Matthias Kuehne

Curriculum vitae

Assistant Professor of Physics
Brown University | Department of Physics
184 Hope Street
Providence, RI 02912, USA
+1 401 863 1010
kuehne@brown.edu

Education

2012 – 2017	Doctor of Natural Sciences (Physics), University of Stuttgart, Germany Dissertation: Lithium Intercalation in Bilayer Graphene Devices
2006 – 2011	Diploma (Physics), Karlsruhe Institute of Technology, Karlsruhe, Germany
2008 – 2011	Diplôme d'Ingénieur, Grenoble Institute of Technology, Grenoble, France
2009 – 2010	Master (France), Joseph Fourier University, Grenoble, France

Professional Appointments

2023 – present	**Brown University**, Department of Physics Assistant Professor
2018 – 2022	**Massachusetts Institute of Technology**, Department of Chemical Engineering Postdoctoral researcher in the group of Michael S. Strano
2017 – 2018	**Max Planck Institute for Solid State Research**, Stuttgart, Germany Postdoctoral researcher in the group of Jurgen H. Smet

Publications

Books/Dissertation

2018 **M. Kuehne**. *Lithium Intercalation in Bilayer Graphene Devices*, a volume of *Springer Theses* (Springer Cham)

Refereed journal publications

25. G. Zhang, S. Yang, J. F. Yang, D. Gonzalez-Medrano, M. Z. Miskin, V. B. Koman, Y. Zeng, S. X. Li, **M. Kuehne**, A. T. Liu, A. M. Brooks, M. Kumar, M. S. Strano. High energy density picoliter-scale zinc-air microbatteries for colloidal robotics. *Science Robotics* 9, eade4642 (2024).

24. Y.-M. Tu, **M. Kuehne**, R. P. Misra, C. L. Ritt, H. Oliaei, S. Faucher, H. Li, X. Xu, A. Penn, S. Yang, J. F. Yang, K. Sendgikoski, J. Chakraverty, J. Cumings, A. Majumdar, N. R. Aluru, J. A. Hachtel, D. Blankschtein, M. S. Strano. Environmental damping and vibrational coupling of confined fluids within isolated carbon nanotubes. *Nature Communications* 15, 5605 (2024).

23. D. Zhao, L. Debbeler, **M. Kuehne**, S. Fecher, N. Gross, J. H. Smet. Evidence of finite-momentum pairing in a centrosymmetric bilayer. *Nature Physics* 19, 1599–1604 (2023).

22. N. R. Aluru, F. Aydin, M. Z. Bazant, D. Blankschtein, A. H. Brozena, J. P. de Souza, M. Elimelech, S. Faucher, J. T. Fourkas, V. B. Koman, **M. Kuehne**, H. J. Kulik, H.-K. Li, Y. Li, Z. Li, A. Majumdar, J. Martis, R. P. Misra, A. Noy, T. A. Pham, H. Qu, A. Rayabharam, M. A. Reed, C. L. Ritt, E. Schwegler, Z. Siwy, M. S. Strano, Y. Wang, Y.-C. Yao, C. Zhan, Z. Zhang. Fluids and electrolytes under confinement in single-digit nanopores. *Chemical Reviews* 123, 2737–2831 (2023).

21. S. X. Li, T. Ichihara, H. Park, G. He, D. Kozawa, Y. Wen, V. B. Koman, Y. Zeng, **M. Kuehne**, Z. Yuan, S. Faucher, J. Warner, and M. S. Strano. Prolonged photostability in hexagonal boron nitride quantum emitters. *Communications Materials* 4, 19 (2023).

20. S. Faucher, **M. Kuehne**, H. Oliaei, R. P. Misra, S. X. Li, N. R. Aluru, and M. S. Strano. Observation and Isochoric Thermodynamic Analysis of Partially Water-Filled 1.32 and 1.45 nm Diameter Carbon Nanotubes. *Nano Letters* 23, 389–397 (2023).

19. D. Kozawa, S. X. Li, T. Ichihara, A. G. Rajan, X. Gong, G. He, V. B. Koman, Y. Zeng, **M. Kuehne**, K. S Silmore, D. Parviz, P. Liu, A. T. Liu, S. Faucher, Z. Yuan, J. Warner, D. Blankschtein, M. S. Strano. Discretized hexagonal boron nitride quantum emitters and their chemical interconversion. *Nanotechnology* 34, 115702 (2023).

18. S. Yang, S. Fecher, Q. Wang, **M. Kuehne**, J. H. Smet. Device level reversible potassium intercalation into bilayer graphene. *2D Materials* 9, 025020 (2022).

17. Y. Zeng, P. Gordiichuk, T. Ichihara, G. Zhang, E. Sandoz-Rosado, E. D. Wetzel, J. Tresback, J. Yang, D. Kozawa, Z. Yang, **M. Kuehne**, M. Quien, Z. Yuan, X. Gong, G. He, D. J. Lundberg, P. Liu, A. T. Liu, J. F. Yang, H. J. Kulik, M. S. Strano, Irreversible synthesis of an ultrastrong two-dimensional polymeric material. *Nature* 602, 91–95 (2022).

16. X. Gong, L. Shuai, R. L. Beingessner, T. Yamazaki, J. Shen, **M. Kuehne**, K. Jones, H. Fenniri, M. S. Strano. Size selective corona interactions from self-assembled rosette and single-walled carbon nanotubes. *Small* 18, 2104951 (2022).

15. V. B. Koman, X. Gong, N. A. Bakh, K. Silmore, D. P. Salem, T. T. S. Lew, **M. Kuehne**, D. Kozawa, M. Park, M. S. Strano. Atomically thin 2d interfaces as sensors for molecular permeability through cellular layers and thin tissues. *Advanced Functional Materials* 32, 2109598 (2022).

14. **M. Kuehne**, S. Faucher, M. Liew, Z. Yuan, S. X. Li, T. Ichihara, Y. Zeng, P. Gordiichuk, V. B. Koman, D. Kozawa, A. Majumdar, M. S. Strano. Impedance of Thermal Conduction from Nanoconfined Water in Carbon Nanotube Single Digit Nanopores. *The Journal of Physical Chemistry C* 125, 25717 (2021).

13. Z. Yuan, G. He, S. Faucher, **M. Kuehne**, S. X. Li, D. Blankschtein, and M. S. Strano. Direct chemical vapor deposition synthesis of porous single-layer graphene membranes with high gas permeances and selectivities. *Advanced Materials* 33, 2104308 (2021).

12. P. Gordiichuk, S. Coleman, G. Zhang, **M. Kuehne**, T. T. S. Lew, M. Park, J. Cui, A. M. Brooks, K. Hudson, A. M. Graziano, D. J. M. Marshall, Z. Karsen, S. Kennedy, M. S. Strano. Augmenting the living plant mesophyll into a photonic capacitor. *Science Advances* 7, eabe9733 (2021).

11. S.-Y. Cho, X. Gong, V. B. Koman, **M. Kuehne**, S. J. Moon, M. Son, T. T. S. Lew, P. Gordiichuk, X. Jin, H. D. Sikes, M. S. Strano. Cellular lensing and near infrared fluorescent nanosensor arrays to enable chemical efflux cytometry. *Nature Communications* 12, 3079 (2021).

10. S. Faucher, **M. Kuehne**, V. B. Koman, N. Northrup, D. Kozawa, Z. Yuan, S. X. Li, Y. Zeng, T. Ichihara, R. P. Misra, N. Aluru, D. Blankschtein, M. S. Strano. Diameter dependence of water

filling in lithographically segmented isolated carbon nanotubes. *ACS Nano* 15, 2778–2790 (2021).

9. **M. Kuehne**, D. Zhao, U. Zschieschang, R. Buck, M. Müller, H. Klauk, J. H. Smet. Wettability engineering for studying ion transport in 2D layered materials. *Advanced Materials Interfaces* 8, 2001453 (2021).
8. D. Kozawa, P. Liu, Y. Zheng, V. B. Koman, **M. Kuehne**, M. S. Strano. Highly ordered 2D MoS2 Archimedean scroll Bragg reflectors as chromatically adaptive fibers. *Nano Letters* 20, 3067–3078 (2020).
7. P. Zielinski, **M. Kuehne**, D. Kärcher, F. Paolucci, P. Wochner, S. Fecher, J. Drnec, R. Felici, J. H. Smet. Probing exfoliated graphene layers and their lithiation with micro-focused X-rays. *Nano Letters* 19, 3634–3640 (2019).
6. **M. Kuehne**, F. Börrnert, S. Fecher, M. Ghorbani-Asl, J. Biskupek, D. Samuelis, A. V. Krasheninnikov, U. Kaiser, J. H. Smet. Reversible superdense ordering of lithium between two graphene sheets. *Nature* 564, 234–239 (2018).
5. **M. Kuehne**, F. Paolucci, J. Popovic, P. M. Ostrovsky, J. Maier, J. H. Smet. Ultrafast lithium diffusion in bilayer graphene. *Nature Nanotechnology* 12, 895–900 (2017).
4. P. Kossacki, C. Faugeras, **M. Kuehne**, M. Orlita, A. Mahmood, E. Dujardin, R. R. Nair, A.K. Geim, M. Potemski. Circular dichroism of magnetophonon resonance in doped graphene. *Physical Review B* 86, 205431 (2012).
3. **M. Kuehne**, C. Faugeras, P. Kossacki, A. Nicolet, M. Orlita, Yu.I. Latyshev, M. Potemski. Polarization-resolved magneto-Raman scattering of graphenelike domains on natural graphite. *Physical Review B* 85, 195406 (2012).
2. P. Kossacki, C. Faugeras, **M. Kuehne**, M. Orlita, A. A. L. Nicolet, J. M. Schneider, D. M. Basko, Yu. I. Latyshev, M. Potemski. Electronic excitations and electron-phonon coupling in bulk graphite through Raman scattering in high magnetic fields. *Physical Review B* 84, 235138 (2011).
1. C. Faugeras, M. Amado, P. Kossacki, M. Orlita, **M. Kuehne**, A. A. L. Nicolet, Yu. I. Latyshev, M. Potemski. Magneto-Raman scattering of graphene on graphite: electronic and phonon excitations. *Physical Review Letters* 107, 036807 (2011).

Manuscripts under peer review

3. C. Peng, J. Ginzburg, U. Dickman, J. Bair, **M. Kuehne**. *submitted* (2025)
2. G. He, Z. Yuan, J.-H. Park, L. F. Villalobos, H.-Y. Chi, **M. Kuehne**, Y. Zeng, Y.-M. Tu, H. Kim, J. Zhao, J. Kong, Z. Jiang, K. V. Agrawal, D. Blankschtein, M. S. Strano. *submitted* (2024)
1. X. Xu, X. Jin, **M. Kuehne**, D.-L. Bao, J. Martis, Y.-M. Tu, C. L. Ritt, J. C. Idrobo, M. S. Strano, A. Majumdar, S. T. Pantelides, J. A. Hachtel. Hydrogen bonding in water under extreme confinement unveiled by nanoscale vibrational spectroscopy and simulations. *submitted* (2024)

Preprints (not peer reviewed)

1. X. Xu, X. Jin, **M. Kuehne**, D.-L. Bao, J. Martis, Y.-M. Tu, C. L. Ritt, J. C. Idrobo, M. S. Strano, A. Majumdar, S. T. Pantelides, J. A. Hachtel. Hydrogen bonding in water under extreme confinement unveiled by nanoscale vibrational spectroscopy and simulations. arXiv:2402.17989 [physics.chem-ph]

Research Grants

Current grants

2. NSF – CHE-2341781 *Thermodynamics of Water Phase Change in Isolated Single Digit Nanopores*, PI, $520,000

1. Brown University – OVPR Seed Fund *Designing and controlling quantum optical properties at 1D-2D mixed dimensional interfaces*, Co-PI, $50,000

Past grants

1. Brown University – ISE Seed Fund *Osmotic energy conversion in nanofluidic arrays of hexagonal boron nitride*, PI, $50,000

Service

To the University

2025-26	Physics Department Colloquium/Seminar Committee (Chair)
	Physics Department Laboratory Instruction Committee (Chair)
	Physics Department Graduate Admissions Committee
	Physics Department Master's Advisor Committee
2024-25	Physics Department Colloquium/Seminar Committee (Chair)
	Physics Department Graduate Admissions Committee
	Physics Department Master's Advisor Committee
	Women in Physics Mentorship Program Mentor
2023-24	Physics Department Colloquium/Seminar Committee
	Physics Department Graduate Admissions Committee
	Physics Department Master's Advisor Committee

<u>Served on Ph.D. thesis committee:</u>

2024	Nicholas Drachmann, Physics (Advisor: Derek Stein)
2024	Boyuan Xu, Physics (Advisor: Yue Qi)

To the Profession

<u>Editorial Service</u>

2023	Guest editor Nanotechnology, focus issue "2D Materials-Based Sensors" featuring 1 topical review and 29 research articles

<u>Panel Service</u>

Panel Reviewer, National Science Foundation (3 panels in 2025)

Peer Review for Academic Journals

ACS Omega (1)

Journal of Physical Chemistry Letters (1)

Nano Letters (1)

Nanoscale Advances (1)

Nanotechnology (1)

Nature Communications (8)

Physical Review Applied (1)

Physical Review B (21)

Physical Review Letters (9)

Physical Review Materials (3)

Physical Review X (1)

Proceedings of the National Academy of Sciences of the United States of America (1)

Science Advances (5)

Reviewer for Book Proposals

Cambridge University Press (1 in 2025)

Awards and Honors

2025 ICDCM Early Career Research Award

2020 German Research Foundation (DFG) Postdoctoral Fellowship

2018 European Microscopy Society Outstanding Paper Award

2018 Springer Theses Award

2017 Materials Horizons Talk Prize at Graphene 2017, Barcelona, Spain

2015 Oral Presentation Award, Competence Network “Functional Nanostructures” Bad Herrenalb, Germany

Invited Talks

2025 Osaka University, Institute of Scientific and Industrial Research (SANKEN)

2025 National Institute for Materials Science (NIMS)

2024 Lehigh University, Physics Colloquium

2024 99th New England Complex Fluids

2023 Caltech, Materials Research Lecture

2022 Brown University, Condensed Matter Seminar

2022 Western Digital, San Jose

2022 Arizona State University, Department of Physics

2022 Brown University, Department of Physics

2021 Free University of Berlin, Netz Group Seminar

2021 National Institute of Science and Technology

2017 Weizmann Institute of Science, Department of Chemistry

2016 Korea Institute of Science and Technology (KIST Jeonbuk)

Conference Activity/Participation

Papers presented

Underlined author presented

1. **M. Kuehne**. Fluidics and Ionics in Graphene and Carbon Nanotube Devices. *35th International Conference on Diamond and Carbon Materials (ICDCM)*. 8/31-9/4/2025, Glasgow, United Kingdom (2025)
2. **M. Kuehne**. Multi-modal carbon nanotube characterization for nano-confined thermodynamics. *NT'25*, June 15-20, Kyoto, Japan (2025)
3. C. Peng, J. Bair, **M. Kuehne**. Progress towards interior mass measurements in carbon nanotube single-digit nanopores. *APS Global Physics Summit 2025*, abstract id.N65.008 (2025)
4. **M. Kuehne**. Probing water phase change in isolated single digit nanopores. *99th New England Complex Fluids Workshop*. 6/21 (2024)
5. R. P. Misra, Y.-M. Tu, **M. Kuehne**, S. Faucher, L. Arcuri, M. S. Strano, D. Blankschtein. Uncovering the Thermodynamics of Capillary Phase Transitions Under Non-Isothermal Conditions. *2024 AIChE Annual Meeting* (2024)
6. **M. Kuehne**, S. Faucher, R.P. Misra, H. Oliaei, H. Li, J. Yang, A. Penn, Y.-M. Tu, X. Xu, G. Zhang, V. B. Koman, A. Majumdar, N. Aluru, D. Blankschtein, M. S. Strano. Evidence and analysis of discontinuous thermodynamic properties under extreme one dimensional confinement. *NT'23*, June 4-9, Arcachon, France (2023)
7. X. Jin, **M. Kuehne**, X. Gong, A. Ucko, V. B. Koman, M. S. Strano. Polarization Resolved Fluorescence Detection of Carbon Nanotube Corona Phases. *2023 AIChE Annual Meeting* (2023)
8. X. Jin, **M. Kuehne**, X. Gong, A. Ucko, M. S. Strano. Polarization Resolved Fluorescence Detection of Carbon Nanotube Corona Phases. 2023 *ECS Meet. Abstr.* MA2023-01, 1219 (2023)
9. **M. Kuehne**, S. Faucher, R. P. Misra, H. Oliaei, H.-K. Li, J. Yang, A. Penn, Y.-M. Tu, X. Xu, Z. Yuan, S. X. Li, G. He, G. Zhang, V. B. Koman, A. Majumdar, N. R. Aluru, D. Blankschtein, M. S. Strano. Observation and Thermodynamic Analysis of Reversible Fluid Isobars in Isolated Single Digit Nanopore Carbon Nanotubes. 2023 *ECS Meet. Abstr.* MA2023-01 1231 (2023)
10. G. Zhang, J. F. Yang, V. B. Koman, S. Yang, A. Brooks, **M. Kuehne**, M. Strano. High Energy

Density Picoliter Batteries for Colloidal Robots and State Machines. *2022 AIChE Annual Meeting* (2022)

11. Y. Zeng, M. Quien, P. Gordiichuk, T. Ichihara, G. Zhang, E. Sandoz-Rosado, E. D. Wetzel, J. Tresback, J. Yang, D. Kozawa, Z. Yang, **M. Kuehne**, Z. Yuan, X. Gong, G. He, D. J. Lundberg, P. Liu, A. Liu, J. F. Yang, H. Kulik, M. Strano. Irreversible Synthesis of an Ultrastrong Two-Dimensional Polymeric Material. *2022 AIChE Annual Meeting* (2022)
12. **M. Kuehne**, S. Faucher, M. S. Strano. Thermodynamics of Reversible Fluid Phase Transitions in Isolated Carbon Nanotubes. *Lake Tahoe Nanofluidics*, May 23-27, Tahoe City, CA, United States
13. **M. Kuehne**, S. Faucher, Z. Yuan, M. S. Strano. Diffusive Heat Transfer in Isolated, Free-Standing, Single-Walled Carbon Nanotubes. *2021 AIChE Annual Meeting* (2021)
14. G. Zhang, V. B. Koman, **M. Kuehne**, J. F. Yang, M. S. Strano. Picoliter-Sized Zn-Air Batteries for Releasable Microscopic Sensors and Robots. *2021 AIChE Annual Meeting* (2021)
15. S. Faucher, **M. Kuehne**, M. S. Strano. Dynamics of Reversible Nanofluidic Water Filling inside Isolated Single-Walled Carbon Nanotubes. *2021 AIChE Annual Meeting* (2021)
16. G. Zhang, M. Strano, V. Koman, J. Yang, Y. Zeng, **M. Kuehne**, A. T. Liu, S. Yang, A. M. Brooks. Picoliter-Sized Zn-Air Batteries for Releasable Microscopic Sensors and Colloidal Robots. *2021 MRS Fall Meeting*, 11/29-12/2 (2021)
17. M. S. Strano, **M. Kuehne**, S. Faucher. Phase Behavior and Filling Dynamics of Water inside Isolated Carbon Nanotubes. *APS March Meeting 2021*, abstract id.B25.009 (2021)
18. **M. Kuehne**, S. Faucher, M. S. Strano. Individual Carbon Nanotube Nanofluidics. *NT'21,* June 6-11, virtual (2021)
19. S. Faucher, **M. Kuehne**, M. S. Strano. Nanofluidic Phase Behavior, Droplets, and Condensation of Water inside Isolated Single-Walled Carbon Nanotubes. *2020 Virtual AIChE Annual Meeting* (2020).
20. **M. Kuehne**. Fluidics and Ionics at the Nanoscale. *2020 Virtual AIChE Annual Meeting* (2020).
21. **M. Kuehne**, S. Faucher, M. Liew, Z. Yuan, D. Kozawa, M. Strano. Fluid Filling Impedes Thermal Conduction in Free-Standing, Single-Walled Carbon Nanotubes. *2020 Virtual AIChE Annual Meeting* (2020).
22. **M. Kuehne**, S. Faucher, M. T. Dronadula, M. Heiranian, N. Aluru, M. S. Strano. Liquid-Vapor Phase Transition of Water in Individual Single-Walled Carbon Nanotubes. *2020 MRS Virtual Spring/Fall Meeting*, 11/27-12/4 (2020)
23. **M. Kuehne**. Understanding Nanoscale Confinement and Nanoscale Fluid Phase Transitions. *GRC Micro and Nanoscale Phase Change Heat Transfer*, 2/3-2/8, Lucca, Italy (2019)
24. **M. Kuehne**, F. Börrnert, S. Fecher, M. Ghorbani-Asl, J. Biskupek, A. V. Krasheninnikov, U. Kaiser, J. H. Smet. In situ investigations on gate-controlled intercalation of graphene, *FET International Workshop*, 8/20-8/24, Groningen, The Netherlands (2018)
25. **M. Kuehne**, F. Paolucci, J. Popovic, P. M. Ostrovsky, J. Maier, J. H. Smet. Ultrafast lithium diffusion in bilayer graphene. *21st International Conference on Solid State Ionics (SSI)*, 6/18-6/23, Padua, Italy (2017)
26. **M. Kuehne**, F. Paolucci, J. Popovic, P. M. Ostrovsky, J. Maier, J. H. Smet. Ultrafast lithium diffusion in bilayer graphene, *Graphene 2017*, 3/28-3/31, Barcelona, Spain (2017)

27. **M. Kuehne**, F. Paolucci, J. H. Smet. Lithium-Intercalation in Bilayer Graphene Devices, *33rd International Conference on the Physics of Semiconductors (ICPS)*, 7/31-8/5, Beijing, China (2016)
28. **M. Kuehne**, F. Paolucci, J. H. Smet. Lithiating Bilayer Graphene, *Graphene Week 2016*, 6/13-6/17, Warsaw, Poland (2016)
29. **M. Kuehne**, F. Paolucci, J. H. Smet. Lithiating Bilayer Graphene, *19th Int. Winter School "New Developments in Solid State Physics"*, 2/20-2/25, Mauterndorf, Austria (2016)
30. **M. Kuehne**, C. Faugeras, P. Kossacki, A. L. L. Nicolet, M. Orlita, Yu. I. Latyshev, M. Potemski. Polarization resolved magneto-Raman scattering of graphene on natural graphite, *76th Annual Conference of the German Physical Society (DPG)*, 3/25-3/30, Berlin, Germany (2012)
31. **M. Kuehne**, C. Faugeras, P. Kossacki, M. Orlita, M. Potemski. Phonon and electronic magneto-Raman scattering in multilayer epitaxial graphene, *International Symposium "Controlling Spin at the Nanoscale"*, October, Ottawa, Canada (2010)

Campus or Departmental Talks

2025 Chemistry Colloquium, Brown University

2024 Initiative for Sustainable Energy (ISE) Mini-Symposium

2023 Physics Colloquium, Brown University

Teaching Experience

Brown University

- Advanced Physics Laboratory (PHYS2010, instructor Spring 2025)
- Biological Physics (PHYS1610/2630, instructor Fall 2024)
- Basic Physics A (PHYS0030, instructor Fall 2023)
- Basic Physics B (PHYS0040, course manager Spring 2023)
- Directed 1 Honors thesis in Physics
- Supervising 2 Ph.D. theses
- Advising 4 undergraduate students
- Mentored 2 Sc.M. students
- Mentored 1 Postdoctoral Fellow

Massachusetts Institute of Technology

- Nanotechnology Engineering (co-instructor Fall 2020, guest lecturer Fall 2021 & Fall 2019)
- Chemical Engineering Project Labs (consultant Spring 2021 & Spring 2020)
- Kaufman Teaching Certificate (Summer 2019)

University of Stuttgart, Germany

- Advanced Physical Laboratory (TA Summer 2014 & Summer 2015)

Karlsruhe Institute of Technology, Germany

- Physics IV - Atoms and Molecules (TA Summer 2012)
- Physics III – Optics and Thermodynamics (TA Winter 2011)