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Education

2024.09-present	Postdoc researcher , Department of Chemistry and Chemical Biology, <i>Cornell University</i> (Ithaca, NY, USA) (Host: Prof. Yao Yang) <i>*Sejong Science Fellowship (Sep 24' – Aug 25')</i>
2024.03-2024.08	Postdoc researcher , Department of Chemical and Biological Engineering, <i>Seoul National University</i> (Seoul, South Korea) (Host: Prof. Jungwon Park & Prof. Jaeyune Ryu)
2017.09-2024.02	Ph.D. , Department of Chemical and Biological Engineering, <i>Seoul National University</i> (Seoul, South Korea). GPA: 3.9/4.3 <i>Advisor</i> : Prof. Jungwon Park <i>Thesis</i> : Investigating Surface Atomic Coordination Chemistry and Degradation Processes of Pt Nanocrystals by Liquid-Cell TEM
2013.03-2017.08	B.S. , Department of Chemical and Biological Engineering, <i>Seoul National University</i> (Seoul, South Korea). GPA: 3.7/4.3 (<i>cum laude</i>)

Research Interests & Experiences

My research focus lies in extending dimensionality in energy material analysis by developing and employing advanced analytic methods to establish rational design principles for high-performance energy materials.

- Resolving the **time-resolved structural dynamics in energy materials under operating conditions** through electrochemical liquid-cell transmission electron microscopy (EC-LCTEM): Unraveling their *in situ* electrochemical reaction mechanisms
- Resolving the **3D atomic structures of inorganic nanocrystals** through the graphene liquid-cell (GLC) technique: Revealing their structure-property relationships

1) Time-resolved structural dynamics in energy materials under operating conditions

- Unraveling serial degradation process of fuel cell catalysts (Pt/C) under AST.
** (Journal of the American Chemical Society 2025, 147, 181-191)*
- Revealing *in situ* formation of Cu₂O adparticles on the Cu-Ag alloy during CO₂RR.
** (Nature Catalysis 2025, 8, 697-713)*
- Developing heating/cooling EC-LCTEM method and exploring temperature-dependent Cu electrodeposition dynamics.
** (Journal of the American Chemical Society 2025, 147, 23654-23671)*
- Revealing *in situ* formation of Cu nanograins from Cu single-atom catalyst.
** (Journal of the American Chemical Society 2025, 147, 37808-37818)*

- Demonstrating the EC-LCTEM with external standard reference electrode and unraveling mass-transfer effect on Cu electrodeposition behavior.

* (*In revision*)

- Investigating Li plating and stripping behaviors under different current conditions.

* (*In preparation*)

- Investigating aqueous battery chemistry under potential applied condition.

* (*In preparation*)

2) 3D atomic structures of inorganic nanocrystals

- Determining the 3D atomic structures of synthesized Pt nanocrystals

* (*Science* **2020**, 368, 60-67. 2nd author)

- Quantifying surface atomic structures of the synthesized Pt nanocrystals

* (*Nano Letters* **2021**, 21, 1175-1183)

- Investigating adsorption properties of large-sized molecules on complex surfaces

* (*Nanoscale* **2023**, 15, 532-539)

- Revealing a structure-activity (alkaline HER) relationship of the synthesized Pt nanocrystals by using multi-scale simulation

* (*In preparation*)

Peer-reviewed Publications ([†] equal contribution)

8 x first author | 4 x second author

2025

20) Z. Zhang[†], **S. Kim**[†], V. Briega-Martos, E. R. Kennedy, S. E. Zeltmann, E. H. Thiede, and Y. Yang*, "Benchmarking Nanoscale Electrochemistry in Operando TEM with Standard Reference Electrode", *In revision*.

19) J. Choi[†], **S. Kim**[†], J. Y. Choi[†], S. Park[†], K. Je, S. Liu, J. Jiang, S. Yang, C. J. Pollock, R. Guzman-Soriano, K. Bairley, E. H. Thiede, Y. J. Hwang*, J. Park*, and Y. Yang*, "Dynamic Evolution from Single-Atom Catalysts to Active Nanograins for CO₂ Reduction", *Journal of the American Chemical Society* **2025**, 147, 37808-37818. [<https://doi.org/10.1021/jacs.5c14123>]

18) D. D. Mal, N. Redkar, K. Liu, H. Park, E. R. Kennedy, **S. Kim**, W. Li, Y. Yang*, Y. Qi*, M. Neurock*, and L. Luo*, "Electrosynthesis of Agrochemicals via Alternating-Current-Driven Selective, Continuous Dehalogenation", *Journal of the American Chemical Society* **2025**, 147, 37611-37621. [<https://doi.org/10.1021/jacs.5c12620>]

17) **S. Kim**[†], V. Briega-Martos[†], S. Liu, K. Je, C. Shi, K. Marusak, S. E. Zeltmann, Z. Zhang, R. Guzman-Soriano, W. Li, J. Jiang, J. Choi, Y. J. Negash, F. S. Walden II, N. L. Marthe Jr., P. S. Wellborn, Y. Guo, J. Damiano, Y. Han, E. H. Thiede, and Y. Yang*, "Operando Heating and Cooling Electrochemical 4D-STEM Probing Nanoscale Dynamics at Solid-Liquid Interfaces", *Journal of the American Chemical Society* **2025**, 147, 23654-23671. [<https://doi.org/10.1021/jacs.5c05005>]

16) I. Kim[†], G.-B. Lee[†], **S. Kim**[†], H. D. Jung[†], J.-Y. Kim, T. Lee, H. Choi, J. Jo, G. Kang, S.-H. Oh, W. Kwon, D. Hong, H. G. Kim, Y. Lee, U. Kim, H. Kim, M. Kim, S. Back*, J. Park*, Y.-C. Joo*, and D.-H. Nam*, "Unveiling the reconstruction of copper bimetallic catalysts during electrochemical CO₂ reduction", *Nature Catalysis* **2025**, 8, 697-713. [<https://doi.org/10.1038/s41929-025-01368-9>]

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- 15) S. Kang[†], J. Kim[†], **S. Kim**[†], H. Chun, J. Heo, C. F. Reboul, R. Meana-Pañeda, C. T. S. Van, H. Choi, Y. Lee, J. Rhee, M. Lee, D. Kang, B. H. Kim, T. Hyeon, B. Han*, P. Ercius*, W. C. Lee*, H. Elmlund*, and J. Park*, “Time-resolved Brownian tomography of single nanocrystals in liquid during oxidative etching”, *Nature Communications* **2025**, 16, 1158. [<https://doi.org/10.1038/s41467-025-56476-8>]
- 14) **S. Kim**, J. Kwag, M. Lee, S. Kang, D. Kim, J.-G. Oh, Y.-J. Heo*, J. Ryu*, and J. Park*, “Unraveling Serial Degradation Pathways of Supported Catalysts through Reliable Electrochemical Liquid-Cell TEM Analysis”, *Journal of the American Chemical Society* **2025**, 147, 181-191. [<https://doi.org/10.1021/jacs.4c08825>]
- 13) M. Lee, Y. Jeon, **S. Kim**, I. Jung, S. Kang, S.-H. Jeong*, and J. Park*, “Unravelling complex mechanisms in materials processes with cryogenic electron microscopy”, *Chemical Science* **2025**, 16, 1017-1035. [<https://doi.org/10.1039/D4SC05188B>]
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- 2024 12) J. Kim, **S. Kim**, J. Park, S. Kang, D. J. Seo, N. Park, S. Lee, J. J. Kim, W. B. Lee, J. Park*, and J.-C. Lee*, “Covalent-Frameworked 2D Crown Ether with Chemical Multifunctionality”, *Journal of the American Chemical Society* **2024**, 146, 4532-4541. [<https://doi.org/10.1021/jacs.3c11182>]
- 11) H. Wietfeldt, R. Meana-Pañeda, C. Machello, C. F. Reboul, C. T. S. Van, **S. Kim**, J. Heo, B. H. Kim, S. Kang, P. Ercius, J. Park*, H. Elmlund*, “Small, solubilized platinum nanocrystals consist of an ordered core surrounded by mobile surface atoms”, *Communications Chemistry* **2024**, 7, 4. [<https://doi.org/10.1038/s42004-023-01087-x>]
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- 2023 10) J. Kwag, **S. Kim**, S. Kang, and J. Park*, “Multiple-length scale investigation of Pt/C degradation by identical-location transmission electron microscopy”, *Bulletin of the Korean Chemical Society* **2023**, 44, 488-494. [<https://doi.org/10.1002/bkcs.12690>]
- 9) J. Heo[†], D. Kim[†], H. Choi[†], **S. Kim**, H. Chun, C. F. Reboul, C. T. S. Van, D. Elmlund, S. Choi, K. Kim, Y. Park, H. Elmlund*, B. Han*, and J. Park*, “Method for 3D atomic structure determination of multi-element nanoparticles with graphene liquid-cell TEM”, *Scientific Reports* **2023**, 13, 1814. [<https://doi.org/10.1038/s41598-023-28492-5>]
- 8) D. Kang[†], **S. Kim**[†], J. Heo, D. Kim, H. Bae, S. Kang, S. Shim*, H. Lee*, and J. Park*, “Complex ligand adsorption on 3D atomic surfaces of synthesized nanoparticles investigated by machine-learning accelerated ab initio calculation”, *Nanoscale* **2023**, 15, 532-539. [<https://doi.org/10.1039/d2nr05294f>]
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- 2022 7) J. Kim, A. Park, J. Kim, S. J. Kwak, J. Y. Lee, D. Lee, S. Kim, B. K. Choi, **S. Kim**, J. Kwag, Y. Kim, S. Jeon, W. C. Lee, T. Hyeon, C.-H. Lee, W. B. Lee*, and J. Park*, “Observation of H₂ Evolution and Electrolyte Diffusion on MoS₂ Monolayer by In Situ Liquid-Phase Transmission Electron Microscopy”, *Advanced Materials* **2022**, 34, 2206066. [<https://doi.org/10.1002/adma.202206066>]
- 6) J. Heo, D. Kang, **S. Kim**, H. Chun, B. Han*, B. H. Kim*, and J. Park*, “3-Dimensional Scanning of Entire Unit Cells in Single Nanoparticles”, *ChemNanoMat* **2022**, 8, e202200057. [<https://doi.org/10.1002/cnma.202200057>]
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- 2021
- 5) S. Jeon[†], T. Heo[†], S.-Y. Hwang[†], J. Ciston, K. C. Bustillo, B. W. Reed, J. Ham, S. Kang, **S. Kim**, J. Lim, K. Lim, J. S. Kim, M.-H. Kang, R. S. Bloom, S. Hong, K. Kim, A. Zettl, W. Y. Kim, P. Ercius*, J. Park*, and W. C. Lee*, “Reversible disorder-order transitions in atomic crystal nucleation”, *Science* **2021**, 371, 498-503. [<https://doi.org/10.1126/science.aaz7555>]
- 4) C. F. Reboul[†], J. Heo[†], C. Machello, S. Kiesewetter, B. H. Kim, **S. Kim**, D. Elmlund, P. Ercius, J. Park*, and H. Elmlund*, “SINGLE: Atomic-resolution structure identification of nanocrystals by graphene liquid cell EM”, *Science Advances* **2021**, 7, eabe6679. [<https://doi.org/10.1126/sciadv.abe6679>]
- 3) **S. Kim**, J. Kwag, C. Machello, S. Kang, J. Heo, C. F. Reboul, D. Kang, S. Kang, S. Shim, S.-J. Park, B. H. Kim, T. Hyeon, P. Ercius*, H. Elmlund*, and J. Park*, “Correlating 3D Surface Atomic Structure and Catalytic Activities of Pt Nanocrystals”, *Nano Letters* **2021**, 21, 1175-1183. [<https://doi.org/10.1021/acs.nanolett.0c04873>]
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- 2020
- 2) B. H. Kim[†], J. Heo[†], **S. Kim**, C. F. Reboul, H. Chun, D. Kang, H. Bae, H. Hyun, J. Lim, H. Lee, B. Han, T. Hyeon, A. P. Alivisatos, P. Ercius*, H. Elmlund*, and J. Park*, “Critical differences in 3D atomic structure of individual ligand-protected nanocrystals in solution”, *Science* **2020**, 368, 60-67. [<https://doi.org/10.1126/science.aax3233>]
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- 2019
- 1) J. Sung[†], B. K. Choi[†], B. Kim, B. H. Kim, J. Kim, D. Lee, **S. Kim**, K. Kang*, T. Hyeon*, and J. Park*, “Redox-Sensitive Facet Dependency in Etching of Ceria Nanocrystals Directly Observed by Liquid Cell TEM”, *Journal of the American Chemical Society* **2019**, 141, 18395-18399. [<https://doi.org/10.1021/jacs.9b09508>]
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Presentations

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- 2025
- 15) **S. Kim**, Valentin Briega-Martos, Kwanghwi Je, Zhijing Zhang, Yimo Han, Erik H. Thiede, Yao Yang*, “Operando Heating/Cooling Electrochemical Liquid-Cell STEM Probing Nanoscale Dynamics at Solid-Liquid Interfaces”, *Materials Research Society (MRS) 2025 Fall meeting*, Dec. 2025 (Oral presentation)
- 14) **S. Kim**, “Electrochemical Liquid-Cell Transmission Electron Microscopy (EC-LCTEM) for Advanced Analysis of Energy Materials”, *The Korean Scientists and Engineers Community at Cornell (KSECC) Seminar*, Mar. 2025 (Oral presentation)
- 13) **S. Kim**, “Quantitative Electrochemical Liquid-Cell TEM Studies of Catalyst Degradation Mechanisms”, *Protophysics Webinar*, Jan. 2025 (Oral presentation)
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- 2024
- 12) **S. Kim**, “Advanced Analysis of Energy Materials through Electrochemical Liquid-Cell Transmission Electron Microscopy”, *BMCE Seminar at Catholic University*, Oct. 2024 (Oral presentation)
- 11) **S. Kim**, Z. Zhang, and Y. Yang*, “Operando Electrochemical Liquid-Cell STEM (EC-STEM) at Dynamic Battery Interfaces”, *New York Battery and Energy Storage Technology Consortium (NY-BEST) 2024 Annual Fall Technology and Innovation Conference*, Oct. 2024 (Poster)
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	10) S. Kim , J. Kwag, and J. Park*, “Reproducible Electrochemical Liquid-cell TEM for Tracking Degradation of Individual Pt nanoparticles on Carbon Supports”, <i>The Korean Electrochemical Society (KECS) 2024 Spring meeting</i> , Apr. 2024 (Oral presentation)
	9) S. Kim , J. Kwag, and J. Park*, “Reproducible Electrochemical Liquid-cell TEM for Tracking Degradation of Individual Pt nanoparticles in Fuel Cell Catalysts”, <i>Nano Convergence Conference 2024 (NCC2024)</i> , Jan. 2024 (Oral presentation)
2023	8) S. Kim , J. Kwag, and J. Park*, “Developing a Reliable and Reproducible Electrochemical Liquid-cell TEM Method for Understanding the Degradation Process of Fuel Cell Catalysts”, <i>The 20th International Microscopy Congress (IMC20)</i> , Sep. 2023 (Oral presentation)
	7) S. Kim , G. H. Gu*, and J. Park*, “Investigating catalytic activity of an ensemble of synthesized small Pt nanocrystals through their 3D atomic structure and multiscale simulation”, <i>Samsung Global Technology Symposium</i> , Aug. 2023 (Poster)
	6) S. Kim , Y. Kim, G. H. Gu*, and J. Park*, “Investigating catalytic activity of an ensemble of synthesized small Pt nanocrystals through 3D atomic structure and multiscale simulation”, <i>The Korean Society of Industrial and Engineering Chemistry (KSIEC) 2023 Spring meeting</i> , May 2023 (Poster)
2022	5) S. Kim , D. Kang, J. Kwag, D. Kim, J. Heo, and J. Park*, “3D atomic structure of Pt nanocrystals related to their catalytic activity and surface ligand adsorption”, <i>Materials Research Society (MRS) 2022 Fall meeting</i> , Dec. 2022 (Oral presentation)
	4) S. Kim , D. Kang, and J. Park*, “Complex adsorption behavior of a PVP ligand on 3D atomic surfaces of synthesized Pt nanoparticles”, <i>The Korean Institute of Chemical Engineers (KICChE) 2022 Fall meeting</i> , Oct. 2022 (Poster)
	3) S. Kim , D. Kang, and J. Park*, “Complex adsorption behavior of a PVP ligand on 3D atomic surfaces of synthesized Pt nanoparticles”, <i>Center for Hybrid Interfacial Chemical Structure (CICS) 2022 Workshop</i> , Jun. 2022 (Poster)
2021	2) S. Kim , J. Kwag, and J. Park*, “Reproducible real-time imaging method for degradation process of fuel cell catalysts using <i>in situ</i> TEM”, <i>72nd Annual Meeting of the International Society of Electrochemistry</i> , Sep. 2021 (Poster)
2018	1) S. Kim , B. H. Kim, J. Heo, D. Kang, and J. Park*, “3D reconstruction of single nanoparticle and structure analysis in atomic resolution”, <i>The Korean Society of Industrial and Engineering Chemistry (KSIEC) 2018 Spring meeting</i> , May 2018 (Poster)

Teaching Experience

Teaching assistant

Spring 2020	Physical Chemistry 1 (45 contact hours)
Fall 2018	Elementary Lab. for Chemical and Biological Engineering (40 contact hours)

Mentoring

Spring 2019	Tutor for Learning Community 'Sublime' (2 students, one for Organic Chemistry – 13.5 contact hours and the other for General Chemistry – 15 contact hours)
Fall 2018	Tutor for Learning Community 'Sublime' (2 students, one for General Chemistry – 15 contact hours and the other for General Chemistry – 9 contact hours)
Summer 2018	Tutor for Learning Community 'Sublime' (1 student for General Chemistry – 9 contact hours)
Spring 2018	Tutor for Learning Community 'Sublime' (1 student for General Chemistry – 12 contact hours)

Awards and Honors

2025	MRS Communications Early Carrer Distinguished Presenters, <i>Materials Research Society (MRS) 2025 Fall meeting</i>
2024	Student Poster Prizes (3rd place), <i>New York Battery and Energy Storage Technology Consortium (NY-BEST) 2024 Annual Fall Technology and Innovation Conference</i>
	Best Student Oral Presentation Awards, <i>Nano Convergence Conference 2024 (NCC2024)</i>
2023	Best Oral Presentation Awards, <i>The 20th International Microscopy Congress (IMC20)</i>
2020	Jeju Human Resources Development Scholarship (~\$1,600), <i>Jeju Institute for Lifelong Education and Scholarship</i>
2017, 2018	Lecture & Research Scholarship (2 terms: ~\$8,000 total), <i>School of Chemical and Biological Engineering, Seoul National University</i>
2017	cum Laude, <i>Seoul National University</i>
2016, 2017	Work-Study Scholarship (2 terms: ~\$2,400 total), <i>Seoul National University</i>
2016	GS Caltex Global Project (Gold Prize: ~\$800). <i>School of Chemical and Biological Engineering, Seoul National University</i>
2014-2016	Chungsoo Scholarship (Full funding of tuition for 6 terms: ~\$15,000 total), <i>Chungsoo Scholarship Foundation</i>

Skills

Research Skills:

- *In situ* electrochemical liquid-cell TEM/STEM (EC-LCTEM/STEM)
- Identical-Location TEM/STEM (IL-TEM/STEM)
- Electrocatalysis performance test (RDE, H-cell) for ORR, HER, and CO₂RR
- 3D structure determination for nanocrystals (3D SINGLE)
- Nanomaterial characterization (Raman, XRD, NMR, IR, and so on)
- Photolithography
- Nanoparticles/Catalysts synthesis

Software:

- Python

Leadership Experiences

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| 2025 | President (Sep 25' – Aug 26'),
KSECC (Korean Scientists and Engineers Community at Cornell University)
<i>@ Cornell University</i> |
| 2019 | Vice President (Sep 19' – Feb 20'),
ACT (Startup Consulting Group)
<i>@ Seoul National University</i> |
| 2014 | President (Mar 14' – Dec 14'),
SOCHEM (Department Soccer Club)
<i>@ Seoul National University</i> |
| 2013 | President (Mar 13' ~ Aug 13'),
Class A in Department of Chemical and Biological Engineering
<i>@ Seoul National University</i> |

Academic References

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