detectors”, *J. Appl. Phys.* **114**, 104506, 2013 (with R. T. Hinkey).
- “Narrow-Bandgap Photovoltaic Devices Operating at Room Temperature and Above with High Open-Circuit Voltage”, *Appl. Phys. Lett.* **102**, 211103, 2013 (with H. Lotfi, *et al.*)
- “Interband Cascade (IC) Lasers”, Chap. 12, in *Semiconductor lasers: fundamentals and applications*, edited by A. Baranov and E. Tournie, Woodhead Publishing Limited, Cambridge, UK, 2013.
- “Interband Cascade Photovoltaic Devices for Conversion of Mid-IR Radiation”, *IEEE J. Photovoltaics*, **3**, 745, 2013 (with R. T. Hinkey, *et al.*).
- “Single-waveguide dual-wavelength interband cascade lasers”, *Appl. Phys. Lett.* **101**, 171118, 2012 (with L. Li, *et al.*)
- “InAs-based interband cascade lasers with emission wavelength at 10.4 μm ”, *Electronics Lett.* **48**, 113, 2012 (with Z. Tian, *et al.*).
- “Reflectance spectrum of plasmon waveguide interband cascade lasers and observation of the Berreman effect”, *J. Appl. Phys.* **110**, No. 4, 043113, 2011 (with R. T. Hinkey, *et al.*).
- “Interband cascade infrared photodetectors with superlattice absorbers”, *J. Appl. Phys.* **107**, No. 5, article 054514, 2010 (with Z. Tian, Z. Cai, J. F. Klem, M. B. Johnson, and H. C. Liu).
- “Thermoelectrically cooled interband cascade laser for field measurements”, *Optical Engineering*, **49**, article 111119, 2010 (with L. E. Christensen, K. Mansour).
- “Interband cascade photovoltaic devices”, *Appl. Phys. Lett.* **96**, No. 6, article 063504, 2010 (with Z. Tian, J. F. Klem, T. D. Mishima, M. B. Santos, and M. B. Johnson).
- “Plasmon-Waveguide Interband Cascade Lasers Near 7.5 μm ”, *Photonics Technol. Lett.* **21**, p. 1588, 2009 (with Z. Tian, T. D. Mishima, M. B. Santos, and M. B. Johnson).
- “InAs-based interband cascade lasers near 6 μm ,” *Electronics Letters*, **45**, p. 48, 2009 (with Z. Tian, *et al.*).
- “Distributed feedback mid-infrared interband cascade lasers at thermoelectric cooler temperatures,” *IEEE J. Selected Topics of Quantum Electronics*, **13**, p. 1074, 2007 (with C. J. Hill, *et al.*).
- “Optical gain, loss and transparency current in high performance mid-IR interband cascade lasers”, *J. Appl. Phys.* **101**, article 093104, 2007 (with A. Soibel, K. Mansour, Y. Qiu, C. J. Hill).
- “Mid-IR interband cascade lasers at thermoelectric cooler temperatures”, *Electronics Letters*, **42**, p. 1034, 2006 (with K. Mansour, Y. Qiu, C. J. Hill, A. Soibel).
- “MBE Growth Optimization of Sb-Based Interband Cascade Lasers”, *J. Crystal Growth* **278**, p. 167, 2005 (with C. J. Hill).
- “Novel Concepts and Structures for Infrared Lasers,” Chap. 2, in *Long Wavelength Infrared Emitters Based on Quantum Wells and Superlattices*, edited by M. Helm (Gordon & Breach Pub., Singapore, 2000).



楊瑞青 (YANG, Rui Qing) - 1982 年获得浙江大学物理学学士学位, 1984 年和 1987 年先后获得南京大学物理学硕士和博士学位。1987 年曾与他人共同获得中国国家自然科学奖(四等)。博士毕业后在中国科技大学物理系从事科研工作。1990 年至 1994 年, 在加拿大多伦多大学从事半导体量子结构和器件的研究。其间, 他在世界上首先提出了带间级联激光器这个变革性的概念, 开创中红外半导体激光器研发的新方向, 也从此推动了这个以后被世界上广泛认可的新激光技术的实现, 发展和应用。他 1995 年于美国休斯顿大学任研究科学家, 并担任红外激光器项目领导。1997 年, 升为研究副教授, 并转为器件物理和模拟项目领导。1999 年转到美国陆军研究实验室工作。2000 年担任某公司首席技术总监(CTO), 负责公司的技术研究和开发。2001 年到美国加州理工喷气推进实验室 (JPL) 任资深工程师, 负责中红外半导体激光器的研发工作。

他随后升为主任 (Principal) 工程师和项目经理, 并在 2007 年被授予爱德华·斯通奖 (Edward Stone Award), 以表彰其杰出的研究贡献, 特别是成功地促进带间级联激光器前沿技术在火星探测计划中的应用。他于 2007 年到美国俄克拉荷马大学 (University of Oklahoma) 电子工程系任教授, 主要从事半导体物理和器件的教学和研发。

楊瑞青博士从事跨越凝聚态物理到实际半导体量子器件及应用的研究 30 多年, 是世界公认的带间级联激光器发明人和开创者。他 (或与人合作) 在同行评审的期刊上发表论文 140 余篇, 撰写专著中的二章, 获专利 9 项, 并很多次受邀在学术会议和讲座上发表专题报告。他在半导体量子结构和器件方面的工作有广泛深远的影响, 并获得美国多项研究基金的支持。他目前最具影响力的成就是在带间级联激光器方面的开创性工作和对其随后发展的持续贡献。他发明和领导开发的中红外带间级联激光器, 已被应用到许多重要分子的探测, 并被选用在美国航天署火星探测计划“好奇号”的仪器中, 且成功地在火星上检测到甲烷, 从 2012 年登陆火星到目前仍在工作。带间级联激光器是已被证实唯一能覆盖广泛中红外波段, 且功耗低的半导体激光器, 已经被开发成商业产品, 正在满足越来越多的应用需求。

楊瑞青博士其他方面的成就包括: 发展了量子阱子带间光跃迁的理论, 帮助澄清了该领域相关问题的混乱和争议; 首先提出和发展了带间级联红外探测器及相关的理论, 并在实验上证实它们可以在高速和高温下工作, 深具巨大的潜力和应用的前景; 首先提出和实验证实了带间级联光伏器件, 它们可以有效地将热辐射转换成电, 具有譬如废热回收和自由空间功率输送的应用; 首先在世界上实验验证了带间隧穿二极管电流峰谷比在室温超过 100; 首先提出量子实空间转移机理和实现的方案。他在 2013 年当选国际电子电气工程师学会会士 (IEEE Fellow) 和光学学会会士 (OSA Fellow), 并荣获 IEEE 光电子学会 2018 年度阿伦克雷塞尔奖 (Aron Kressel Award)。