

Sungin Kim

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Education

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- | | |
|---------------------|---|
| 2024.03-
present | 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> |
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Research Interests & Experiences

My research interest is to maximize the utilization of electrochemical energy for the practical use of renewable energy technologies with high efficiency.

For this purpose, my focus lies in the fundamental understanding of electrochemical mechanisms governing interfacial reaction, activation, and degradation processes of electrocatalysts.

To approach, my works have combined:

- Developing the reproducible electrochemical liquid-cell TEM (e-LCTEM) method
 - Developing the 3D atomic structure identification method for metal nanocrystals
- 1) Developing the reproducible e-LCTEM method:
 - Acquiring STEM images of small Pt nanocrystals (< 3 nm) on carbon supports.
 - Obtaining CV curves of the Pt/C catalysts comparable to bulk measurement.
 - Investigating the degradation process of Pt/C catalysts under AST.
* (*In preparation*)
 - 2) Developing the 3D atomic structure identification method:
 - Determining the 3D atomic structures of synthesized Pt nanocrystals
* (*Science* **368**, 6486, 60-67 (2020))
 - Quantifying surface atomic structures of the synthesized Pt nanocrystals
* (*Nano Letters* **21**, 2, 1175-1183 (2021))
 - Investigating adsorption properties of large-sized molecules on complex surfaces
* (*Nanoscale* **15**, 532-539 (2023))
 - Revealing a structure-activity (alkaline HER) relationship of the synthesized Pt nanocrystals by using multi-scale simulation
* (*In preparation*)
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Peer-reviewed Publications ([†] equal contribution)

2 x first author | 4 x second author

- 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 Multi-functionality”, *Journal of the American Chemical Society* **146**, 7, 4532-4541 (2024).
[<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* **7**, 4 (2024).
[<https://doi.org/10.1038/s42004-023-01087-x>]
- 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* **44**, 6, 488-494 (2023).
[<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* **13**, 1814 (2023). [<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* **15**, 532-539 (2023).
[<https://doi.org/10.1039/d2nr05294f>]
- 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* **10**, 45, 2206066 (2022).
[<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* **8**, 5, e202200057 (2022).
[<https://doi.org/10.1002/cnma.202200057>]
- 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* **371**, 6528, 498-503 (2021). [<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* **7**, 5, eabe6679 (2021).
[<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* **21**, 2, 1175-1183 (2021).
[<https://doi.org/10.1021/acs.nanolett.0c04873>]
- 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* **368**, 6486, 60-67 (2020). [<https://doi.org/10.1126/science.aax3233>]
- 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* **141**, 46, 18395-18399 (2019).
[<https://doi.org/10.1021/jacs.9b09508>]

Manuscripts in review:

Presentations

- 2024 9) **S. Kim**, J. Kwag, and J. Park, “Reproducible Electrochemical Liquid-cell TEM for Tracking Degradation of individual Pt nanoparticles in Fuel Cell Catalysts”, *Nano Convergence Conference 2024 (NCC2024)*, 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”, *The 20th International Microscopy Congress (IMC20)*, 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”, *Samsung Global Technology Symposium*, 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”, *The Korean Society of Industrial and Engineering Chemistry (KSIEC) 2023 Spring meeting*, 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”, *Materials Research Society (MRS) 2022 Fall meeting*, 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”, *The Korean Institute of Chemical Engineers (KICChE) 2022 Fall meeting*, 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”, *Center for Hybrid Interfacial Chemical Structure (CICS) 2022 Workshop*, 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 *in situ* TEM”, *72nd Annual Meeting of the International Society of Electrochemistry*, 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”, *The Korean Society of Industrial and Engineering Chemistry (KSIEC) 2018 Spring meeting*, 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

- 2023 **Best Oral Presentation Awards**,
The 20th International Microscopy Congress (IMC20)
- 2020 **Jeju Human Resources Development Scholarship** (~\$1,600),
Jeju Institute for Lifelong Education and Scholarship
- 2017, 2018 **Lecture & Research Scholarship** (2 terms: ~\$8,000 total),
School of Chemical and Biological Engineering,
Seoul National University
- 2017 ***cum Laude***,
Seoul National University
- 2016, 2017 **Work-Study Scholarship** (2 terms: ~\$2,400 total),
Seoul National University
- 2016 **GS Caltex Global Project** (Gold Prize: ~\$800).
School of Chemical and Biological Engineering,
Seoul National University
- 2014-2016 **Chungsoo Scholarship**
(Full funding of tuition for 6 terms: ~\$15,000 total),
Chungsoo Scholarship Foundation
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Skills

Research Skills:

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

Software:

- Python

Academic References

[1] Jungwon Park

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[2] Jaeyune Ryu

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