**Ge Zhang**

Department of Chemical Engineering • **M**assachusetts **I**nstitute of **T**echnology

77 Massachusetts Ave, Building 66, Room 564, Cambridge, MA 02139

(857) 999-5196 • email: gezhang@mit.edu

**Education**

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| 09/2017−12/2022 | Ph.D., Chemical Engineering, Massachusetts Institute of Technology. (GPA: 5.0/5.0) |
| 09/2013−07/2017 | B.Eng., Chemical Engineering, Tsinghua University. (GPA: 92/100; Rank: 1/75) |

**Research Experiences**

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| 2017−2022 (expected) | **Energy Source and Material Engineering for Microscopic Robots and Sensors**  Advisor: Michael. S. Strano, Chemical Engineering, Massachusetts Institute of Technology.   * Studied the kinetics and mechanisms of producing two-dimensional polymers from irreversible polymerization in solution, from theory *for the first time*. Two mechanisms were found to promote 2-D growth over 3-D, namely bond-planarity and templated autocatalysis. * Invented picoliter-sized, high-energy-density Zn-air batteries for powering microscopic robots. First of its class, mass-fabricated, can be integrated with micro-electronic loads. * Explored thermal diodes in resonant thermal energy harvesting from temperature fluctuations. |
| 2016 | **Impedance Spectra Simulation for Mixed Ionic-Electronic Conductors.**  Advisor: *William Chueh*, Materials Science and Engineering, Stanford University. |
| 2013−2017 | **Electrocatalyst and High‐Dielectric Electrolyte for Lithium–Sulfur Batteries.**  Advisor: *Qiang Zhang*, Chemical Engineering, Tsinghua University.   * Developed high-solubility electrolyte with improved stability at lithium anode, which achieved high energy density of 326 Wh kg−1 via a radical-based sulfur reaction pathway. * Elucidated the role of catalyst conductivity in the kinetics of sulfur redox reaction. * Summarized the methods and protocols for characterizing Li–S batteries. |

**Publications**

**Peer-reviewed papers (**[**Google Scholar**](https://scholar.google.com/citations?user=peGivKAAAAAJ&hl=en)**)**

(**+**Equal contribution; \*Corresponding author)

1. **G. Zhang**, JF. Yang, D. Gonzalez-Medrano, M. Z. Miskin, V. B. Koman, Y. Zeng, S. X. Li, M. Kuehne, A. T. Liu, S. Yang, A. M. Brooks, M. S. Strano\*, High Energy Density Picoliter Zn-Air Batteries for Colloidal Robots and State Machines. *In revision*. [10.26434/chemrxiv-2022-20jjz](https://doi.org/10.26434/chemrxiv-2022-20jjz).
2. **G. Zhang**, JF. Yang, A. T. Liu, S. Yang, V. B. Koman, A. M. Brooks, X. Gong, M. S. Strano\*, Colloidal State Machines as Smart Tracers for Concentration Mapping in Laminar Flow Reactors. *In preparation*.
3. **G. Zhang**, Y. Zeng, P. Gordiichuk, M. S. Strano\*, Chemical Kinetic Mechanisms and Scaling of Two Dimensional Polymers via Irreversible Solution-Phase Reactions. [*J. Chem. Phys.* **2021**, 154, 194901.](https://aip.scitation.org/doi/10.1063/5.0044050)
4. **G.** **Zhang**, V. B. Koman, T. Shikdar, R. J. Oliver, N. Perez‐Lodeiro, M. S. Strano\*, High Thermal Effusivity Nanocarbon Materials for Resonant Thermal Energy Harvesting. [*Small*, **2021**, 17, 2006752.](https://onlinelibrary.wiley.com/doi/full/10.1002/smll.202006752)
5. **G. Zhang**+, A. L. Cottrill+, V. B. Koman, A. T. Liu, S. G. Mahajan, D. E. Piephoff, M. S. Strano\*, Persistent, single-polarity energy harvesting from ambient thermal fluctuations using a thermal resonance device with thermal diodes. [*Appl. Energy*, **2020**, 280, 115881.](https://www.sciencedirect.com/science/article/abs/pii/S0306261920313520)
6. **G. Zhang**+, H.-J. Peng+, C.-Z. Zhao, X. Chen, L.-D. Zhao, P. Li, J.-Q. Huang, Q. Zhang\*, The Radical Pathway Based on a Lithium‐Metal‐Compatible High‐Dielectric Electrolyte for Lithium–Sulfur Batteries. [*Angew. Chem. Int. Ed.* **2018**, 57, 16732.](https://onlinelibrary.wiley.com/doi/full/10.1002/anie.201810132)
7. **G. Zhang+**, Z.-W. Zhang+, H.-J. Peng, J.-Q. Huang, and Q. Zhang\*, A Toolbox for Lithium–Sulfur Battery Research: Methods and Protocols. [*Small Methods*, **2017**, 1, 1700134.](https://onlinelibrary.wiley.com/doi/full/10.1002/smtd.201700134)
8. H.-J. Peng+, **G. Zhang**+, X. Chen, Z.-W. Zhang, W.-T. Xu, J.-Q. Huang, Q. Zhang\*, Enhanced Electrochemical Kinetics on Conductive Polar Mediators for Lithium–Sulfur Batteries.[*Angew. Chem. Int. Ed.* **2016**, 55, 12990.](https://onlinelibrary.wiley.com/doi/full/10.1002/anie.201605676)
9. A. Bakytbekov\*, T. Q. Nguyen, **G. Zhang**, M. S. Strano, K. N. Salama, A. Shamim, Synergistic multi-source ambient RF and thermal energy harvester for green IoT applications. [*Energy Reports*, **2023**, 9, 1875.](https://www.sciencedirect.com/science/article/pii/S2352484723000276)
10. JF. Yang+, T. A. Berrueta+, A. M. Brooks, A. T. Liu, **G. Zhang**, D. Gonzalez-Medrano, S. Yang, V. B. Koman, P. Chvykov, M. Z. Miskin, T. D. Murphey, Michael S. Strano\*, Emergent Microrobotic Oscillators via Asymmetry-Induced Order.[*Nat. Comm.* **2022**,13, 5734.](https://www.nature.com/articles/s41467-022-33396-5)
11. A. T. Liu, M. Hempel, JF. Yang, A. M. Brooks, A. Pervan, V. B. Koman, **G. Zhang**, D. Kozawa, S. Yang, D. I. Goldman, M. Z. Miskin, A. W. Richa, D. Randall, T. D. Murphey, T. Palacios,\* M. S. Strano\*, Colloidal Robotics. *In revision*.
12. S. Faucher, M. Kuehne, H. Oliaei, R. Prasanna Misra, S. X. Li, **G. Zhang,** N. R. Aluru, and M. S. Strano\*, Observation and Thermodynamic Analysis of Partially Water-Filled 1.35 nm and 1.48 nm Diameter Carbon Nanotubes: the Sealed Ampoule. *In revision*.
13. A. Bakytbekov, T. Q. Nguyen, **G. Zhang**, M. S. Strano, K. N. Salama, A. Shamim\*, Dual-Function Triple-Band Heatsink Antenna for Ambient RF and Thermal Energy Harvesting. [*IEEE Open Journal of Antennas and Propagation*. **2022**, 3, 263.](https://doi.org/10.1109/OJAP.2022.3149392)
14. Y. Zeng, P. Gordiichuk, T. Ichihara, **G.** **Zhang**, S.-R. Emil, E. D. Wetzel, J. Tresback, J. Yang, D. Kozawa, Z. Yang, M. Kuehne, M. Quien, Z. Yuan, X. Gong, G. He, D. Lundberg, P. Liu, A. T. Liu, JF. Yang, H. J. Kulik, M. S. Strano\*, Irreversible Synthesis of an Ultra-Strong Two-Dimensional Polymeric Material. [*Nature.* **2022**,602, 91.](https://www.nature.com/articles/s41586-021-04296-3)
15. JF. Yang, A. T. Liu, **G. Zhang**, A. M. Brooks, V. B. Koman, S. Yang, M. S. Strano\*, Memristor Circuits for Colloidal Robotics: Temporal Access to Memory, Sensing, and Actuation. [*Adv. Intell. Syst.* **2021**, 3, 2100205.](https://onlinelibrary.wiley.com/doi/full/10.1002/aisy.202100205)
16. A. T. Liu+, Y. Kunai+, A. L. Cottrill, A. Kaplan, **G. Zhang**, H. Kim, R. S. Mollah, Y. L. Eatmon, M. S. Strano\*, Solvent-Induced Electrochemistry at an Electrically Asymmetric Carbon Janus Particle. [*Nat. Comm*. **2021**, 12, 3415](https://doi.org/10.1038/s41467-021-23038-7).
17. P. Gordiichuk, S. Coleman, **G. Zhang**, M. Kuehne, T.T.S. Lew, M. Park, L. 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. [*Sci. Adv.* **2021**, 7, eabe9733](https://www.science.org/doi/10.1126/sciadv.abe9733).
18. A. T. Liu+, JF. Yang+, L. N. LeMar, **G. Zhang**, A. Pervan, T. D. Murphey, M. S. Strano\*, Autoperforation of two-dimensional materials to generate colloidal state machines capable of locomotion. [*Faraday Discuss.* **2021**, 227, 213.](https://pubs.rsc.org/en/content/articlehtml/2020/fd/d0fd00030b)
19. A. Bakytbekov, T. Q. Nguyen, W. Li, A. L. Cottrill, **G. Zhang**, M. S. Strano, K. N. Salama, A. Shamim\*, Multi-source ambient energy harvester based on RF and thermal energy: Design, testing, and IoT application. [*Energy Sci. Eng*. **2020**, 8, 3883.](https://onlinelibrary.wiley.com/doi/full/10.1002/ese3.784)
20. A. L. Cottrill, **G. Zhang**, A. T. Liu, A. Bakytbekov, K. S. Silmore, V. B. Koman, A. Shamim, M. S. Strano\*, Persistent energy harvesting in the harsh desert environment using a thermal resonance device: Design, testing, and analysis. [*Appl. Energy*, **2019**, 235, 1514.](https://www.sciencedirect.com/science/article/pii/S0306261918317471)
21. A. T. Liu, **G. Zhang**, A. L. Cottrill, Y. Kunai, A. Kaplan, P. Liu, V. B. Koman, M. S. Strano\*, Direct Electricity Generation Mediated by Molecular Interactions with Low Dimensional Carbon Materials—A Mechanistic Perspective. [*Adv. Energy Mater.* **2018**, 8, 1802212.](https://onlinelibrary.wiley.com/doi/full/10.1002/aenm.201802212)
22. L. Kong+, H.-J. Peng +, J.-Q. Huang,\* W. Zhu,\* **G. Zhang**, Z.-W. Zhang, P.-Y. Zhai, P. Sun, J. Xie, Q. Zhang\*, Beaver-dam-like membrane: A robust and sulphifilic MgBO2(OH)/CNT/PP nest separator in Li-S batteries. [*Energy Storage Materials*, **2017**, 8, 153.](https://www.sciencedirect.com/science/article/abs/pii/S2405829717301484)
23. H.-J. Peng+, Z.-W. Zhang +, J.-Q. Huang\*, **G. Zhang**, J. Xie, W.-T. Xu, J.-L. Shi, X. Chen, X.-B. Cheng, Q. Zhang\*, A Cooperative Interface for Highly Efficient Lithium–Sulfur Batteries. [*Adv. Mater.* **2016**, 28, 9551.](https://onlinelibrary.wiley.com/doi/full/10.1002/adma.201603401)

**Book Chapter**

A. T. Liu, **G. Zhang**, M. S. Strano, Energy Harvesting Techniques Mediated by Molecular Interactions with Nanostructured Carbon Materials. *Robotic Systems and Autonomous Platforms*, edited by Walsh, S. M.; Strano, M. S. (Elsevier [ISBN 978-0-08-102260-3](https://www.sciencedirect.com/science/article/pii/B9780081022603000160?via%3Dihub), *Woodhead Publishing in Materials* **2019**, 389–424).

**Honors and Awards**

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| 2021 | **Excellence in Polymer Graduate Research Symposium Finalist,** AIChE |
| 2021 | **MathWorks Engineering Fellowship,** MIT School of Engineering |
| 2018 | **David H. Koch (1962) Fellowship,** MIT |
| 2017 | **Best Bachelor Thesis Award**, Tsinghua University |
| 2017 | **Excellent Graduate Award**, Tsinghua University |
| 2016 | **China National Scholarship**, Tsinghua University |
| 2016 | **First Prize,** 34th Challenge Cup, Tsinghua University |
| 2015 | **China National Scholarship**, Tsinghua University |
| 2015 | **Third Prize,** 33th Challenge Cup, Tsinghua University |
| 2014 | **Departmental Scholarship for Outstanding Student**, Tsinghua University |
| 2014 | **Second Prize,** 30th National Physics Competition for Undergraduates, Tsinghua University |
| 2012 | **First Prize,** Chinese Chemistry Olympiad, Chinese Chemical Society |
| 2012 | **First Prize,** China High School Biology Olympiad, Zoological Society and Botanical Society of China |
| 2012 | **Second Prize,** Chinese Physics Olympiad, Chinese Physical Society |

**Teaching Experiences**

**Course Instructor**, Engineering Nanotechnology (10.585, co-instructor Michael S. Strano, MIT, Fall 2022)

**Teaching Assistant**, Thermodynamics and Statistical Mechanics for Chemical Engineering (10.40, Arup K. Chakraborty, Bradley D. Olsen, MIT, Fall 2020)

**Grader**, Chemical Reactor Engineering (10.65, Klavs F. Jensen, Michael S. Strano, MIT, Spring 2019)

**Invited Seminars**

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| 2021 | High Energy Density Picoliter Zn-Air Batteries for Colloidal Robots and State Machines. **Materials Research Society Fall Meeting,** Boston |
| 2021 | Picoliter-sized Zn-air Batteries for Releasable Microscopic Sensors and Robots. **AIChE Annual National Meeting,** Boston |
| 2021 | Scaling and Chemical Kinetic Mechanisms of Two Dimensional Polymers via Irreversible Solution-Phase Synthesis. **AIChE Annual National Meeting,** Boston |
| 2021 | High Energy Density Picoliter Zn-Air Batteries for Colloidal Robots and State Machines. ZJU-MIT Virtual Graduate Forum 2021, Zhejiang University, Virtual |
| 2021 | Climate Change Mitigation in Future Space Launches. Sino-American Youth Dialogue, Tsinghua University, Virtual |
| 2020 | Chemical Kinetics and Mechanisms for the Synthesis of 2D Polymers via Irreversible Solution-Phase Reactions. **Materials Research Society Fall Meeting,** Virtual |
| 2020 | Energy Harvesting from Ambient Thermal Fluctuations using a Thermal Resonance Device. **AIChE Annual National Meeting,** Virtual |
| 2019 | Single-polarity energy harvesting from diode thermal resonator. **Materials Research Society Fall Meeting,** Boston |
| 2016 | Equivalent circuit for Impedance Spectra Simulation of MIEC. **Chinese Undergraduate Visiting Research (UGVR) Seminar,** Stanford University |

**Skills and Others**

**Languages:** Chinese, English, Japanese (N2).

**Computer skills:** MATLAB, LATEX, COMSOL, ANSYS, Python, LabView, C.

**MIT courses:** Numerical Methods (10.34), Thermodynamics (10.40), Analysis of Transport Phenomena (10.50), Chemical Reactor Engineering (10.65), Electrochemical Energy Systems (10.626); Solid State Physics (3.23), Quantum Theory (8.321), Plasma Physics (8.613), Aerospace Propulsion (16.50) and Machine Learning (6.036).

**Hobbies:** Animations, Kerbal space program, skiing and snowboarding.