

XING SHENG

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Associate Professor

Department of Electronic Engineering
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Education

- *Ph.D., Materials Science and Engineering, Massachusetts Institute of Technology, 2012*
Thesis advisor: Lionel C. Kimerling
- *B. Eng., Materials Science and Engineering, Tsinghua University, 2007*

Professional Experiences

- *Assistant Professor, Dept. Electronic Engineering, Tsinghua University, 2015–present*
- *Postdoctoral Associate, University of Illinois at Urbana-Champaign, 2012–2015*
Advisor: John A. Rogers

Research Interests

- Non-conventional optoelectronics for biomedical applications
- Silicon, III-V and tandem thin-film solar cells and concentrators
- Photonic integrated circuits
- Inorganic (Si, Ge and III-V) thin-film photonic devices (photodetectors, LEDs, lasers, etc)
- Biocompatible and biodegradable photonics

Awards and Honors

- Young Scientist Award, Progress in Electromagnetics Research Symposium (PIERS), 2018
- Young Scientist Award, Microsystems & Nanoengineering Summit (MINE), 2018
- Best Poster Award (2nd prize) in Nature Conference on Flexible Electronics, Nanjing, 2016
- ‘1000 Plan Program for Young Talents’, Chinese government, 2015
- Gordon Engineering Leadership Teaching Assistantship, MIT, 2011
- Energy Initiative Seed Fund Award, MIT, 2010
- Best Poster Award (runner-up) in the 35th IEEE Photovoltaic Specialists Conference, 2010
- Energy Initiative Martin Fellowship, MIT, 2010
- DuPont-MIT Alliance Fellowship, 2007
- MIT Presidential Fellowship, 2007
- Outstanding Graduates, Tsinghua University, 2007
- DuPont Scholarship, Tsinghua University, 2006
- Samsung Scholarship, Tsinghua University, 2005
- Wuzhande Scholarship, Tsinghua University, 2004
- Freshman Scholarship, Tsinghua University, 2003

Teaching Experience

- Leading Lecturer at Tsinghua
 - 80230992 “Principles of Micro- and Nanofabrication for Electronic and Photonic Devices”
 - 80231001 “Laboratory of Micro- and Nanofabrication for Electronic and Photonic Devices”
 - “Academic Writings and Presentations”
- Worked as a guest lecturer and a teaching assistant for multiple courses at Tsinghua, MIT and UIUC
- Supervised undergraduate and graduate students at MIT, UIUC and Tsinghua

Publications

Peer-Reviewed Journals:

Google Scholar: <https://scholar.google.com/citations?hl=en&user=bS9skH4AAAAJ>

#co-first author, *corresponding author

1. H. Ding#, L. Lu#, Z. Shi, D. Wang, L. Li, X. Li, Y. Ren, C. Liu, D. Cheng, H. Kim, N. C. Giebink, X. Wang, L. Yin, L. Zhao, M. Luo, **X. Sheng***, “Microscale Optoelectronic Infrared-to-Visible Upconversion Devices and Their Use as Injectable Light Sources”, *Proceedings of the National Academy of Sciences USA* **115**, 6632–6637 (2018).
2. C. Liu#, Q. Zhang#, D. Wang, G. Zhao, X. Cai, L. Li, H. Ding, K. Zhang, H. Wang, D. Kong, L. Yin, L. Liu, G. Zou, L. Zhao, **X. Sheng***, “High Performance, Biocompatible Dielectric Thin-Film Optical Filters Integrated with Flexible Substrates and Microscale Optoelectronic Devices”, *Advanced Optical Materials* **6**, 1800146 (2018) (**Back Cover**).
3. R. Fu#, W. Luo#, R. Nazempour#, D. Tan, H. Ding, K. Zhang, L. Yin, J. Guan*, **X. Sheng***, “Implantable and Biodegradable Poly(L-lactic acid) Fibers for Optical Neural Interfaces”, *Advanced Optical Materials* **6**, 1700941 (2018).
4. L. Li#, C. Liu#, Y. Su, J. Bai, J. Wu, Y. Han, Y. Hou, S. Qi, Y. Zhao, H. Ding, Y. Yan, L. Yin, P. Wang, Y. Luo, **X. Sheng***, “Heterogeneous Integration of Microscale GaN Light Emitting Diodes and Their Electrical, Optical and Thermal Characteristics on Flexible Substrates”, *Advanced Materials Technologies* **3**, 1700239 (2018) (**Back Cover**).
5. L. Lu#, P. Gutruf#, L. Xia#, D. Bhatti, X. Wang, A. Vazquez-Guardado, X. Ning, X. Shen, T. Sang, R. Ma, G. Pakeltis, G. Sobczak, H. Zhang, D. Seo, M. Xue, L. Yin, D. Chanda, **X. Sheng***, M. Bruchas*, J. A. Rogers*, “Wireless Optoelectronic Photometers for Monitoring Neuronal Dynamics in the Deep Brain”, *Proceedings of the National Academy of Sciences USA* **115**, E1374–E1383 (2018).
6. L. Lu#, Z. Yang#, K. Meacham, C. Cvetkovic, E. A. Corbin, A. Vazquez-Guardado, M. Xue, L. Yin, J. Boroumand, G. Pakeltis, T. Sang, K. J. Yu, D. Chanda, R. Bashir, R. W. Gereau, **X. Sheng***, J. A. Rogers*, “Biodegradable Monocrystalline Silicon Photovoltaic Microcells as Power Supplies for Transient Biomedical Implants”, *Advanced Energy Materials* **8**, 1703035 (2018).
7. H. Xu#, L. Yin#, C. Liu, **X. Sheng***, N. Zhao*, “Recent Advances in Biointegrated Optoelectronic Devices”, *Advanced Materials* **30**, 1800156 (2018) (**Invited**).
8. Z. Shi, L. Li, Y. Zhao, R. Fu, **X. Sheng***, “Implantable Optoelectronic Devices and Systems for Biomedical Application”, *中国激光 (Chinese Journal of Lasers)* **45**, 0207001 (2018) (In Chinese) (**Invited**) (**Front Cover**).
9. R. Nazempour, Q. Zhang, R. Fu, **X. Sheng***, “Biocompatible and Implantable Optical Fibers and Waveguides for Biomedicine”, *Materials* **11**, 1283 (2018) (**Invited**).

10. X. Huang, D. Wang, Z. Yuan, W. Xie, Y. Wu, R. Li, Y. Zhao, D. Luo, L. Cen, B. Chen, H. Wu, H. Xu, **X. Sheng**, M. Zhang, L. Zhao, L. Yin*, “A Fully Biodegradable Battery for Self-Powered Transient Implants”, *Small* **12**, 1800994 (2018) (*Inside Front Cover*).
11. X. Wang, Y. Ma, **X. Sheng**, Y. Wang*, H. Xu*, “Ultrathin Polypyrrole Nanosheets via Space-Confined Synthesis for Efficient Photothermal Therapy in the Second Near-Infrared Window”, *Nano Letters* **18**, 2217 (2018).
12. R. Li, S. Xie, L. Zhang, L. Li, D. Kong, Q. Wang, R. Xin, **X. Sheng**, L. Yin, C. Yu, Z. Yu, X. Wang*, L. Gao*, “Soft and transient magnesium plasmonics for environmental and biomedical sensing”, *Nano Research* **XX**, XXX (2018).
13. Y. Yao, K. Lee, **X. Sheng**, N. A. Batara, N. Hong, J. He, L. Xu, M. M. Hussain, H. A. Atwater, N. S. Lewis, R. G. Nuzzo*, J. A. Rogers*, “Porous Nanomaterials for Ultra broadband Omnidirectional Anti-Reflection Surfaces with Applications in High Concentration Photovoltaics”, *Advanced Energy Materials* **7**, 1601992 (2017) (*Frontispiece Cover*).
14. H. Araki, J. Kim, S. Zhang, A. Banks, K. E. Crawford, **X. Sheng**, P. Gutruf, Y. Shi, R. M. Pielak, J. A. Rogers*, “Materials and Device Designs for an Epidermal UV Colorimetric Dosimeter with Near Field Communication Capabilities”, *Advanced Functional Materials* **27**, 1604465 (2017) (*Back Cover*).
15. K. Lee, Y. Yao, J. He, B. Fisher, **X. Sheng**, M. Lumb, L. Xu, M. A. Anderson, D. Scheiman, S. Han, Y. Kang, A. Gumus, R. Bahabry, J. W. Lee, U. Paik, N. D. Bronstein, A. P. Alivisatos, M. Meitl, S. Burroughs, M. M. Hussain, J. C. Lee*, R. Nuzzo*, J. A. Rogers*, “Concentrator Photovoltaic Module Architectures With Capabilities for Capture and Conversion of Full Global Solar Radiation”, *Proceedings of the National Academy of Sciences USA*, **113**, E8210–E8218 (2016).
16. J. Kim, G. A. Salvatore*, H. Araki, A. M. Chiarelli, Z. Xie, A. Banks, **X. Sheng**, Y. Liu, J. W. Lee, K. Jang, S. Y. Heo, K. Cho, H. Luo, B. Zimmerman, J. Kim, L. Yan, X. Feng, S. Xu, M. Fabiani, G. Gratton, Y. Huang, U. Paik*, J. A. Rogers*, “Battery-free, Stretchable Optoelectronic Systems for Wireless Optical Characterization of the Skin”, *Science Advances* **2**, e1600418 (2016).
17. Y. Yao, L. Xu, **X. Sheng**, N. D. Bronstein, J. A. Rogers, A. P. Alivisatos, R. G. Nuzzo*, “Full solar spectrum conversion via multi-junction architectures and optical concentration”, in *Roadmap on optical energy conversion*, *Journal of Optics* **18**, 073004 (2016) (*Invited*).
18. X. Guo*, D. Wang, B. Liu, S. Li, **X. Sheng**, “Enhanced light absorption in thin film silicon solar cells with Fourier-series based periodic nanostructures”, *Optics Express* **24**, A408–A413 (2016).
19. **X. Sheng**#, C. Robert#, S. Wang, G. Pakeltis, B. Corbett*, J. A. Rogers*, “Transfer Printing of Fully Formed Thin-Film Microscale GaAs Lasers on Silicon with a Thermally Conductive Interface Material”, *Laser and Photonics Reviews* **9**, L17–L22 (2015) (*Back Cover*).
20. **X. Sheng**, M. H. Yun, C. Zhang, A. M. Al-Okaily, M. Masouraki, L. Shen, S. Wang, W. L. Wilson, J. Y. Kim, P. Ferreira, X. Li, E. Yablonovitch, J. A. Rogers*, “Device Architectures for Enhanced Photon Recycling in Thin-Film Multijunction Solar Cells”, *Advanced Energy Materials* **5**, 1400910 (2015) (*Back Cover*).
21. J. S. Price#, **X. Sheng**#, B. Meulblok, J. A. Rogers*, N. C. Giebink*, “Wide-angle Planar Microtracking for Quasi-static Microcell Concentrating Photovoltaics”, *Nature Communications* **6**, 6223 (2015).
22. J. S. Price, N. C. Giebink, **X. Sheng**, J. A. Rogers, “Putting CPV on Rooftops”, *Compound Semiconductor Magazine* **21**, 44 (2015) (*Invited*).
23. **X. Sheng**#, C. A. Bower#, S. Bonafede, J. W. Wilson, B. Fisher, M. Meitl, H. Yuen, S. Wang, L. Shen, A. R. Banks, C. J. Corcoran, R. G. Nuzzo, S. Burroughs*, J. A. Rogers*, “Printing-based Assembly of Quadruple Junction, Four-terminal Microscale Solar Cells and Their Use in High-efficiency Modules”, *Nature Materials* **13**, 593–598 (2014).
24. **X. Sheng**#, C. Yu#, V. Malyarchuk, Y. Lee, S. Kim, T. Kim, L. Shen, C. Horng, J. Lutz, N. C. Giebink, J. Park, J. A. Rogers*, “Silicon based visible-blind ultraviolet detection and imaging using

- down-shifting luminophores”, *Advanced Optical Materials* **2**, 313 (2014) (*Frontispiece Cover*).
25. **X. Sheng***, L. Z. Broderick, L. C. Kimerling, “Photonic crystal structures for light trapping in thin-film Si solar cells: modeling, process and optimizations”, *Optics Communications* **314**, 41 (2014) (*Invited*).
 26. H. Ning, N. A. Krueger, **X. Sheng**, H. Keum, C. Zhang, K. D. Choquette, X. Li, S. Kim, J. A. Rogers, P. V. Braun*, “Transfer printing of tunable porous silicon microcavities with embedded emitters”, *ACS Photonics* **1**, 1144–1150 (2014).
 27. Y. Shen, Y. Jia, **X. Sheng**, L. Shen, J. A. Rogers, N. C. Giebink*, “Nonimaging optical gain in luminescent concentration through photonic control of emission etendue”, *ACS Photonics* **1**, 746–753 (2014).
 28. Y. Zou, **X. Sheng**, K. Xia, H. Fu, J. Hu*, “Parasitic loss suppression in photonic and plasmonic photovoltaic light trapping structures”, *Optics Express* **22**, A1197–A1202 (2014).
 29. **X. Sheng#**, L. Shen#, T. Kim, L. Li, X. Wang, R. Dowdy, P. Froeter, K. Shigeta, X. Li, R.G. Nuzzo, N. C. Giebink*, J. A. Rogers*, “Doubling the power output of bifacial thin-film GaAs solar cells by embedding them in luminescent waveguides”, *Advanced Energy Materials* **3**, 991–996 (2013) (*Front Cover*).
 30. **X. Sheng#**, C. J. Corcoran#, J. He, L. Shen, S. Kim, J. Park, R. G. Nuzzo*, J. A. Rogers*, “Enhanced ultraviolet responses in thin-film InGaP solar cells by down-shifting”, *Physical Chemistry Chemical Physics* **15**, 20434–20437 (2013).
 31. **X. Sheng***, J. Hu, J. Michel, L. C. Kimerling, “Light trapping limits in plasmonic solar cells: an analytical investigation”, *Optics Express* **20**, A496–A501 (2012).
 32. **X. Sheng***, S. G. Johnson, L. Z. Broderick, J. Michel, L. C. Kimerling, “Integrated photonic structures for light trapping in thin-film Si solar cells”, *Applied Physics Letters* **100**, 111110 (2012).
 33. **X. Sheng**, J. Liu, I. Kozinsky, A. M. Agawal, J. Michel*, L. C. Kimerling, “Design and non-lithographic fabrication of light trapping structures for thin film silicon solar cells”, *Advanced Materials* **23**, 843–847 (2011).
 34. **X. Sheng***, S. G. Johnson, J. Michel, L. C. Kimerling, “Optimization-based design of surface textures for thin-film Si solar cells”, *Optics Express* **19**, A841–A850 (2011).
 35. **X. Sheng***, L. Z. Broderick, J. Hu, L. Yang, A. Eshed, E. A. Fitzgerald, J. Michel, L. C. Kimerling, “Design and fabrication of high-index-contrast self-assembled texture for light extraction enhancement in LEDs”, *Optics Express* **19**, A701–A709 (2011).
 36. **X. Sheng***, J. Liu, N. Coronel, A. M. Agawal, J. Michel, L. C. Kimerling, “Integration of self-assembled porous alumina and distributed bragg reflector for light trapping in Si photovoltaic devices”, *IEEE Photonics Technology Letters* **22**, 1394–1396 (2010).
 37. X. Zhou, Z. Li, Y. Wang, **X. Sheng**, Z. Zhang*, “Photoluminescence of amorphous niobium oxide films synthesized by solid-state reaction”, *Thin Solid Films* **516**, 4213–4216 (2008).
 38. G. Sheng, Z. Li*, **X. Sheng**, Y. Hu, Z. Zhang, “Microcosmic behavior research of palladium membrane irradiated by helium ions”, *原子能科学与技术 (Atomic Energy Science Technology)* **41**, 418 (2007) (in Chinese).
 39. Y. Wang, Z. Li, **X. Sheng**, Z. Zhang*, “Synthesis and optical properties of V₂O₅ nanorods”, *Journal of Chemical Physics* **126**, 164701 (2007).

Book Chapters:

1. H. Ding, **X. Sheng**, “Thin-Film III-V Single Junction and Multijunction Solar Cells and Their Integration onto Heterogeneous Substrates”, in *Inorganic Flexible Optoelectronics: Materials and Applications* ed. by Z. Ma and D. Liu, Wiley-VCH (2018).

2. **X. Sheng**, S. Wang, L. Yin, “Flexible, Stretchable and Biodegradable Thin-Film Silicon Photovoltaics”, in *Advances in Silicon Solar Cells* ed. by S. J. Ikhmayies, Springer-Verlag (2018).
3. L. Yin, **X. Sheng**, “Nonconventional Biosensors Based on Nanomembrane Materials”, in *Nanobiomaterials: Classification, Fabrication and Biomedical Applications* ed. by X. Wang, M. Ramalingam, X. Kong and L. Zhao, Wiley-VCH (2018).
4. **X. Sheng**, *Thin-film Silicon Solar Cells: Photonic Design, Process and Fundamentals*, LAMBERT Academic Publishing (2012).

Patents:

1. **X. Sheng**, H. Ding, Z. Shi, “Optoelectronic Upconversion Devices”, filed PCT/CN2017/113106.
2. J. A. Rogers, **X. Sheng**, C. A. Bower, M. Meitl, S. Burroughs, “Printing-based multi-junction, multi-terminal photovoltaic devices”, US20150207012 / WO2015109242.
3. A. Agarwal, B. Albert, L. Z. Broderick, J. Cheng, J. Hu, L. C. Kimerling, J. Liu, J. Michel, **X. Sheng**, “Methods and apparatus for concentration photovoltaics”, US20140090686 / WO2013056139.
4. **X. Sheng**, J. Liu, J. Michel, A. M. Agarwal, L. C. Kimerling, “Pseudo-periodic structure for use in thin film solar cells”, US20100307579 / WO2010141145.

Invited Talks

2018

- Progress in Electromagnetics Research Symposium (PIERS), Toyama, Japan
- International Symposium on the Physics of Semiconductors and Applications, Jeju, Korea
- Laser Technology and Optoelectronics (LTO) Conference, Shanghai, China
- China Semiconductor Technology International Conference, Shanghai, China

2017

- Conference on Micro/Nano Optical Technology and Application, Suzhou, China
- International Conference on Advanced Fibers and Polymer Materials, Shanghai, China
- School of Electronic Information and Electrical Engineering, Shanghai Jiaotong University, China
- Suzhou Inst. Nanotech. & Nano-bionics, Chinese Academy of Sciences
- China Biomedical Engineering Conference, Beijing, China
- International Conference on Energy, Materials and Photonics, Shenzhen, China
- Wiley Small Science Symposium: Flexible and Wearable Devices, Hong Kong, China
- Laser Technology and Optoelectronics (LTO) Conference, Shanghai, China

2016

- Light, Energy and the Environment Congress, OSA meeting, Leipzig, Germany
- International Conference on Optoelectronics and Microelectronics Technology, Shanghai, China
- Leibniz Institute for Solid State and Materials Research, Dresden, Germany
- School of Electronic Science and Engineering, Nanjing University
- Institute of Microelectronics and Optoelectronics, Zhejiang University

2015

- School of Optoelectronic Information, Univ. Electronic Sci. & Tech. China
- 227th the Electrochemical Society (ECS) meeting, Chicago, IL, USA

- Dept. Electrical Engr., The Pennsylvania State University
- Nano-Electronics & Photonics Seminar, University of Illinois Urbana-Champaign
- Suzhou Inst. Nanotech. & Nano-bionics, Chinese Academy of Sciences
- University of Michigan – Shanghai Jiao Tong University Joint Institute

2014

- School of Engr. & Appl. Sci., Harvard University
- US DOE Energy Frontier Research Center – Light-Material Interactions Annual Meeting, San Francisco, CA, USA
- Dept. Electrical & Computer Engr., University of Wisconsin-Madison
- Dept. Electrical Engr., Tsinghua University

2013

- School of Materials Sci. & Engr., Huazhong Univ. Sci. & Tech.
- Wuhan National Lab of Optoelectronics
- School of Microelectronics and Solid-State Electronics, Univ. Electronic Sci. & Tech. China
- School of Materials Sci. & Engr., Tsinghua University

Services

Internal at Tsinghua:

- *Panelist in postdoc searching committee*
- *Panelist in graduate admission committee*
- *Panelist in undergraduate admission committee*
- *Panelist in graduate thesis committee*
- *Freshmen Mentor*
- *Supervising undergraduate students supported by the Student Research Training (SRT) program*

External:

- *Journal Editor*
 - *Optical Materials Express*, Associate Editor, 2017–present.
- *Conference Organizer*
 - 2019 MRS spring meeting, Phoenix, AZ, USA. Symposium Organizer.
 - 2017 OSA IPR meeting, New Orleans, LA, USA. Subcommittee.
 - 2016 MRS fall meeting, Boston, MA, USA. Symposium Organizer.
 - 2016 MRS spring meeting, Phoenix, AZ, USA. Symposium Organizer.
- *Journal Reviewer*
 - NPG: *Scientific Reports*, *Flexible Electronics*
 - Wiley: *Advanced Materials*, *Advanced Optical Materials*, *Small*, *Progress in Photovoltaics: Research and Applications*, *Physica Status Solidi - Rapid Research Letters*, *Energy Science and Engineering*, *International Journal of Numerical Modeling: Electronic Networks, Devices and Fields*
 - AIP: *Applied Physics Letters*, *Journal of Applied Physics*, *AIP Advances*
 - OSA: *Optics Letters*, *Optics Express*, *Optica*, *Journal of the Optical Society of America B*, *Chinese*

- Optics Letters, Optical Materials Express, Applied Optics*
- IEEE: *Journal of Photovoltaics, Photonics Journal, Photonics Technology Letters*
 - ACS: *ACS Nano, ACS Photonics*
 - Elsevier: *Optics Communications, Optical Materials, Applied Surface Science, Materials Science in Semiconductor Processing, Photonics and Nanostructures - Fundamentals and Applications, Optics and Laser Technology*
 - RSC: *Journal of Materials Chemistry A, Journal of Materials Chemistry C, RSC Advances*
 - Springer: *Journal of Materials Science, Metallurgical and Materials Transactions B, Optimization and Engineering*
 - SPIE: *Optical Engineering*
 - others: *MRS Advances, Journal of Modern Optics, Journal of Visualized Experiments, Frontiers in Materials: Optics and Photonics*
-
- Co-president, MIT Chinese Association of Science and Technology, 2010.
 - Scientific consultant for several high-tech start-up companies.