

# Wenhao Shao

Davidson School of Chemical Engineering  
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## Education

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- Purdue University, West Lafayette, IN** From 2022
- Postdoctoral Assistant, Davidson School of Chemical Engineering
  - Advisor: Professor [Letian Dou](#)
- University of Michigan, Ann Arbor, MI** 2017-2022
- Ph.D. in Chemistry / Graduate Certificate in Computational Discovery and Engineering
  - Advisor: Professor [Jinsang Kim](#)
  - Thesis: Purely Organic Triplet Emitters: From Fundamental Molecular Design to Performance Amplification in Modern Applications
- Fudan University, Shanghai, China** 2013-2017
- Bachelor of Science in Chemistry
  - Advisors: Professor Fuyou Li & Professor Wei Feng
  - Thesis: The Relationship between Shell Thickness and FRET Efficiency in Dye-Sensitized Luminescent Core-Shell Rare-Earth Upconversion Nanoparticles

## Experience

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- Purdue University, West Lafayette, IN** From 2022
- Postdoctoral Associate, Letian Dou Group, Davidson School of Chemical Engineering*
- Molecular design and synthesis of organic spacers and band-gap engineering in layered perovskites for thin-film quasi-2D and 2D/3D heterostructure-based LEDs.
  - Solution-phase perovskite single crystal growth, nanocrystal fabrication, and crystallographic investigation on crystal self-assembly.
  - Optical system design for chiral-optics and optically pumped lasing.
- University of Michigan, Ann Arbor, MI** 2018-2022
- Research Assistant, Jinsang Kim Group, Materials Science & Engineering*
- First principle design of organic triplet emitters and photophysical characterizations.
  - Aromatic ring modification on small molecule and polymeric semiconductors.
  - OLED fabrication, characterization, and solution-processability.
- Research Assistant, Mark Banaszak Holl Group, Department of Chemistry* 2017
- Molecular-to-morphological characterization of mechanically loaded Anterior Cruciate Ligament with AFM-IR and second harmonic generation confocal microscopy.
- Research Assistant, Raoul Kopelman Group, Department of Chemistry* 2015-2016
- Hydrogel nanoparticle design and synthesis for chemotherapeutic delivery.
- Fudan University, Shanghai, China** 2014-2017
- Research Assistant, Fuyou Li & Wei Feng Group, Department of Chemistry*
- Colloidal synthesis of core-shell rare-earth upconversion nanoparticles.

## Leading Grant Proposals

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- Development of Novel Strategies for Solution Processable Multilayer Organic Light-Emitting Diodes Based on Reversible Diels-Alder Chemistry. *Funded by LG Chem, 2018-2019.*
- Synergetic Manipulation of Heavy Atom Effects and Orbital Angular Momentum for the Rational Design of Novel Metal-Free Organic Semiconductors. *Submitted to NSF / DMREF, 2021.*

## Publications

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### Leading Projects <sup>+</sup>equal contribution

- **Shao, W.**<sup>+</sup>; Kim, J. H.<sup>+</sup>; Simon, J.; Nian, Z.; Baek, S. -B.; Lu, Y.; Fruling, C. B.; Yang, H.; Wang, K.; Park, J. Y.; Huang, L.; Yu, Y.; Boltasseva, A.; Savoie, B. M.; Shalaev, V. M.; Dou, L. Molecular templating of layered halide perovskite nanowires. *Science* **2024**, *384(6699)*, 1000-1006.
  - News highlight: [Purdue](#), [Bioengineer.org](#), [ScienceDaily](#), [Phys.org](#).
- Xu, W.<sup>+</sup>; **Shao, W.**<sup>+</sup>; Tang, Y.; Lin, C.; Yang, H.; Yang, Y. -T.; Kim, J. H.; Lee, G.; Kumar, P.; Pedersen, K. R.; Coffey, A. H.; Harvey, S. P.; Graham, K. R.; Zhu, C.; Zhu, K.; Dou, L. Ionic liquids improve perovskite solar cells long-term stability. *Submitted*.
- Baek, S. -B.<sup>+</sup>; **Shao, W.**<sup>+</sup>; Feng, W. -J.; Tang, Y.; Lee, Y. H.; Loy, J.; Gunnarsson, W. B.; Yang, H.; Zhang, Y.; Faheem, M. B.; Kaswekar, P. I.; Atapattu, H. R.; Coffey, A.; Park, J. Y.; Yang, S. J.; Yang, Y. -T.; Zhu, C.; Wang, K.; Graham, K.; Gao, F.; Qiao, Q.; Guo, L. J.; Rand, B.; Dou, L. Grain engineering for efficient near-infrared perovskite light-emitting diodes. *Nat. Commun.* **2024**, *15*, 10760.
- **Shao, W.**; Yang, S.; Wang, K.; Dou, L. Light-Emitting Organic Semiconductor-Incorporated Perovskites: Fundamental Properties and Device Applications. *J. Phys. Chem. Lett.* **2023**, *14(8)*, 2034-2046.
- **Shao, W.**; Kim, J. Metal-Free Organic Phosphors toward Fast and Efficient Room-Temperature Phosphorescence. *Acc. Chem. Res.* **2022**, *55(11)*, 1573-1585.
- **Shao, W.**; Hao, J.; Jiang, H.; Zimmerman, P.; Kim, J. Metal-Free Organic Triplet-Emitters with On-Off Switchable Excited State Intramolecular Proton Transfer. *Adv. Funct. Mater.* **2022**, *32(29)* 2201256.
- **Shao, W.**; Jiang, H.; Ansari, R.; Zimmerman, P.; Kim, J. Heavy Atom Oriented Orbital Angular Momentum Manipulation in Metal-Free Organic Phosphors. *Chem. Sci.* **2022**, *13(3)*, 789-797.
- Song, B.<sup>+</sup>; **Shao, W.**<sup>+</sup>; Jung, J.; Yoon, S. -J.; Kim, J. Organic Light-Emitting Diode Employing Metal-Free Organic Phosphor. *ACS Appl. Mater. Interfaces* **2020**, *12(5)*, 6137-6143.

### Contributing

- Choi, J. <sup>+</sup>; Im, H. <sup>+</sup>; Kim, D. W.; Jiang, H.; Stark, A.; **Shao, W.**; Zimmerman, P. M.; Jeon G. W.; Jang, J. W.; Hwang, E. H.; Kim, S.; Park, D. H.; Kim, J. Microsecond Triplet Emitters by Hybridizing Organic with 2-D Transition Metal Dichalcogenides. *Nat. Commun.* **2024**, *15*, 10282.
  - News highlight: [Michigan Engineering](#).
- Baek, S. -D.; Yang, S. J.; Yang, H.; **Shao, W.**; Yang, Y. -T.; Dou, L. Exciton Dynamics in Layered Halide Perovskite Light-Emitting Diodes. *Adv. Mater.* **2024**, 2411998.
- Tang, Y.; Ma, K.; **Shao, W.**; Lee, Y. H.; Abtahi, A.; Sun, J.; Yang, J.; Coffey, A. H.; Atapattu, H.; Ahmed, M.; Hu, Q.; Xu, W.; Dani, R.; Wang, L.; Zhu, C.; Graham, K. R.; Mei, J.; Dou, L. A Pyrrole Modified 3,4-Propylenedioxythiophene Conjugated Polymer as Hole Transport Layer for Efficient and Stable Perovskite Solar Cells. *Small* **2024**, 2408440.
- Wang, K.; Lin, Z. -Y.; De, A.; Kocoj, C.; **Shao, W.**; Yang, H.; Coffey, A.; Fruhling, C. B.; Tang, Y.; Varadharajan, D.; Zhu, C.; Boltasseva, A.; Shalaev, V. M.; Guo, P.; Savoie, B. M.; Dou, L. Two-Dimensional Lattice Confined Single-Molecule-Like Aggregates. *Nature* **2024**, *633*, 567-574.
- Tang, Y.; Yang, H.; Sun, J.; Wu, Z.; **Shao, W.**; Joy, S.; Kim, J. H.; Xu, W.; Coffey, A. H.; Lee, Y. H.; Lin, C.; Wang, L.; Ma, K.; Zhu, C.; Graham, K. R.; Tao, S.; Huang, L.; Dou, L. Triplet Management at Ligand-Perovskite Interface to Enhanced Photovoltaics Performance. *ACS Eng. Lett.* **2024**, *9*, 4323-4330.
- Yang, H.; **Shao, W.**; Sun, J.; Kim, J. H.; Lee, Y. H.; Huang, L.; Dou, L. Ligand-variant two-dimensional halide perovskite lateral heterostructure. *MRS Bulletin* **2024**, *49*, 1-7.
- Zhao, H.; Wang, Q.; Wang, S.; Yin, J.; Wang, H.; **Shao, W.**; Yao, Z.; Yao, J.; Zang, L. Balancing the Phosphorescence and Fluorescence of a Double-Ring Porphyrin Using Different Lanthanides for Ratiometric Oxygen Sensing. *Inorg. Chem. Front.* **2023**, *10*, 5161-5166.
- Zang, L.; **Shao, W.**; Bolton, O.; Ansari, R.; Yoon, S. -J.; Heo, J. -M.; Kieffer, J.; Matzger, A. J.; Kim, J. Polarity-Induced Dual Room-Temperature Phosphorescence Involving the T2 States of Pure Organic Phosphors. *J.*

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*Mater. Chem. C* **2022**, *10*, 14746-14753.

- Ansari, R.; **Shao, W.**; Yoon, S. -J.; Kim, J; Kieffer, J. Charge Transfer as the Key Parameter Affecting the Color Purity of Thermally Activated Delayed Fluorescence Emitters. *ACS Appl. Mater. Interfaces*. **2021**, *13*, 28529-28537.
- Zang, L.; **Shao, W.**; Kwon, M. S.; Zhang, Z.; Kim, J. Photoresponsive Luminescence Switching of Metal-Free Organic Phosphors Doped Polymer Matrices. *Adv. Opt. Mater.* **2020**, *8(23)*, 2000654.
- Lee, D. R.; Lee, K. H.; **Shao, W.**; Kim, C. L.; Kim, J.; Lee, J. Y. Heavy Atom Effect of Selenium for Metal-Free Phosphorescent Light-Emitting Diodes. *Chem. Mater.* **2020**, *32(6)*, 2583–2592.
- Chen, J.; Kim, J. -H; **Shao, W.**; Schlecht, S. H.; Baek, S. Y.; Jones, A. K.; Ahn, T.; Ashton-Miller, J. A.; Banaszak Holl, M. M.; Wojtys E. M. An Anterior Cruciate Ligament Failure Mechanism. *Am. J. Sports Med.* **2019**, *47*, 2067-2076.

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### Awards

- MSED 1<sup>st</sup> Place Poster Award @AICHE, 2024
- Rackham Predoctoral Fellowship @University of Michigan, 2021-2022.
- Overall Best Poster Award @42<sup>nd</sup> Annual Macro Symposium, University of Michigan, 2018.
- Outstanding Presentation Award @Undergraduate Technology and Academy Forum, Fudan University, 2016.

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### Presentations (invited)

- *Topological Modifications of Layered Materials*. @Department of Chemistry, New York University, Dec. 2024. (host: *Bart Kahr*)
- *Topological Modification at Organic Inorganic Interface*. @Materials Chemistry Seminar, Purdue, Mar. 2024. (host: *Department*)
- *Heavy Atom Oriented Orbital Angular Momentum Manipulation in Metal-Free Organic Phosphors*. @ACS Energy and Fuels Division Student Seminar Series (3S), Oct. 2021.

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### Teaching, Mentoring, Coaching, Service

*At Fudan University*

- President of Junior Achievement, campus chapter: *design and coordinate career coaching* 2014-2015 courses at the University level.

*At University of Michigan*

- “Investigation in Organic Chemistry” (Laboratory, Chem 211) Fall 2017/2018
- “Polymer Synthesis and Characterization” (Laboratory, Chem 436) Winter 2018
- “Advanced Functional Polymers: Molecular Design and Applications” (Lecture, MSE 517) 2019F
- “General Chemistry” (Lecture, Chem 130) 2020F, 2021W
- Peer Mentor at Graduate Rackham International (GRIN) 2020F
- Chemistry Instructional Coaching Team: *supporting new graduate student investigators navigate their teaching role.* 2020-2022

*After Ph.D.*

- OPTICA Technical Groups – Quantum Applications in Biomedicine and Material Chemistry 2024-