Dr. Rui Chen
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Curriculum Vitae

Photonic Materials Lab
182 Memorial Dr., Building 13-4152
Cambridge, Massachusetts 02139

- Research expertise in design, fabrication and measurement of photonic integrated circuits, phase change materials, metasurfaces, and silicon photonics
- Experience working with multiple photonic foundries, such as AIM Photonics, AMF, CompoundTek and *Intel 300-mm silicon photonic fab*
- Extensive collaboration with institutions such as MIT, Stanford, Columbia University, UC Davis, and Draper Laboratory
- Authored or co-authored 32 peer-reviewed journal papers (9 first-authored, including two *Nature Communications, Science Advances, npj Nanophotonics, ACS Nano, ACS Photonics*) and 9 conference presentations including two invited talks; >1,500 citations with h-index 17.

EDUCATION

University of Washington (UW) Seattle, WA
Ph.D., Electrical Engineering Sep 2020 – Mar 2025
- Cumulated GPA: 3.94/4.0
- *Thesis: Programmable nano-photonics with electrically controlled phase-change materials*
- Award for Scientific Achievement in Nano-Engineered Systems (UW, 2024)

Columbia University (CU) New York, NY
M.S., Electrical Engineering Aug 2018 - May 2020
- Cumulated GPA: 4.2/4.0, EE MS Honors Program (top 5%)

Zhejiang University (ZJU) Hangzhou, CN
B.Eng., Opto-Electronics Information Science & Engineering Sep 2014 - Jun 2018
- Major GPA: 3.9/4.0, ranking top 10%
- *Thesis: Design of dispersion-free spectrometers using gratings and prisms for spectrum-domain OCT*

RESEARCH EXPERIENCE

Massachusetts Institute of Technology Cambridge, MA
Professor Juejun Hu April 2025 – current

Phase-change material integration in SuMMIT
- Led the world's first **Su**bstrate-inverted **M**ulti-**M**aterial **I**ntegration **T**echnology (SuMMIT), working with CompoundTek (Singapore), NHanced Semiconductor (USA), Optelligent, and Micross
- Built a complete fiber-coupled optical characterization platform for novel grating couplers
- Developed post-fabrication integration workflows for PCMs, BTO, and magneto-optical materials using wafer- and die-level bonding

University of Washington Seattle, WA

Professor Arka Majumdar Jul 2020 – Mar 2025

Broadband non-volatile electrically controlled programmable units

- Developed semi-analytical models for low-loss three-waveguide GST directional couplers
- Fabricated devices in the Washington Nanofabrication Facility using advanced material characterization (ellipsometry, XRD, AFM)
- Built an electro-optical cyclability platform in LabVIEW and demonstrated record endurance of ~2,800 cycles
- Published in ACS Photonics (2022) and Journal of Optical Microsystems (2024)

Low-loss 5-bit non-volatile silicon photonics for in-memory computing

- Conceived, designed, fabricated, and characterized multi-level Sb_2S_3-based phase shifters
- Demonstrated the record high endurance of >1,000 cycles for Sb_2S_3 and low insertion loss < -1.0 dB
- Demonstrated the world-first electrically programmed 5-bit non-volatile photonic memory
- Published in Nature Communications (2022)

Large-scale non-volatile photonic programmable gate array in the Intel 300-mm fab

- Developed full-stack design, integration, and measurement capabilities for backend-of-line PCM-integrated silicon photonics
- Demonstrated the first MZI-mesh-based PICs on a wafer-scale commercial platform
- Published in npj Nanophotonics (2024); Submitted to Science Advances (2025)

Non-volatile phase modulation in individual pixel electrically controllable metasurface

- Fabricated the first 17-pixel electrically addressable PCM metasurface with PCB-based control
- Characterized novel deterministically tunable spectra in near-IR transmissive spectroscopy setup

and beam profiles in a motor-stage beam profilometer setup

- Published in ACS Nano (2024)

Million-Q free-space resonators in near-visible spectrum

- Conceived the idea and developed the first etch-less fabrication process for near-visible spectrum
- Co-developed the first laser scanning momentum-space-resolved spectroscopy and measured the band structure of ultra-high Q resonances
- Pioneered the world highest Q-factor of 1 million in near-visible free-space metasurfaces
- Published in Nature Communications (2024)

Columbia University in the City of New York New York, NY

Professor Keren Bergman Nov 2018 – May 2020

Integrated Photonic Chip Testing & Characterization

- Built an edge-coupling fiber-array platform for electro-optic chip testing
- Characterized polarization-insensitive photonic switch arrays (AIM Photonics) and Hitless-Switch architectures (Elenion Technologies)

- Published in *OFC (2020)*

RESEARCH COLLABORATORS

- **Prof. Eric Pop (Stanford University)**

Low loss phase-change materials for programmable integrated photonics and metasurfaces

- **Prof. P. James Schuck (Columbia University)**

High-speed 3R-MoS_2 EO modulators and ferroelectric devices on silicon photonics

- **Prof. Kenneth E. Goodson (Stanford University)**

Characterization of thermal coefficients of chalcogenide phase change materials

- **Prof. Minho Choi (Ulsan National Institute of Science and Technology)**

Novel metasurfaces for photodetectors with high responsivity

- **Prof. S. J. Ben Yoo (University of California Davis)**

Low-power, 3D integrated optical computing with III-V materials and phase-change materials

- **Prof. Sajjad Moazeni (University of Washington)**

Tunable silicon photonics with phase change materials under cryogenic temperatures

- **Prof. Matthew S. Reynolds (University of Washington)**

Design of printed circuits boards and electronic integrated circuits

- **Prof. Jia Xu Brian Sia (Nanyang Technological University)**

Chip bonding for hybrid integration of BTO

INDUSTRIAL EXPERIENCE

Meta Platforms, Inc. (Meta) Redmond, WA

Prof. Zhujun Shi Jul 2024 – Sep 2024

Intern Research Scientist

- Developed semi-analytical modeling and design frameworks for AR/VR optical components.

PUBLICATIONS

† Equal contributor

Journal publication

Last authored

[1] J. Ye, A. Majumdar, and **R. Chen**, "Statistical analysis and inverse design of programmable photonic integrated circuits using a Python-interfaced simulation framework," *Optics Continuum*, vol. 5, no. 5, pp. 1601–1612, 2026.

First- and Co-First-Authored Publications

[1] **R. Chen**, A. Tang, J. Dutta, V. Tara, J. Ye, Z. Fang, and A. Majumdar, "NEO-PGA: Nonvolatile electro-optically programmable gate array," Science Advances, vol. 12, no. 10, Art. no. eaea9383, 2026.

[2] J. Fang†, **R. Chen**†, D. Sharp†, E. M. Renzi, A. Manna, A. Kala, S. A. Mann, K. Yao, C. Munley, H. Rarick, A. Tang, S. Pumulo, Y. Zheng, V. M. Menon, A. Alù, and A. Majumdar, "Million-Q free-space meta-optical resonator at near-visible wavelengths," Nature Communications, vol. 15, Art. no. 10341, 2024.

[3] Z. Fang†, **R. Chen**†, J. E. Fröch, Q. A. A. Tanguy, A. I. Khan, X. Wu, V. Tara, A. Manna, D. Sharp, C. Munley, F. Miller, Y. Zhao, S. Geiger, K. F. Böhringer, M. S. Reynolds, E. Pop, and A. Majumdar, "Nonvolatile phase-only transmissive spatial light modulator with electrical addressability of individual pixels," ACS Nano, vol. 18, no. 17, pp. 11245–11256, 2024.

[4] **R. Chen**, V. Tara, J. Dutta, Z. Fang, J. Zheng, and A. Majumdar, "Low-loss multilevel operation using lossy phase-change-material-integrated silicon photonics," Journal of Optical Microsystems, vol. 4, no. 3, Art. no. 031202, 2024.

[5] **R. Chen**†, V. Tara†, M. Choi, J. Dutta, J. Sim, J. Ye, Z. Fang, J. Zheng, and A. Majumdar, "Deterministic quasi-continuous tuning of phase-change material integrated on a high-volume 300-mm silicon photonics platform," npj Nanophotonics, vol. 1, Art. no. 7, 2024.

[6] **R. Chen**, V. Tara, A.-W. Singh, A. Saxena, J. E. Fröch, M. S. Reynolds, and A. Majumdar, "A hybrid solution for spatial light modulators with a large space-bandwidth product: Opinion," Optical Materials Express, vol. 13, no. 8, pp. 2416–2421, 2023.

[7] **R. Chen**, Z. Fang, C. Perez, F. Miller, K. Kumari, A. Saxena, J. Zheng, S. J. Geiger, K. E. Goodson, and A. Majumdar, "Non-volatile electrically programmable integrated photonics with a 5-bit operation," Nature Communications, vol. 14, Art. no. 3465, 2023.

[8] **R. Chen**, Z. Fang, F. Miller, H. Rarick, J. E. Fröch, and A. Majumdar, "Opportunities and challenges for large-scale phase-change-material-integrated electro-photonics," ACS Photonics, vol. 9, no. 10, pp. 3181–3195, 2022.

[9] **R. Chen**, Z. Fang, J. E. Fröch, P. Xu, J. Zheng, and A. Majumdar, "Broadband nonvolatile electrically controlled programmable units in silicon photonics," ACS Photonics, vol. 9, no. 6, pp. 2142–2150, 2022.

Other Journal Publications

[1] C.-C. Popescu, M. R. A. Peters, O. Maksimov, H. B. Bhandari, R. Sharma, K. A. Richardson, A. Majumdar, H. J. Kim, **R. Chen**, K. P. Dao, L. Ranno, B. Mills, D. M. Calahan, T. Gu, and J. Hu, "Two-dimensional pixel-level addressable mid-infrared metasurface spatial light modulator," *Nature Communications*, early access, Jul. 7, 2026, doi: 10.1038/s41467-026-75346-5.

[2] J. Dutta, A. Tang, B. Mills, **R. Chen**, A. Manna, G. N. SJ, V. Tara, D. Callahan, C. C. Popescu, J. Hu, and A. Majumdar, "Increased endurance of nonvolatile photonics enabled by nanostructured phase-change materials," *Advanced Materials*, vol. 38, no. 31, Art. no. e22895, 2026.

[3] Z. Xu, J. F. Lim, **R. Chen**, K. P. Dao, B. Neltner, D. Bono, M. Polking, and J. Hu, "Fast-track process development: Using semiconductor platforms to accelerate semiconductor progress [Invited]: Opinion," *Optical Materials Express*, vol. 16, no. 4, pp. 793–802, 2026.

[4] V. Tara, R. Audhkhasi, A. Tang, **R. Chen**, J. E. Fröch, A. Kala, J. Hu, and A. Majumdar, "Electrically reconfigurable nonvolatile transmissive metasurface in the visible," *Advanced Optical Materials*, vol. 14, no. 11, Art. no. e71094, 2026.

[5] J. Fang, A. Kala, R. Johnson, D. Sharp, **R. Chen**, C. Chang, C. Munley, J. E. Fröch, N. Varnakavi, A. Tang, A. Manna, V. Tara, B. Datta, Z. Zhou, D. S. Ginger, V. M. Menon, L. Y. Lin, and A. Majumdar, "Free-space few-photon nonlinearity in critically coupled polaritonic metasurfaces," *Nature Communications*, vol. 16, Art. no. 10099, 2025.

[6] U. Adya, S. Singhal, **R. Chen**, I.-T. Chen, S. Joshi, A. Majumdar, M. Li, and S. Moazeni, "Non-volatile tuning of cryogenic silicon photonic microring modulators," *Nature Communications*, vol. 16, Art. no. 9290, 2025.

[7] R. Audhkhasi, V. Tara, M. Klein, A. Tang, **R. Chen**, S. Vangala, J. R. Hendrickson, and A. Majumdar, "Electrically reconfigurable nonvolatile flatband absorbers in the mid-infrared with wide spectral tuning range," *Nano Letters*, vol. 25, no. 36, pp. 13533–13538, 2025.

[8] K. Xiao, V. Tara, P. D. Reddy, J. E. Meyer, A. M. Skipper, **R. Chen**, L. J. Nordin, A. Majumdar, and K. Mukherjee, "Heteroepitaxial growth of highly anisotropic Sb_2Se_3 films on GaAs," *Materials Horizons*, vol. 12, no. 15, pp. 5829–5838, 2025.

[9] J. Dutta, A. Ferraro, A. Manna, **R. Chen**, A. Pane, G. E. Lio, R. Caputo, and A. Majumdar, "Near-visible low-power tuning of nematic-liquid-crystal-integrated silicon nitride ring resonator," *ACS Photonics*, vol. 12, no. 9, pp. 4967–4980, 2025.

[10] J. Dutta, **R. Chen**, V. Tara, and A. Majumdar, "Low-power quasi-continuous hybrid volatile/nonvolatile tuning of ring resonators," *APL Photonics*, vol. 10, no. 2, Art. no. 020803, 2025.

[11] V. Tara, **R. Chen**, J. E. Fröch, Z. Fang, J. Fang, R. Audhkhasi, M. Choi, and A. Majumdar, "Non-volatile reconfigurable transmissive notch filter using wide-bandgap phase-change material antimony sulfide," *IEEE Journal of Selected Topics in Quantum Electronics*, vol. 30, no. 4, Art. no. 4700108, 2024.

[12] U. Adya, D. Sturm, **R. Chen**, C. Wu, A. Majumdar, M. Li, and S. Moazeni, "Post-processing of phase-change material in a zero-change commercial silicon photonic process," *Optics Express*, vol. 32, no. 16, pp. 27552–27562, 2024.

[13] D. Sharp, C. Flower, M. J. Mehrabad, A. Manna, H. Rarick, **R. Chen**, M. Hafezi, and A. Majumdar, "Near-visible topological edge states in a silicon nitride platform," *Optical Materials Express*, vol. 14, no. 6, pp. 1596–1602, 2024.

[14] F. Miller, **R. Chen**, J. E. Fröch, Z. Fang, V. Tara, S. Geiger, and A. Majumdar, "Rewritable photonic integrated circuit canvas based on low-loss phase-change material and nanosecond pulsed lasers," *Nano Letters*, vol. 24, no. 23, pp. 6844–6849, 2024.

[15] M. Choi, C. Munley, J. E. Fröch, **R. Chen**, and A. Majumdar, "Nonlocal, flat-band meta-optics for monolithic, high-efficiency, compact photodetectors," *Nano Letters*, vol. 24, no. 10, pp. 3150–3156, 2024.

[16] Z. Fang†, B. Mills†, **R. Chen**, J. Zhang, P. Xu, J. Hu, and A. Majumdar, "Arbitrary programming of racetrack resonators using low-loss phase-change material Sb_2Se_3," *Nano Letters*, vol. 24, no. 1, pp. 97–103, 2024.

[17] Z. Fang, **R. Chen**, V. Tara, and A. Majumdar, "Non-volatile phase-change materials for programmable photonics," *Science Bulletin*, vol. 68, no. 8, pp. 783–786, 2023.

[18] F. Miller, **R. Chen**, J. E. Fröch, H. Rarick, S. Geiger, and A. Majumdar, "Rewritable photonic integrated circuits using dielectric-assisted phase-change material waveguides," *Optics Letters*, vol. 48, no. 9, pp. 2385–2388, 2023.

[19] P. Prabhathan, K. V. Sreekanth, J. Teng, J. H. Ko, Y. J. Yoo, H.-H. Jeong, Y. Lee, S. Zhang, T. Cao, C.-C. Popescu, B. Mills, T. Gu, Z. Fang, **R. Chen**, H. Tong, Y. Wang, Q. He, Y. Lu, Z. Liu, H. Yu, A. Mandal, Y. Cui, A. S. Ansari, V. Bhingardive, M. Kang, C. K. Lai, M. Merklein, M. J. Müller, Y. M. Song, Z. Tian, J. Hu, M. Losurdo, A. Majumdar, X. Miao, X. Chen, B. Gholipour, K. A. Richardson, B. J. Eggleton, M. Wuttig, and R. Singh, "Roadmap for phase-change materials in photonics and beyond," *iScience*, vol. 26, no. 10, Art. no. 107946, 2023.

[20] Z. Fang, **R. Chen**, B. Tossoun, S. Cheung, D. Liang, and A. Majumdar, "Non-volatile materials for programmable photonics," *APL Materials*, vol. 11, no. 10, Art. no. 100603, 2023.

[21] Z. Fang, **R. Chen**, J. Zheng, A. I. Khan, K. M. Neilson, S. J. Geiger, D. M. Callahan, M. G. Moebius, A. Saxena, M. E. Chen, C. Rios, J. Hu, E. Pop, and A. Majumdar, "Ultra-low-energy programmable non-volatile

silicon photonics based on phase-change materials with graphene heaters," *Nature Nanotechnology*, vol. 17, no. 8, pp. 842–848, 2022.

[22] Z. Fang, **R. Chen**, J. Zheng, and A. Majumdar, "Non-volatile reconfigurable silicon photonics based on phase-change materials," *IEEE Journal of Selected Topics in Quantum Electronics*, vol. 28, no. 3, Art. no. 8200317, 2022.

[23] Z. Fang, **R. Chen**, A. Ryou, and A. Majumdar, "1D self-healing beams in integrated silicon photonics," *ACS Photonics*, vol. 8, no. 7, pp. 2139–2147, 2021.

Conference Publications (presented orally)

[1] (Invited) **R. Chen**, V. Tara, M. Choi, J. Duta, J. Sim, J. Ye, J. Zheng, Z. Fang, and A. Majumdar, "Toward very-large-scale nonvolatile electrically programmable photonic integrated circuits with deterministic multilevel operation," in *CLEO 2024*, Optica Publishing Group, paper AM1J.5, 2024.

[2] (Invited) **R. Chen**, V. Tara, J. Duta, M. Choi, J. Sim, J. Ye, J. Zheng, Z. Fang, and A. Majumdar, "Toward large-scale nonvolatile electrical programmable photonics with deterministic multilevel operation," in *Optical Fiber Communication Conference (OFC) 2024*, Optica Publishing Group, paper M4A.4, 2024.

[3] **R. Chen**, Z. Fang, J. Zheng, J. E. Fröch, and A. Majumdar, "Nonvolatile electrically controllable broadband switches based on phase-change material GST," in *Conference on Lasers and Electro-Optics (CLEO) 2022*, Optica Publishing Group, paper SF2N.1, 2022.

[4] **R. Chen**, Z. Fang, J. Zheng, and A. Majumdar, "Quasi-continuously tunable non-volatile photonic switches," in *Proc. SPIE Active Photonic Platforms 2022*, vol. 12196, Art. no. 1219607, 2022.

[5] **R. Chen**, Z. Fang, F. Miller, K. Kumari, A. Saxena, and A. Majumdar, "Electrically programmable wide-bandgap phase-change material Sb_2S_3 enabling multilevel non-volatile photonics," in *Frontiers in Optics + Laser Science 2022*, Optica Publishing Group, paper FTu6C.1, 2022.

[6] **R. Chen**, V. Tara, A. Tang, J. Ye, and A. Majumdar, "Nonvolatile programmable Mach–Zehnder meshes," in *Proc. SPIE Active Photonic Platforms 2025*, vol. PC13578, Art. no. PC135780V, 2025.

[7] (Invited) A. Majumdar and **R. Chen**, "Tunable free-space optics via phase-change materials," in *Proc. SPIE Active Photonic Platforms 2025*, vol. PC13578, Art. no. PC1357812, 2025.

[8] **R. Chen**, A. Tang, Z. Chen, Z. Fang, B. Mills, J. Fang, Y. Zheng, J. Hu, and A. Majumdar, "Million-event, single-pulse arbitrary access of PCM-silicon photonic devices," in *Proc. SPIE Active Photonic Platforms 2025*, vol. PC13578, Art. no. PC135780U, 2025.

[9] Z. Fang†, **R. Chen**†, J. E. Fröch, Q. A. A. Tanguy, A. I. Khan, X. Wu, V. Tara, A. Manna, D. Sharp, C. Munley, Y. Zhao, K. F. Böhringer, M. S. Reynolds, E. Pop, and A. Majumdar, "Nonvolatile transmissive metasurface with phase-only modulation," in *Frontiers in Optics + Laser Science 2023*, Optica Publishing Group, paper LTh3F.3, 2023.

ACADEMIC EXPERIENCE

Mentored over 10 undergraduate or master's students in design, fabrication, and experimental photonics, resulting in co-authorships in *Optics Letters*, *Nano Letters*, *ACS Nano*, *npj Nanophotonics* and conferences such as *CLEO*

Serving as a **reviewer** for > 50 papers across multiple scientific journals, including *Microsystems & Nanoengineering, Advanced Materials, Advanced Functional Materials, Advanced Optical Materials, Laser & Photonics Reviews, Nano Letters, Nanophotonics, ACS Photonics, New Journal of Physics, Optics Express, Optics Letters, Journal of Optics, Journal of Lightwave Technology, Optical Materials Express, Applied Optics, Journal of Nanophotonics, Photonics Technology Letters, Infrared Physics and Technology, Advanced Physics Research*.

Member of Optica and SPIE

Presided in CLEO (2023) and FiO (2023)

Postdoctoral Research Associate — April 2025 – current
Massachusetts Institute of Technology, Prof. Juejun Hu — Cambridge, MA

Teaching Assistant, EE 535 Applied Nanophotonics — Mar 2022 – Jun 2022
University of Washington, Prof. Arka Majumdar — Seattle, WA

Teaching Assistant, EE 299 Intro to Nanotechnology — Jan 2022 – Mar 2022
University of Washington, Prof. Arka Majumdar — Seattle, WA

Teaching Assistant, EE 331 Devices and Circuits — Mar 2021 – Jun 2021
University of Washington, Prof. Tai Chen — Seattle, WA

Teaching Assistant, EE 233 Circuit Theory — Jan 2021 – Mar 2021
University of Washington, Prof. Scott Dunham — Seattle, WA

Teaching Assistant, EE 332 Devices and Circuits — Sep 2020 – Dec 2020
University of Washington, Prof. Sajjad Moazeni — Seattle, WA

Teaching Assistant, ELEN 4944 Principles of Microfabrication — Aug 2019 – Dec 2019
Columbia University, Prof. Jacob Trevino — New York, NY

Course Assistant, ELEN 3401 Electromagnetics — Feb 2020 – Jun 2020
Columbia University, Prof. Keren Bergman — New York, NY