

Lili Cai

Assistant Professor
Department of Mechanical Science and Engineering
University of Illinois at Urbana-Champaign

<https://cai.mechse.illinois.edu/>
Email: lilicai@illinois.edu
Phone: +1(217)-300-9673

Professional Positions

Assistant Professor Department of Mechanical Science and Engineering University of Illinois at Urbana-Champaign	2019 – present
Postdoctoral Fellow Department of Materials Science and Engineering Stanford University	2016 – 2018

Education

Ph.D. in Mechanical Engineering Stanford University, Stanford, CA	2016
M.S. in Mechanical Engineering Stanford University, Stanford, CA	2012
B.S. in Materials Science and Engineering University of Science and Technology of China (USTC), Hefei, China	2009

Honors & Awards

• Office of Naval Research Young Investigator Program (ONR YIP) Award	2024
• Engineering Council Outstanding Advisor Award (UIUC)	2023
• SME Outstanding Young Manufacturing Engineer Award	2023
• National Science Foundation (NSF) CAREER Award	2022
• List of Teachers Ranked as Excellent by Their Students (UIUC)	2022
• ACS Petroleum Research Fund Doctoral New Investigator Award	2022
• MIT Technology Review Innovators 35 under 35	2020
• Rising Stars in Mechanical Engineering (MIT)	2018
• Sustainable Energy & Fuels Poster Award (2017 MRS Fall Meeting)	2017

Peer-Reviewed Journal Publications

Citations: ~ 7500; h-index: 28

40. H. K. Woo, A. K. Gautam, J. S. Barroso-Martínez, A. P. Baddorf, K. Zhou, Y. Y. Choi, J. He, A. V. Mironenko, J. Rodríguez-López, L. Cai, "Defect Engineering of WO₃ by Rapid Flame

- Reduction for Efficient Photoelectrochemical Conversion of Methane into Liquid Oxygenates", *Nano Letters*, 23, 11493-11500 (2023).
39. K. Zhou, X. Yan, S. J. Oh, G. Padilla-Rivera, H. A. Kim, D. M. Cropek, N. Miljkovic, L. Cai, "Hierarchically Patterned Self-Cleaning Polymer Composites for Daytime Radiative Cooling", *Nano Letters*, 23, 9, 3669-3677 (2023).
 38. H. K. Woo, K. Zhou, S.-K. Kim, A. Manjarrez, M. J. Hoque, T.-Y. Seong, **L. Cai**, "Visibly Transparent and Infrared Reflective Coatings for Personal Thermal Management and Thermal Camouflage", *Advanced Functional Materials*, 32, 2201432 (2022).
 37. A. Manjarrez, K. Zhou, Y.-K. Tzeng, C. Q. Chen, **L. Cai**, "Atmospheric-Pressure Flame Vapor Deposition of Nanocrystalline Diamonds: Implications for Scalable and Cost-Effective Coatings", *ACS Applied Nano Materials*, 5, 10715–10723 (2022).
 36. J. Fei, D. Han, J. Ge, X. Wang, S. W. Koh, S. Gao, Z. Sun, M. P. Wan, B. F. Ng, **L. Cai**, H. Li, "Switchable Surface Coating for Bifunctional Passive Radiative Cooling and Solar Heating", *Advanced Functional Materials*, 32, 2203582 (2022).
 35. K. Zhou, W. Li, B. B. Patel, R. Tao, Y. Chang, S. Fan, Y. Diao, **L. Cai**, "3D Printable Nanoporous Polymer Matrix Composites for Daytime Radiative Cooling", *Nano Letters*, 21, 1493-1499 (2021).
 34. K. Zhou, N. Miljkovic, **L. Cai**, "Performance analysis on system-level integration and operation of daytime radiative cooling technology for air-conditioning in buildings", *Energy and Buildings*, 235, 110749 (2021).
 33. S. Vaziri, V. Chen, **L. Cai**, Y. Jiang, M. E. Chen, R. W. Grady, X. L. Zheng, Eric Pop, "Ultrahigh Doping of Graphene Using Flame-Deposited MoO₃", *IEEE Electron Device Letters*, 41, 1592-1595 (2020).
 32. H. Wang, Y.-K. Tzeng, Y. Ji, Y. Li, J. Li, X. Zheng, A. Yang, Y. Liu, Y. Gong, **L. Cai**, Y. Li, X. Zhang, W. Chen, B. Liu, H. Lu, N. A. Melosh, Z. X. Shen, K. Chan, T. Tan, S. Chu, Y. Cui, "Synergistic enhancement of electrocatalytic CO₂ reduction to C₂ oxygenates at nitrogen-doped nanodiamonds/Cu interface", *Nature Nanotechnology*, 15, 131–137 (2020).
 31. **L. Cai**, Y. Peng, J. Xu, C. Zhou, C. Zhou, P. Wu, D. Lin, S. Fan, Y. Cui, "Temperature regulation in colored infrared-transparent polyethylene textiles", *Joule*, 3, 1478-1486 (2019).
 30. **L. Cai**, A. Y. Song, W. Li, P. C. Hsu, D. Lin, P. Catrysse, Y. Liu, Y. Peng, J. Chen, H. Wang, A. Yang, S. Fan, Y. Cui, "Spectrally Selective Nanocomposite Textile for Outdoor Personal Cooling", *Advanced Materials*, 30, 1802152 (2018).
 29. Y. Peng, J. Chen, A. Y. Song, P. B. Catrysse, P.-C. Hsu, **L. Cai**, B. Liu, Y. Zhu, G. Zhou, D. S. Wu, H. R. Lee, S. Fan, Y. Cui, "Nanoporous Polyethylene Microfibres for Large-scale Radiative Cooling Fabric", *Nature Sustainability*, 1, 105 (2018).
 28. X. Shi, **L. Cai**, I. Y. Choi, M. Ma, K. Zhang, J. Zhao, J. K. Kim, J. K. Kim, X. Zheng, J. H. Park, "Epitaxial growth of WO₃ nanoneedles achieved using a facile flame surface treatment process engineering of hole transport and water oxidation reactivity", *Journal of Materials*

- Chemistry A*, 6, 19542-19546 (2018).
27. P.-C. Hsu, C. Liu, A. Y. Song, Z. Zhang, Y. Peng, J. Xie, K. Liu, C.-L. Wu, P. B. Catrysse, **L. Cai**, S. Zhai, A. Majumdar, S. Fan, Y. Cui, "A Dual-mode Textile for Human Body Radiative Heating and Cooling", *Science advances*, 3, e1700895 (2017).
 26. **L. Cai**, A. Y. Song, P. Wu, P. C. Hsu, Y. Peng, J. Chen, C. Liu, P. B. Catrysse, Y. Liu, A. Yang, S. Fan, Y. Cui, "Warming up Human Body by Nanoporous Metallized Polyethylene Textile", *Nature Communications*, 8, 496 (2017).
 25. **L. Cai**, C. McClellan, A. L. Koh, H. Li, E. Pop, X. L. Zheng, "Rapid Flame Synthesis of Atomically Thin MoO₃ down to a Monolayer for Effective Hole Doping of WSe₂", *Nano Letters*, 17, 3854–3861 (2017).
 24. J. K. Kim, S. U. Chai, Y. Cho, **L. Cai**, S. J. Kim, S. Park, J. H. Park, X. L. Zheng, "Ultrafast Flame Annealing of TiO₂ Paste for Fabricating Dye-Sensitized and Perovskite Solar Cells with Enhanced Efficiency", *Small*, 1702260 (2017).
 23. A. Yang, **L. Cai**, R. Zhang, J. Wang, P. C. Hsu, H. Wang, G. Zhou, J. Xu, Y. Cui, "Thermal Management in Nanofiber-based Face Mask", *Nano Letters*, 17, 3506–3510 (2017).
 22. J. Zhao, **L. Cai**, H. Li, X. Shi, and X. L. Zheng, "Stabilizing Silicon Photocathodes by Solution-Deposited NiFe Layered Double Hydroxide for Efficient Hydrogen Evolution in Alkaline Media", *ACS Energy Letters*, 2, 1939–1946 (2017).
 21. A. S. Crampton, **L. Cai**, N. Janvelyan, X. L. Zheng and C. M. Friend, "Methanol Photo-Oxidation on Rutile TiO₂ Nanowires: Probing Reaction Pathways on Complex Materials", *J. Phys. Chem. C*, 121, 9910–9919 (2017).
 20. **L. Cai**, J. Zhao, H. Li, H. S. Han, X. L. Zheng, "One-Step Hydrothermal Deposition of Ni:FeOOH onto Photoanodes for Enhanced Water Oxidation", *ACS Energy Letters*, 1, 624-632 (2016).
 19. H. Li, C. Tsai, A. L. Koh, **L. Cai**, A. Contryman, A. Fragapane, J. Zhao, H. S. Han, H. Manoharan, F. A., J. Nørskov, X. L. Zheng, "Activating and Optimizing MoS₂ Basal Planes for Hydrogen Evolution through the Formation of Strained Sulphur Vacancies", *Nature Materials*, 15, 48-53 (2016).
 18. H. Li, S. Ahn, S. Park, **L. Cai**, J. Zhao, J. He, M. Zhou, J. Park, X. L. Zheng, "Molybdenum Disulfide Catalyzed Tungsten Oxide for on-Chip Acetone Sensing", *Applied Physics Letters*, 109, 133103 (2016).
 17. P. Allen, **L. Cai**, L. Zhou, C. Zhao, P. M. Rao, "Rapid Synthesis of Thin and Long Mo₁₇O₄₇ Nanowire-Arrays in an Oxygen Deficient Flame", *Scientific Reports*, 6, 27832 (2016).
 16. J. Zhao, Y. Guo, **L. Cai**, H. Li, K. Wang, I. Cho, C. Lee, S. Fan, and X. L. Zheng, "High-Performance Ultrathin BiVO₄ Photoanode on Textured Polydimethylsiloxane Substrates for Solar Water Splitting", *ACS Energy Letters*, 1, 68–75 (2016).
 15. M. Zhou, **L. Cai**, M. Bajdich, M. G. Melchor, H. Li, J. He, J. Wilcox, W. Wu, A. Vojvodic, X.

- L. Zheng, "Enhancing Catalytic CO Oxidation over Co₃O₄ Nanowires by Substituting Co²⁺ with Cu²⁺", *ACS Catalysis*, 5, 4485-4491 (2015).
14. X. Shi, **L. Cai**, M. Ma, X. L. Zheng, J. H. Park, "General Characterization Methods for Photoelectrochemical Cells for Solar Water Splitting", *ChemSusChem*, 8, 3192-3203 (2015).
 13. I.S. Cho, J. Choi, K. Zhang, S.J. Kim, M.J. Jeong, **L. Cai**, T. Park, X. L. Zheng, J. H. Park, "Highly Efficient Solar Water Splitting from Transferred TiO₂ Nanotube Arrays", *Nano Letters*, 15, 5709-5715 (2015).
 12. **L. Cai**, I. S. Cho, M. Logar, A. Mehta, J. He, C. H. Lee, P. M. Rao, Y. Feng, J. Wilcox, F. B. Prinz, X. L. Zheng, "Sol-Flame Synthesis of Cobalt-doped TiO₂ Nanowires with Enhanced Electrocatalytic Activity for Oxygen Evolution Reaction", *Physical Chemistry Chemical Physics*, 16, 12299-12306 (2014).
 11. P. M. Rao, **L. Cai**, C. Liu, I. S. Cho, C. H. Lee, J. M. Weisse, P. D. Yang, X. L. Zheng, "Simultaneously Efficient Light Absorption and Charge Separation in WO₃/BiVO₄ Core/Shell Nanowire Photoanode for Photoelectrochemical Water Oxidation", *Nano Letters*, 14, 1099-1105 (2014).
 10. I. S. Cho, M. Logar, C. H. Lee, **L. Cai**, F. B. Prinz, X. L. Zheng, "Rapid and Controllable Flame Reduction of TiO₂ Nanowires for Enhanced Solar Water Splitting", *Nano Letters*, 14, 24-31 (2014).
 9. I. S. Cho, C. H. Lee, Y. Feng, M. Logar, P. M. Rao, **L. Cai**, D. R. Kim, R. Sinclair, X. L. Zheng, "Codoping Titanium Dioxide Nanowires with Tungsten and Carbon for Enhanced Photoelectrochemical Performance", *Nature Communications*, 4:1723 (2013).
 8. **L. Cai**, P. M. Rao, Y. Feng, X. L. Zheng, "Flame Synthesis of 1-D Complex Metal Oxide Nanomaterials", *Proceedings of the Combustion Institute*, 34, 2229-2236 (2013).
 7. Y. Ohkura, J. M. Weisse, **L. Cai**, X. L. Zheng, "Flash Ignition of Freestanding Porous Silicon Film: Effects of Film Thickness and Porosity", *Nano Letters*, 13, 5528-5533 (2013).
 6. J. M. Weisse, C. H. Lee, D. R. Kim, **L. Cai**, P. M. Rao, X. L. Zheng, "Electro-Assisted Transfer of Vertical Silicon Wire Arrays Using a Sacrificial Porous Silicon Layer", *Nano Letters*, 13, 4362-4368 (2013).
 5. R. Luo, I. S. Cho, Y. Feng, **L. Cai**, P. M. Rao, X. L. Zheng, "Morphological Control of Heterostructured Nanowires Synthesized by Sol-flame Method", *Nanoscale Research Letter*, 8:437 (2013).
 4. Y. Feng, I. S. Cho, P. M. Rao, **L. Cai**, X. L. Zheng, "Sol-Flame Synthesis: A General Strategy to Decorate Nanowires with Metal Oxide/Noble Metal Nanoparticles", *Nano Letters*, 13, 855-860 (2013).
 3. Y. Feng, I. S. Cho, **L. Cai**, P. M. Rao, X. L. Zheng, "Sol-Flame Synthesis of Hybrid Metal Oxide Nanowires", *Proceedings of the Combustion Institute*, 34, 2179-2186 (2013).
 2. **L. Cai**, P. M. Rao, X. L. Zheng, "Morphology-Controlled Flame Synthesis of Single, Branched,

and Flower-like α -MoO₃ Nanobelt Arrays", *Nano Letters*, 11, 872-877 (2011).

1. Z. Y. Jiang, L. Zhang, **L. Cai**, C. R. Xia, "Bismuth Oxide-Coated (La,Sr)MnO₃ Cathodes for Intermediate Temperature Solid Oxide Fuel Cells with Ytria-Stabilized Zirconia Electrolytes", *Electrochimica Acta*, 54, 3059-3065 (2009).

Conference Presentations

1. **Talk**, "Hierarchically Structured Self-Cleaning Polymer Composites for Daytime Radiative Cooling", MRS 2023 Spring Meeting, San Francisco, CA, Apr 2023.
2. **Talk**, "Visibly Transparent and Infrared Reflective Coatings for Personal Thermal Management and Thermal Camouflage", MRS 2023 Spring Meeting, San Francisco, CA, Apr 2023.
3. **Talk**, "Atmospheric-Pressure Flame Vapor Deposition of Nanocrystalline Diamonds over Large Areas", MRS 2022 Fall Meeting, Boston, MA, Nov 2022.
4. **Talk**, "Atmospheric-Pressure Flame Vapor Deposition of Nanocrystalline Diamonds", ASME 2022 International Mechanical Engineering Congress and Exposition (IMECE2022), Columbus, OH, Oct 2022.
5. **Talk**, "Hierarchically Structured Self-Cleaning Polymer Composites for Daytime Radiative Cooling", ASME 2022 International Mechanical Engineering Congress and Exposition (IMECE2022), Columbus, OH, Oct 2022.
6. **Talk**, "Visibly Transparent and Infrared Reflective Coatings for Personal Thermal Management and Thermal Camouflage", ASME 2022 International Mechanical Engineering Congress and Exposition (IMECE2022), Columbus, OH, Oct 2022.
7. **Invited Talk**, "Van der Waals Epitaxy of Atomically Thin Metal Oxides", "Future directions in nanomaterial synthesis: from rational design to data driven manufacturing" virtue workshop hosted by the NSF Hierarchical nanoMFG node, 2021.
8. **Invited Talk**, "Tailoring Thermal Radiation with Nanophotonic Structures for Thermal Management", Army Research Lab, Adelphi, MD, Aug 2019.
9. **Invited Talk**, "Bringing Thermal Science and Nanomaterials for Sustainable Energy Applications", University of Colorado Boulder, Department of Mechanical Engineering, 2018.
10. **Invited Talk**, "Tailoring Thermal Radiation with Nanophotonic Structures for Thermal Management", Washington University, Department of Materials Science and Engineering, 2018.
11. **Invited Talk**, "Tailoring Thermal Radiation with Nanophotonic Structures for Thermal Management", Texas A&M University, Department of Mechanical Engineering, 2018.
12. **Talk**, "Rapid Flame Synthesis of Atomically Thin MoO₃ down to Monolayer Thickness for Effective Hole Doping of WSe₂", Materials Research Society (MRS) Fall Meeting, Boston,

MA, Nov 2017.

13. **Talk**, "Warming up Human Body by Nanoporous Metallized Polyethylene Textile", Materials Research Society (MRS) Fall Meeting, Boston, MA, Nov 2017.
14. **Poster**, "One-Step Hydrothermal Deposition of Ni:FeOOH onto Photoanodes for Enhanced Water Oxidation", Materials Research Society (MRS) Fall Meeting, Boston, MA, Nov 2017.
15. **Talk**, "Sol-Flame Synthesis of Cobalt-doped TiO₂ Nanowires with Enhanced Electrocatalytic Activity for Oxygen Evolution Reaction", Stanford Mechanical Engineering Conference (MECON), Stanford, CA, May 2015.
16. **Talk**, "Morphology-Controlled Flame Synthesis of MoO₃ Nanostructures", Materials Research Society (MRS) Fall Meeting, Boston, MA, Dec 2014.
17. **Talk**, "Sol-Flame Synthesis of Cobalt-doped TiO₂ Nanowires with Enhanced Electrocatalytic Activity for Oxygen Evolution Reaction", MA, Dec 2014.
18. **Talk**, "Engineering of Metal Oxide Nanowires by Flame Synthesis for Efficient Photoelectrochemical Water Splitting", Materials Research Society (MRS) Spring Meeting, San Francisco, CA, April 2014.
19. **Poster**, "Flame Processing of TiO₂ Nanowires to Improve Charge Transport and Transfer Properties for Efficient Photoelectrochemical Water Splitting", Materials Research Society (MRS) Spring Meeting, San Francisco, CA, April 2014.
20. **Talk**, "Combustion Synthesis of 1-D Simple Binary and Complex Metal Oxide Nanomaterials", Materials Research Society (MRS) Fall Meeting, Boston, MA, Nov 2012.
21. **Talk**, "Flame Synthesis of 1-D Complex Metal Oxide Nanomaterials", 34th International Symposium on Combustion, Warsaw, Poland, Aug 2012.
22. **Talk**, "Flame Synthesis of 1-D Complex Metal Oxide Nanomaterials", Materials Research Society (MRS) Spring Meeting, San Francisco, CA, April 2012.

Patents

1. **L. Cai**, H. K. Woo, "Novel Visibly Transparent and Infrared Reflective (VTIR) Coatings", Appl. No. 63/354,530.
2. **L. Cai**, K. Zhou, N. Miljkovic, X. Yan, "Porous Polymer Composite for Daytime Radiative Cooling and Method of Making a Porous Polymer Composite", U.S. Patent Application No.: 63/219,969.
3. Y. Cui, **L. Cai**, "Radiative-Heating Clothing Fabric with Colors", Appl. No. US 16/406,964.
4. Y. Cui, S. Fan, **L. Cai**, W. Li, P.-C. Hsu, "Spectrally Selective Textile for Passive Radiative Outdoor Personal Cooling", Pub. No. US 2019/0239586 A1.