

# Zafer Mutlu

Assistant Professor, Department of Materials Science and Engineering  
University of Arizona, Tucson, Arizona

zmutlu@arizona.edu  
zafermutlu.arizona.edu  
Google Scholar | ORCID | LinkedIn

**Research focus.** Atomically precise graphene nanoribbons for transistors and sensors, quantum materials, surface acoustic wave devices for wireless communication, and hands-on semiconductor education. Our work spans materials synthesis, device fabrication, and chip-scale integration.

## EDUCATION

- **University of California, Riverside** Riverside, CA  
*Ph.D. in Materials Science and Engineering* 2016  
Thesis: *Crystal Growth and Phase Engineering of Two-Dimensional Metal Chalcogenides*  
Advisor: Prof. Cengiz S. Ozkan
- **Selcuk University** Konya, Turkey  
*M.S. in Physics* 2009  
Thesis: *Fabrication and Characterization of YBCO Superconducting Thin Film on Si Substrates*  
*B.S. in Physics Education* 2007

## APPOINTMENTS

- **University of Arizona** Tucson, AZ  
Assistant Professor, Materials Science and Engineering 2022 – present  
Joint Assistant Professor (by courtesy), Physics 2024 – present  
Joint Assistant Professor (by courtesy), Electrical, Computing and Software Engineering 2024 – present  
Co-Director, *Future Advanced Semiconductor Technology Laboratory (FASTLab)* 2024 – present
- **University of California, Berkeley** Berkeley, CA  
Postdoctoral Scholar, Electrical Engineering and Computer Sciences 2018 – 2022  
Affiliate, Molecular Foundry, Lawrence Berkeley National Laboratory 2018 – 2022
- **University of California, Riverside** Riverside, CA  
Assistant Project Scientist, Electrical and Computer Engineering 2017 – 2018  
Postdoctoral Scholar, Mechanical Engineering 2016 – 2017

## SELECTED HONORS AND AWARDS

- **Peterson Family Outstanding Early Career Faculty Award**, College of Engineering, University of Arizona 2025
- **Craig M. Berge Faculty Fellow**, College of Engineering, University of Arizona 2024 – 2027
- **Center for Semiconductor Manufacturing Fellow** (selected twice), University of Arizona 2024, 2025
- **Excellence at the Student Interface Award, Most Supportive Junior Faculty**, Materials Science and Engineering, University of Arizona 2024
- **George H. Davis Travel Fellowship**, University of Arizona Foundation 2023
- **Journal cover and feature recognitions:** *ACS Applied Materials & Interfaces* Supplementary Front Cover (2026), *Applied Physics Reviews* Featured Article (2023), *Small* Front Cover (2022), *Advanced Functional Materials* Frontispiece (2021), *Physica Status Solidi A* Front Cover (2014)
- **Full Ph.D. Scholarship**, Turkish Ministry of National Education 2011

## RESEARCH SUPPORT

To date, I have brought approximately **\$3.7M** to my research program, including \$3.4M from external awards and \$0.3M from internal awards. Our research and education programs are supported by the National Science Foundation, the Department of Defense (Office of Naval Research and the Microelectronics Commons), the Department of Energy user facilities (Molecular Foundry and Center for Integrated Nanotechnologies), the Semiconductor Research Corporation, Intel, Google.org and Google Quantum AI, Freeport-McMoRan, and the State of Arizona Technology and Research Initiative Fund.

## PUBLICATIONS

41 peer-reviewed journal articles and 7 full conference papers. Over 1,700 citations and an h-index of 22 on Google Scholar. † denotes corresponding author. A full list is available on the lab website.

### Selected Journal Articles

1. K. Yumigeta, M. Yusufoglu, J. G. Federice, E. T. Hughes, A. M. Degirmenci, J. T. Njardarson, K. Simmons-Potter, B. G. Potter, and Z. Mutlu<sup>†</sup>, Electrical and Structural Response of Nine-Atom-Wide Armchair Graphene Nanoribbon Transistors to Gamma Irradiation, *ACS Applied Materials & Interfaces*, 2026. **Supplementary Front Cover** <https://doi.org/10.1021/acsami.6c02516>
2. K. Yumigeta, M. Yusufoglu, M. Sarker, R. Raj, F. Daluisio, R. Holloway, H. Yawit, T. Sweepe, J. Battaglia, S. Janssen, A. C. Welch, P. DiPasquale, K. A. Mkhoyan, A. Sinitskii, and Z. Mutlu<sup>†</sup>, Scalable Etch-Free Transfer of Low-Dimensional Materials from Metal Films to Diverse Substrates, *Advanced Materials Interfaces*, 2026. <https://doi.org/10.1002/admi.202500630>
3. F. Najmi, H. Yawit, W. Takeda, A. Basu, S. Biswas, Z. Mutlu, P. Lucas, K. Muralidharan, A. Alù, K. Runge, and P. A. Deymier, Composite Superlattice Radio-Frequency Surface-Acoustic-Wave Devices, *Physical Review Applied*, 2026. <https://doi.org/10.1103/p8q7-r6ck>
4. P. Jacobse, M. Pizzochero, E. Wen, G. B. Barin, X. Li, Z. Mutlu, K. Müllen, E. Kaxiras, M. Crommie, and F. Fischer, Coupling of Nondegenerate Topological Modes in Nitrogen Core-Doped Graphene Nanoribbons, *ACS Nano*, 2025. <https://doi.org/10.1021/acsnano.4c17602>
5. C. Dinh, M. Yusufoglu, K. Yumigeta, A. Kinikar, T. Sweepe, Z. Zesztut, Y.-J. Chang, C. Copic, S. Janssen, R. Holloway, J. Battaglia, A. Kuntubek, F. Zahin, Y. C. Lin, W. G. Vandenberghe, B. J. LeRoy, K. Müllen, R. Fasel, G. B. Barin, and Z. Mutlu<sup>†</sup>, Atomically Precise Graphene Nanoribbon Transistors with Long-Term Stability and Reliability, *ACS Nano*, 2024. <https://doi.org/10.1021/acsnano.4c04097>
6. Z. Mutlu<sup>†</sup>, C. Dinh, G. B. Barin, P. H. Jacobse, A. Kumar, D. Polley, H. Singh, Z. Wang, Y. C. Lin, A. Schwartzberg, M. F. Crommie, K. Müllen, P. Ruffieux, R. Fasel, and J. Bokor, Contact Engineering for Graphene Nanoribbon Devices, *Applied Physics Reviews*, 2023. **Featured Article** <https://doi.org/10.1063/5.0172432>
7. Y. Lin, Z. Mutlu, G. B. Barin, Y. Hong, J. P. Llinas, A. Narita, H. Singh, K. Müllen, P. Ruffieux, R. Fasel, and J. Bokor, Scaling and Statistics of Bottom-Up Synthesized Armchair Graphene Nanoribbon Transistors, *Carbon*, 2023. <https://doi.org/10.1016/j.carbon.2023.01.054>
8. G. B. Barin, Q. Sun, M. Di Giovannantonio, C.-Z. Du, X.-Y. Wang, J. P. Llinas, Z. Mutlu, Y. Lin, *et al.*, J. Bokor, R. Fasel, and P. Ruffieux, Growth Optimization and Device Integration of Narrow-Bandgap Graphene Nanoribbons, *Small*, 2022. **Front Cover** <https://doi.org/10.1002/smll.202202301>
9. Z. Mutlu, P. H. Jacobse, R. D. McCurdy, J. P. Llinas, Y. Lin, G. C. Veber, F. R. Fischer, M. F. Crommie, and J. Bokor, Bottom-Up Synthesized Nanoporous Graphene Transistors, *Advanced Functional Materials*, 2021. **Frontispiece** <https://doi.org/10.1002/adfm.202103798>
10. R. McCurdy, P. Jacobse, I. Piskun, G. Veber, D. Rizzo, R. Zuzak, Z. Mutlu, J. Bokor, M. Crommie, and F. Fischer, Synergetic Bottom-Up Synthesis of Graphene Nanoribbons by Matrix-Assisted Direct Transfer, *Journal of the American Chemical Society*, 2021. <https://doi.org/10.1021/jacs.1c01355>

11. Z. Mutlu, J. P. Llinas, P. H. Jacobse, I. Piskun, R. Blackwell, M. F. Crommie, F. R. Fischer, and J. Bokor, Transfer-Free Synthesis of Atomically Precise Graphene Nanoribbons on Insulating Substrates, *ACS Nano*, 2021. <https://doi.org/10.1021/acsnano.0c07591>
12. Z. Mutlu, R. J. Wu, D. Wickramaratne, S. Shahrezaei, C. Liu, S. Temiz, A. Patalano, M. Ozkan, R. K. Lake, K. A. Mkhoyan, and C. S. Ozkan, Phase Engineering of 2D Tin Sulfides, *Small*, 2016. <https://doi.org/10.1002/sml.201600559>
13. A. Pant\*, Z. Mutlu\*, D. Wickramaratne, H. Cai, R. K. Lake, C. S. Ozkan, and S. Tongay, Fundamentals of Lateral and Vertical Heterojunctions of Atomically Thin Materials, *Nanoscale*, 2016. (\*Equal contribution.) <https://doi.org/10.1039/C5NR08982D>
14. A. S. George, Z. Mutlu, R. Ionescu, R. J. Wu, J. S. Jeong, H. H. Bay, Y. Chai, K. A. Mkhoyan, M. Ozkan, and C. S. Ozkan, Wafer Scale Synthesis and High-Resolution Structural Characterization of Atomically Thin MoS<sub>2</sub> Layers, *Advanced Functional Materials*, 2014. <https://doi.org/10.1002/adfm.201402519>
15. Z. Favors, W. Wang, H. H. Bay, Z. Mutlu, K. Ahmed, C. Liu, M. Ozkan, and C. S. Ozkan, Scalable Synthesis of Nano-Silicon from Beach Sand for Long Cycle Life Li-Ion Batteries, *Scientific Reports*, 2014. <https://doi.org/10.1038/srep05623>

### ***Selected Conference Papers***

16. Z. Mutlu<sup>†</sup>, Y. Lin, G. B. Barin, Z. Zhang, G. Pitner, S. Wang, R. Darawish, M. Di Giovannantonio, H. Wang, J. Cai, M. Passlack, C. H. Diaz, A. Narita, K. Müllen, F. R. Fischer, P. Bandaru, A. C. Kummel, P. Ruffieux, R. Fasel, and J. Bokor, Short-Channel Double-Gate FETs with Atomically Precise Graphene Nanoribbons, *IEEE International Electron Devices Meeting (IEDM)*, 2021. <https://doi.org/10.1109/IEDM19574.2021.9720620>
17. Z. Mutlu<sup>†</sup> and J. Bokor, Bottom-Up Synthesized Graphene Nanoribbon Transistors, *IEEE Electron Devices Technology and Manufacturing Conference (EDTM)*, 2022. <https://doi.org/10.1109/EDTM53872.2022.9798025>

### ***Patents and Patent Applications***

18. B. G. Potter, Z. Mutlu, K. Simmons-Potter, K. Yumigeta, M. Yusufoglu, and J. T. Njardarson, Integrable, Nanoelectronic Neutron Detectors Based on Graphene Nanoribbons and Associated Chemical and Structural Derivatives, patent application filed, University of Arizona. [Tech Launch Arizona listing](#)
19. P. Deymier, F. Najmi, K. Runge, Z. Mutlu, K. Muralidharan, P. Lucas, H. Yawit, and A. Alù, Systems and Methods for Topological Acoustics Based Radio Frequency Surface Acoustic Wave Devices, PCT application filed 2026, University of Arizona. [Tech Launch Arizona listing](#)
20. Z. Mutlu, K. Yumigeta, and M. Yusufoglu, Wafer-Scale Synthesis and Deposition of One-Dimensional Materials with Precisely Controlled Intervals on Thermally Treated Substrates, patent application filed, University of Arizona. [Tech Launch Arizona listing](#)
21. F. R. Fischer, J. Bokor, Z. Mutlu, J. P. Llinas, R. D. McCurdy, G. C. Veber, and D. Joshi Koenigs, Low Band Gap Graphene Nanoribbon Electronic Devices, U.S. Patent Application Publication US 2022/0282029 A1, 2022 (UC Berkeley). [Google Patents](#)
22. M. F. Crommie, F. R. Fischer, J. Bokor, P. H. Jacobse, Z. Mutlu, R. D. McCurdy, G. C. Veber, and D. J. Rizzo, Matrix Assisted Direct Transfer, International Patent Application Publication WO 2022/211916 A2, 2022 (UC Berkeley). [Google Patents](#)

## SELECTED INVITED TALKS

More than 160 presentations, including 23 invited talks at conferences, universities, national laboratories, and industry.

1. “From Molecules to Logic: Atomically Precise Graphene Nanoribbon Transistors,” *Lawrence Symposium on Epitaxy*, Tempe, AZ, 2025.
2. “Atomically Precise Graphene Nanoribbons as Next-Generation Channel Materials for Transistor Scaling Beyond Silicon Limits,” *IEEE Workshop on Microelectronic and Electron Devices (WMED)*, Boise, ID, 2025.
3. “Graphene Nanoribbon-Based Field-Effect Transistors for High-Performance Logic Technology,” *MRS Fall Meeting*, Boston, MA, 2023.
4. “Bottom-Up Synthesized Graphene Nanoribbon Transistors,” *IEEE Electron Devices Technology and Manufacturing Conference (EDTM)*, Oita, Japan, 2022.
5. “Nanoelectronics and the Future of Semiconductors with Atomically Precise Graphene Nanoribbons,” *Arizona Quantum Bootcamp* (UA, NAU, ASU), Tucson, AZ, 2026.
6. “Graphene Nanoribbon Transistors: Making Electronics from Molecules,” Chemical and Environmental Engineering Seminar, University of Arizona, 2026.
7. “High-Performance Graphene Nanoribbon Field-Effect Transistors,” Materials Science and Engineering Colloquium, University of Texas at Dallas, 2024.
8. “Graphene Nanoribbon-Based Field-Effect Transistors for High-Performance Logic Technology,” Electrical and Computer Engineering Seminar, University of Arizona, 2023.
9. “Graphene Nanoribbons for Transistors,” Physics Colloquium, University of Arizona, 2023.
10. Industry research talks on graphene nanoribbon transistors at Intel Components Research (2021, 2023) and TSMC Corporate Research (2021).

## SELECTED MEDIA

1. **KUAZ 89.1 (NPR) / Arizona Public Media, Arizona Science** (2026). “Exploring Advanced Nanoelectronics.” Radio interview on graphene nanoribbon electronics for fusion energy and space systems.
2. **University of Arizona News** (2026). “Quantum materials discovery could advance electronics for extreme environments.” The study on graphene nanoribbon transistors under gamma irradiation was reported by more than 20 outlets, including Phys.org, AAAS EurekAlert!, Nuclear Newswire (American Nuclear Society), Interesting Engineering, Design News, Nanowerk, The Quantum Insider, and Graphene-Info.
3. **UA Materials Science and Engineering News** (2026). “Study finds graphene nanoribbons survive extreme radiation.”
4. **Google Quantum AI Blog** (2026). Announcement of the REPLIQA program naming the University of Arizona among five participating institutions, with University of Arizona coverage. Our group develops graphene nanoribbon-based sensors for molecular sensing within the UA team.
5. **University of Arizona News** (2026). Core Facilities Highlights: Nano Fabrication Center, featuring hands-on semiconductor process training.
6. **BizTucson Magazine** (2025). “From FASTLab to Fusion.” Feature on the Future Advanced Semiconductor Technology Lab.
7. **UA College of Engineering News** (2025). “Semiconductor Prototype Stands Out at Winter Design Day 2025,” on the SEMILITHO capstone project.
8. **University of Arizona News** (2024). “National Leaders Gather at UArizona to Map Future of Semiconductors,” on the FUSENANO 2024 Workshop.

9. **Semiconductor Engineering** (2023). Technical-paper feature on contact engineering for graphene nanoribbon devices.

## TEACHING AND MENTORING

### *Courses Taught at the University of Arizona*

- Semiconductor Processing (MSE/ECE 446/546), in person and online 2023 – present
- Semiconductor Processing Lab (MSE 447L/547L), cleanroom-based 2024 – present
- Solid State Chemistry (MSE 110) 2024 – present

Nine course offerings to date, with nearly 400 students.

### *Course and Educational Materials Development*

- Built the online version of Semiconductor Processing, now offered through Arizona Online, and redesigned the lecture course with modules on modern transistor architectures and metrology.
- Rebuilt the Semiconductor Processing Lab around the core unit operations of device fabrication, with an integrated course-based undergraduate research experience. An online version using simulations and AR/VR launches in 2027.
- Developed open educational resources, including a cleanroom virtual reality tour, an interactive cleanroom map, an interactive cleanroom video, a photolithography simulation, an interactive semiconductor processing course, and a public semiconductor processing video series.

### *Mentoring*

- Since 2022, mentored postdoctoral researchers, graduate students, and more than 20 undergraduate researchers. Group alumni have joined leading semiconductor and technology companies.
- Founded the RISE Arizona undergraduate research initiative, established the ANNLab Vertically Integrated Projects program, and launched the University of Arizona's first Intel-sponsored SRC Undergraduate Research Program.
- Host mentor for the NSF New Frontiers of Sound Research Experience and Mentoring program. Earlier mentor in the NSF Transfer-to-Excellence REU program (UC Berkeley) and the NSF Materials Connection REU program (UC Riverside).
- Faculty sponsor of the SEMILITHO semiconductor lithography capstone project, winner of the Craig M. Berge Dean's Award for Most Outstanding Project (2025).
- Served on more than a dozen graduate examination and defense committees.

## SELECTED PROFESSIONAL SERVICE

### *Leadership and Organization*

- **Lead Organizer**, Symposium on Translating 1D and 2D Materials into Technology: Synthesis, Interfaces, and Reliability, MRS Fall Meeting, Boston, MA 2027
- **General Chair**, FUSENANO National Workshop, Molecules to Systems: The Future of Semiconductors with 1D & 2D Nanomaterials, Tucson, AZ. About 150 participants, with leaders from SRC, IMEC, Intel, TSMC, AMD, Lam Research, NIST, and NSF. Proceedings released publicly on YouTube. Workshop website 2024
- **Session Chair**, MRS Fall Meeting (2023) and MRS Spring Meeting (2018)
- **Panelist and Judge**, Southwest Advanced Prototyping (SWAP) Hub events 2025 – 2026

### **Editorial and Review Service**

- **Member**, Early Career Editorial Board, *Graphene and 2D Materials* (Springer Nature) 2026 – present
- **Journal reviewer** for more than 30 journals, including *Nature*, *Nature Communications*, *ACS Nano*, *Nano Letters*, *Advanced Functional Materials*, *Advanced Science*, *Small*, and *Carbon*
- **Proposal reviewer** for the National Science Foundation and the Swiss National Science Foundation, among others

### **National Committees**

- **Contributing Author**, Semiconductor Research Corporation *Microelectronics and Advanced Packaging Technologies (MAPT) Roadmap 2.0*, chapters on *Digital Processing* and *Workforce Development* 2025
- **Member**, Semiconductor Research Corporation Workforce Advisory Board 2023 – present

### **University Service**

- **Co-Lead**, Semiconductors Working Group, College of Engineering Research Strategic Plan 2024 – 2025
- **Member**, Nanofabrication Cleanroom Oversight Committee, Office of Research and Partnerships 2026 – present
- **Member**, Graduate Studies Committee and Semiconductor Initiatives Group, Materials Science and Engineering 2022 – present
- **Chair or Member**, four faculty search committees in semiconductors and quantum materials 2023 – 2025

### **Outreach**

- Public tours of the University of Arizona Nano Fabrication Center at its *ribbon-cutting event* (2026), and a public demonstration of an augmented reality cleanroom training platform at *SEMICON West*, Phoenix (2025).
- Semiconductor workshops and summer camps for middle and high school students in Tucson and Chandler, and an appearance in the educational short film *Semiconductor U.S.A.* (2024).