So Min Park

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Professional appointments

Assistant Professor Sept 2024 – present
Department of Chemistry, National University of Singapore, Singapore

Postdoctoral Fellow, Northwestern University, US June 2023 - 2024
Postdoctoral Fellow, University of Toronto, Canada 2021 - June 2023
Advisor: Prof. Edward H. Sargent

• **Photovoltaic and reliability group leader**: managed projects, wrote grant proposals and reports, mentored over 12 postdocs and 7 graduate students, edited manuscripts for group members results in more than 10 publications

Research topics: Materials engineering for highly efficient and stable perovskite solar cells (PSCs) and colloidal quantum dot light emitting diodes (QLEDs)
• Achieved record efficiency in inverted PSCs using molecular engineering (*Nature,* 2023)
• Developed new materials enable high temperature operating stable PSCs (*Science,* 2023)
• Demonstrated surface modification of inorganic hole injection layer for InP LEDs (*JACS*, 2022)

Research Assistant, University of Kentucky, US 2014-2020
Advisor: Prof. Kenneth R. Graham
Research topics: Surface ligand effects on energetics, charge transfer, and stability at interfaces between metal halide perovskites and organic semiconductors
• Assisted in set-up of an ultra-high vacuum (UHV) system consisting of an analysis chamber with various photoelectron spectroscopies (XPS, UPS, IPES)
• Supervised 4 undergraduate students

Research Assistant, Gyeongsang National University, South Korea 2010-2014
Advisor: President Soon-Ki Kwon
Research topics: Synthesis and characterization of organic semiconducting polymers and oligomers for organic thin film transistors and organic photovoltaic cells
• Developed donor-acceptor type bulk heterojunction polymers and small molecules
• Received a scholarship for interdisciplinary collaboration between academia and industry

Researcher, Samsung Display OLED Center, Gyeongsang National University 2011-2013
Advisor: President Soon-Ki Kwon, Prof. Yun-Hi Kim
• Synthesized new OLED materials to enhance performance and material stability

Awards and Honors

1. **GLOW 2024 Travel Award,** Nanyang Technological University 2024
   Global conference for women leaders and emerging researchers in materials science
2. **Presidential Young Professorship,** National University of Singapore 2024
3. **ACS PHYS Young Investigator Award** 2023
   American Chemical Society, physical chemistry division
4. **MIT ChemE Rising Stars** 2023
   Awarded to top early-stage academic career female researchers
5. **Rising Stars in MSE** (CMU, MIT, Stanford) 2023
   Workshop for early-career scholars aiming for academic teaching and research positions
6. **PSK-INNOX Young Investigator Award** Polymer Society Korea 2023
7. **Viji Jeganathan Scholarship** 2019
   Cross-cultural understanding, International Student Center, University of Kentucky

First-authored Publications

[†The authors contributed equally, *corresponding author]

1. H. Wan†, E. D. Jung†, T. Zhu†, **S. M. Park**†, J. M. Pina, P. Xia, K. Bertens, Y. Wang, O. Atan, H. Chen, Y. Hou, S. Lee, Y. H. Won, K. H. Kim, S. Hoogland, E. H. Sargent. Nickel oxide hole injection layers for balanced charge injection in quantum dot light-emitting diodes. ***Small*** 2024, 2402371.

2. **S. M. Park**†, M. Wei†, N. Lempesis†, W. Yu, T. Hossain, L. Agosta, V. Carnevali, H. R. Atapattu, P. Serles, F. T. Eickemeyer, H. Shin, M. Vafaie, D. Choi, K. Darabi, E. D. Jung, Y. Yang, D. B. Kim, S. M. Zakeeruddin, B. Chen, A. Amassian, T. Filleter, M. G. Kanatzidis K. R. Graham, L. Xiao, U. Rothlisberger, M. Graetzel, E. H. Sargent. Low-loss contacts on textured substrates for inverted perovskite solar cells. ***Nature*** 2023, 624, 289-294.

   Highlighted by TechXplore, PV magazine, Perovskite-info, AZO Materials, my Science, Northwestern Engineering, EPFL news media coverage

3. W. S. Shen†, Y. Liu†, L. Grater†, **S. M. Park**†, H. Wan, Y. J. Yu, J. L. Pan, F. C. Kong, Q. S. Tian, D. Y. Zhou, Z. Liu, W. Ma, B. Sun, Y. K. Wang, S. Hoogland, L. S. Liao. Thickness-variation-insensitive near-infrared quantum dot LEDs. ***Science Bulletin*** 2023, 68, 2954-2961.

4. **S. M. Park**†, M. Wei†, J. Xu†, H. R. Atapattu, F. T. Eickemeyer, K. Darabi, L. Grater, S. Teale, Y. Yang, C. Liu, B. Chen, H. Chen, T. Wang, L. Zeng, A. Maxwell, Z. Wang, K. R. Rao, Z. Cai, S. M. Zakeeruddin, J. T. Pham, C. M. Risko, A. Amassian, M. G. Kanatzidis, K. R. Graham, M. Graetzel, E. H. Sargent. Engineering ligand reactivity enables high-temperature-operating-stable perovskite solar cells. ***Science*** 2023, 381, 6654, 209-215.

   Highlighted by Chemistry World, Phys.org, Optica, University of Toronto Engineering, Northwestern Engineering, EPFL news media coverage

5. **S. M. Park***, E. H. Sargent. Navigating pathways to increase stability in perovskite solar cells. ***Matter*** 2023, 6, 8, 2488-2490.

6. S. Lee†, **S. M. Park**†, E. D. Jung†, T. Zhu†, J. M. Pina, H. Anwar, F. Li, G. Chen, Y. Dong, T. Cui, M. Wei, K. Bertens, Y. Wang, B. Chen, T. Filleter, S. Hung, Y. Won, K. H. Kim, S. Hoogland, E. H. Sargent. Dipole engineering through the orientation of interface molecules for efficient InP quantum dot light-emitting diodes. ***Journal of the American Chemical Society*** 2022, 144, 20923-20930.

7. **S. M. Park**, A. Abtahi, A. Boehm, K. R. Graham. Surface ligands for methylammonium lead iodide films: surface coverage, energetics, and photovoltaic performance. ***ACS Energy Letters*** 2020, 5, 799-806.

8. **S. M. Park**, S. Mazza, Z. Liang, A. Abtahi, A. Boehm, S. Parkin, J. Anthony, K. R. Graham. Processing dependent influence of the hole transport layer ionization energy on methylammonium lead iodide perovskite photovoltaics. ***ACS Applied Materials & Interfaces*** 2018, 10, 15548-15557.

9. **S. M. Park**, Y. Yoon, C. W. Jeon, H. Kim, M. J. Kim, D. K. Lee, J. Y. Kim, H. J. Son, S. K. Kwon, Y. H. Kim, B. S. Kim. Synthesis of phenanthro[1,10,9,8-cdefg]carbazole-based conjugated polymers for organic solar cell applications. ***Journal of Polymer Science, Part A: Polymer Chemistry*** 2014, 52, 796-803. *Selected as front cover*

10. **S. M. Park**, H. N. Kim, S. C. Shin, Y. H. Kim. New semiconducting copolymers containing alkyl quaterthiophene and alkoxy naphthalene moieties for organic thin film transistors. ***Macromolecular Research*** 2014, 22, 9, 1012-1017.

11. **S. M. Park**, I. Kang, Y. L. Yu, S. Y. Nam, J. Hwang, Y. H. Kim. Organic semiconductor based on asymmetric naphthalene-thiophene molecule for organic thin film transistors. ***Journal of Nanoscience and Nanotechnology*** 2014, 14, 6172-6176.

12. T. K. An†, **S. M. Park**†, S. Nam, J. Hwang, S. J. Yoo, M. J. Lee, W. M. Yun, J. Jang, H. Cha, J. Hwang, S. Park, J. Kim, D. S. Chung, Y. H. Kim, S. K. Kwon, C. E. Park. Thin film morphology control via a mixed solvent system for high-performance organic thin film transistors. ***Science of Advanced Materials*** 2013, 5, 1323-1327.

13. **S. M. Park**, I. Kang, H. J. Yun, S. Y. Nam, J. Hwang, Y. H. Kim. New si-based material with pyridopyrazine substituents. ***Bulletin of the Korean Chemical Society*** 2012, 33, 3469-3472.

Education

Ph.D. in Materials Science and Engineering 2020
University of Kentucky, Lexington, KY, United States

M.S. in Chemistry 2017
University of Kentucky, Lexington, KY, United States

B.S., and M.S. in Materials Science and Engineering 2013
Gyeongsang National University, Jinju, South Korea

Teaching Experience

Pedagogical Training

Teaching in Higher Education THE500, University of Toronto 2022
Teaching Assistant Training Program ESL090, University of Kentucky 2014

Graduate Teaching Assistant, University of Kentucky, US (8 semesters)

CHE111, CHE113 General Chemistry Fall 2014, Spring 2015, Fall 2016, Spring 2017, Fall 2017
4-6 hours class teaching per week, 3 hours office hour per week
Course registered for all Arts & Sciences and Engineering majors

CHE226 Analytical Chemistry Fall 2015, Spring 2016
CHE446 Physical Chemistry Fall 2019

Graduate Teaching Assistant, *Organic Chemistry*, Gyeongsang National University 2012

Service and Outreach

Kentucky Material Networking Day 2019
Wrote a proposal and received a thousand-dollar grant from Materials Research Society (MRS)
Invited keynote speakers and student talks, organized poster session and award ceremony
Engaged nearby universities, industries, and national laboratories in the Midwest local community

Sustainability Pitch 2019
Green planet renewables, University of Kentucky

STEM Summer Camp 2017, 2018, 2019
Blackberry solar cell and lemon battery experiments for 5^{th} to 12^{th} grade students

Women in Engineering Explore Camp 2018
Shape memory polymers demonstration for high school female student

Professional Academic Service

Independent Journal Reviewer

The Journal of Physical Chemistry, Chem Catalysis, Organic Electronics, Journal of Materials Chemistry A, Joule, Journal of American Chemical Society, Energy & Environmental Science

Session Chair Materials Research Society (MRS) meeting, Boston, US 2023
Vice President of Materials Research Society (MRS) University of Kentucky Chapter 2019
Event Chair of Korean-American Scientists and Engineers Association, Kentucky Chapter 2019
President of Korean Scholar Association at University of Kentucky 2018, 2019
Government Scholar of Teach and Learn in Korea (TaLK) program 2009

Presentations

1. JSAP Autumn Meeting, The Japan Society of Applied Physics (Invited speaker) 2024
2. GLOW, Nanyang Technological University, Singapore (Talk, Travel Award) 2024
3. Solution Processed Optoelectronics, University of Michigan, US (Guest lecture) 2023
4. Global Photovoltaic Conference, Gwangju, South Korea (Invited speaker) 2023
5. Ulsan National Institute of Science and Technology, Gwangju Institute of Science and Technology, Sungkyunkwan University, Korea Institute of Energy Technology (Talk) 2023
6. Materials Research Society Fall meeting, Boston, US (Talk) 2022, 2023
7. Materials Research Society Spring meeting, Phoenix, US (Talk) 2019
8. Materials Research Society meeting, US (Poster) Spring 2018, Fall 2018, Fall 2019
9. Material and Chemical Engineering (MACE) symposium, Lexington, US (Poster) 2019
10. Gyeongsang National University, Material Science & Engineering, Jinju, Korea (Talk) 2018
11. Naff symposium, Material Chemistry, Lexington, US (Poster) 2017
12. The International Conference on Molecular Electronics and Devices, Suwon, Korea (Poster) 2012
13. 14th the Asian Chemical Congress (ACC), Bangkok, Thailand (Poster) 2011
14. International Chemical Congress of Pacific Basin Societies (Pacifichem), Honolulu (Poster) 2010

Coauthored Publications

1. J. Xu, A. Maxwell, Z. Song, A. SR Bati, H. Chen, C. Li, **S. M. Park**, Y. Yan, B. Chen, E. H. Sargent. The dynamic adsorption affinity of ligand is a surrogate for the passivation of surface defects. ***Nature Communications*** 2024, 15, 2035.

2. Z. Tang, F. Lyu, J. Gu, H. Guo, W. Yu, Y. Zou, L. Gong, R. Tang, B. Qu, X. Guo, Y. Chen, Y. Deng, M. Bian, Y. Li, D. Zhang, M. Wei, **S. M. Park**, P. Xia, Y. Lv, Q. Gong, S. Wang, Z. Chen, L. Xiao. Sub-second long lifetime triplet exciton reservoir for highly efficient and stable organic light-emitting diode. ***Advanced Materials*** 2024, 2313746.

3. A. Maxwell, H. Chen, L. Grater, C. Li, S. Teale, J. Wang, L. Zeng, Z. Wang, **S. M. Park**, M. Vafaie, S. Sidhik, I. W. Metcalf, Y. Liu, A. D. Mohite, B. Chen, E. H. Sargent. All-perovskite tandems enabled by surface anchoring of long-chain amphiphilic ligands. ***ACS Energy Letters*** 2024, 9, 520-527.

4. Y. Yang, C. Liu, Y. Ding, B. Ding, J. Xu, A. Liu, J. Yu, L. Grater, H. Zhu, S. S. Hadke, V. K. Sangwan, A. SR. Bati, X. Hu, J. Li, **S. M. Park**, M. C. Hersam, B. Chen, M. K. Nazeeruddin, M. G. Kanatzidis, E. H. Sargent. A thermotropic liquid crystal enables efficient and stable perovskite solar modules. ***Nature Energy*** 2024, 9, 316-323.

5. Y. Liu, T. Zhu, L. Grater, H. Chen, R. D. Reis, A. Maxwell, M. Cheng, Y. Dong, S. Teale, A. F. G. Leontowich, C. Kim, P. T. Chan, M. Wang, W. Paritmongkol, Y. Gao, **S. M. Park**, J. Xu, J. I Khan, F. Laquai, G. C. Walker, V. P. Dravid, B. Chen, E. H. Sargent. A three-dimensional quantum dot network stabilizes perovskite solids via hydrostatic strain. ***Matter*** 2024, 7, 107-122.

6. J. Xu, H. Chen, L. Grater, C. Liu, S. Teale, Y. Yang, S. Manesh, B. Rehl, Y. Chang, B. Chen, **S. M. Park**, M. G. Kanatzidis, E. H. Sargent. Anion Optimization for Bifunctional Surface Passivation in Perovskite Solar Cells. ***Nature Materials*** 2023, 22, 1507-1514.

7. M. Imran, W. Paritmongkol, H. A. Mills, Y. Hassan, T. Zhu, Y-K. Wang, Y. Liu, H. Wan, **S. M. Park**, E. D. Jung, J. Tam, Q. Lyu, G. F. Cotella, P. Ijaz, P. Chun, S. Hoogland. Molecular additive-assisted tellurium homogenization in ZnSeTe quantum dots. ***Advanced Materials*** 2023, 2303528.

8. L. Grater, M. Wang, S. Teale, S. Mahesh, A. Maxwell, Y. Liu, **S. M. Park**, B. Chen, F. Laquai, M. G. Kanatzidis, E. H. Sargent. Sterically suppressed halide segregation in 3D hollow mixed-halide wide band gap perovskites. ***The Journal of Physical Chemistry Letters*** 2023, 14, 6157-6162.

9. C. Li, X. Wang, E. Bi, F. Jiang, **S. M. Park**, Y. Li, L. Chen, Z. Wang, L. Zeng, H. Chen, Y. Liu, C. R. Grice, A. Abudulimu, J. Chung, T. Xian, T. Zhu, H. Lai, B. Chen, R. J. Ellingson, F. Fu, D. S. Ginger, Z. Song, E. H. Sargent, Y. Yan. Rational design of lewis base molecules for stable and efficient inverted perovskite solar cells. ***Science*** 2023, 379, 690-694.

10. Z. Wang, L. Zeng, T. Zhu, H. Chen, B. Chen, D. Kubicki, A. Balvanz, C. Li, A. Maxwell, E. Ugur, R. D. Reis, M. Cheng, G. Yang, B. Subedi, D. Luo, J. Hu, J. Wang, S. Teale, S. Mahesh, S. Wang, S. Hu, E. D. Jung, M. Wei, **S. M. Park**, L. Grater, E. Aydin, Z. Song, N. Podraza, Z. H. Lu, J. Huang, V. Dravid, S. D. Wolf, Y. Yan, M. Graetzel. M. Kanatzidis, E. H. Sargent. Lattice distortion suppresses phase segregation in triple-junction perovskite photovoltaics. ***Nature*** 2023, 618, 74-79.

11. Y. Wang, H. Wan, J. Xu, Y. Zhong, E. D. Jung, **S. M. Park**, S. Teale, M. Imran, Y. J. Yu, P. Xia, Y. H. Won, K. H. Kim, Z. H. Lu, L. S. Liao, J. Hoogland, E. H. Sargent. Bi-functional electron-transporting agent for colloidal quantum dot light-emitting diodes. ***Journal of the American Chemical Society*** 2023, 145, 6428-6433.

12. H. Chen, A. Maxwell, C. Li, S. Teale, B. Chen, T. Zhu, E. Ugur, G. Harrison, L. Grater, J. Wang, Z. Wang, Z. Wang, L. Zheng, **S. M. Park**, L. Chen, P. Series, R. A. Awni, B. Subedi, X. Zheng, C. Xiao, N. J. Podraza, T. Filleter, C. Liu, Y. Yang, J. M. Luther, S. D. Wolf, M. G. Kanatzidis, Y. Yan, E. H. Sargent. Regulating surface potential maximized voltage in all-perovskite tandems. ***Nature*** 2023, 613, 676-681.

13. H. Chen, S. Teale, B. Chen, Y. Hou, L. Grater, T. Zhu, K. Bertens, **S. M. Park**, H. R. Atapattu, Y. Gao, M. Wei, A. K. Johnston, Q. Zhou, K. Xu, D. Yu, C. Han, T. Cui, E. H. Jung, C. Zhou, W. Zhou, A. H. Proppe, S. Hoogland, F. Laquai, T. Filleter, K. R. Graham, Z. Ning, E. H. Sargent. Quantum-size-tuned heterostructures enable efficient and stable inverted perovskite solar cells. ***Nature Photonics*** 2022, 16, 5, 352-358.

14. R. Lin, J. Xu, M. Wei, Y. Wang, Z. Qin, Z. Liu, J. Wu, K. Xiao, B. Chen, **S. M. Park**, G. Chen, H. R. Atapattu, K. R. Graham, J. Xu, J. Zhu, L. Li, C. Zhang, E. H. Sargent, H. Tan. All-perovskite tandem solar cells with improved grain surface passivation. ***Nature*** 2022, 603, 73-78.

15. Y. Liu, Z. Li, J. Xu, Y. Dong, B. Chen, **S. M. Park**, D. Ma, S. Lee, J. E. Huang, S. Teale, O. Voznyy, E. H. Sargent. Wide-Bandgap Perovskite Quantum Dots in Perovskite Matrix for Sky-Blue Light-Emitting Diodes. ***Journal of the American Chemical Society*** 2022, 144, 9, 4009-4016.

16. J. L. Lansing, L. Zhao, T. Siboonruang, N. H. Attanayake, A. B. Leo, P. Fatouros, **S. M. Park**, K. R. Graham, J. A. Keith, M. Tang. Gd-Ni-Sb-SnO_2 electrocatalysts for active and selective ozone production. ***AlChE Journal*** 2021, 67, 12, e17486.

17. K. Ma, H. R. Atapattu, Q. Zhao, Y. Gao, B. P. Finkenauer, K. Wang, K. Chen, **S. M. Park**, A. H. Coffey, C. Zhu, L. Huang, K. R. Graham, J. Mei, L. Dou. Multifunctional conjugated Ligand engineering for stable and efficient perovskite solar cells. ***Advanced Materials*** 2021, 33, 2100791.

18. M. A. Uddin, J. D. Glover, **S. M. Park**, J. T. Pham, K. R. Graham. Growth of highly stable and luminescent anisotropic $CsPbX_3$ (X = Cl, Br, and I) nanocrystals via ligand mediated anion exchange of $CsPbCl_3$ nanocubes with AlX_3. ***Chemistry of Materials*** 2020, 32, 12, 5217-5225.

19. A. A. Masud, W. E. Martin, F. H. Munschi, **S. M. Park**, B. R. Srijanto, K. R. Graham, C. P. Collier, C. I, Richards. Mixed metal zero-mode guides (ZMWs) for tunable fluorescence enhancement. ***Nanoscale Advances*** 2020, 2, 1894-1903.

20. A. Boehm, T, Liu, **S. M. Park**, A. Abtahi K. Graham. Influence of surface ligands on energetic at $FASnI_3/C_{60}$ interfaces and their impact on photovoltaic performance. ***ACS Applied Materials & Interfaces*** 2020, 12, 5, 5209-5218.

21. A. Abtahi, S. Johnson, **S. M. Park**, X. Luo, Z. Liang, J. Mei, K. Graham. Designing π-conjugated polymer blends with improved thermoelectric power factors. ***Journal of Materials Chemistry A*** 2019, 7, 19774-19785.

22. F. Wang, Z. Ye, H. Sarvari, **S. M. Park**, A. Abtahi, K. Graham, Y. Zhao, Y. Wang, Z. D. Chen, S. Li. Humidity-insensitive fabrication of efficient perovskite solar cells in ambient air. ***Journal of Power Sources*** 2019, 412, 359-365.

23. N. Y. Jeong, M. S. Jang, **S. M. Park**, D. S. Chung, Y. H. Kim, S. K. Kwon. Synthesis and characterization of highly soluble phenanthro[1,10,9,8-c,d,e,f,g]carbazole-based copolymer: effects of thermal treatment on crystalline order and charge carrier mobility. ***Dyes and Pigments*** 2018, 149, 560-565.

24. C. Sun, S. Song, H. G. Song, **S. M. Park**, J. Y. Kim, Y. H. Kim, S. K. Kwon. A new dithienopyridine-based polymer for an organic electronics. ***Journal of Nanoscience and Nanotechnology*** 2017, 17, 5792-5795.

25. H. G. Song, Y. B. Kim, **S. M. Park**, T. K. An, S. K. Kwon, C. E. Park, Y. H. Kim. Synthesis, characterization, and transistor applications of new linear molecules: Naphthayl-ethynyl-anthracene-based small molecules containing different alkyl end group. ***Dyes and Pigments*** 2016, 131, 349-355.

26. H. J. Yun, M. C. Hwang, **S. M. Park**, R. Kim, D. S. Chung, Y. H. Kim, S. K. Kwon. Synthesis of a low-bandgap fluorinated donor-acceptor copolymer and its optoelectronic application. ***ACS Applied Materials & Interfaces*** 2013, 5, 6045-6053.

27. I. Kang, **S. M. Park**, D. H. Lee, S. H. Han, D. S. Chung, Y. H. Kim, S. K. Kwon. Novel unsymmetric oligomers based on benzo[d,d']Thieno[3,2-b:4,5-b']dithiophenes for solution-processed organic field-effect transistors. ***Science of Advanced Materials*** 2013, 5, 199-208.

28. S. O. Kim, K. Thangaraju, S. Jung, W. Lu, **S. M. Park**, J. Lee, J. I. Lee, H. Y. Chu, Y. H. Kim, S. K. Kwon. Highly efficient phosphorescent organic light emitting diodes based on iridium(III) complex with bulky substituent spacers. ***Journal of Nanoscience and Nanotechnology*** 2012, 12, 4375-4378.

29. S. O. Kim, M. W. Lee, S. H. Jang, **S. M. Park**, J. W. Park, M. H. Park, S. H. Kang, Y. H. Kim, C. K. Song, S. K. Kwon. Organic semiconductor based on phenylethynyl end-capped anthracene. ***Thin Solid Films*** 2011, 519, 7998-8002.