

Jaeyune Ryu

EDUCATION

- 2016.9-2021.7 **Ph.D.**, Department of Chemistry, *Massachusetts Institute of Technology (MIT)*
Advisor: Prof. Yogesh Surendranath
Thesis: Tuning heterogeneous catalysis using interfacial polarization
- 2011.2-2013.2 **M.S.**, Department of Chemistry, *Korea Advanced Institute of Science and Technology (KAIST)*
Advisor: Prof. Sukbok Chang
Thesis: Development of catalytic C-C and C-N bond forming reactions via Rh mediated C-H bond activation
- 2007.2-2011.2 **B.S.**, Department of Chemistry, *Korea Advanced Institute of Science and Technology (KAIST)*
Graduated with the *highest honor (nominated as a valedictorian)*

PROFESSIONAL APPOINTMENT

- 2023.3-present **Assistant Professor**, School of Chemical and Biological Engineering, *Seoul National University (SNU)*
- 2021.9-2023.1 **Postdoctoral Fellow**, Department of Chemistry and Chemical Biology, *Harvard University*
Host: Prof. Daniel G. Nocera
- 2013.3-2016.8 **Staff Research Scientist**, Fuel Cell Research Center, *Korea Institute of Science and Technology (KIST)*

RESEARCH AREAS

- @ Harvard **Photophysics and Photochemistry of Conjugated Molecules and Organic Polymers**
Keywords: Long-lived excited states, Organic chromophores, Photo-redox catalysis
- @ MIT **Physical Electrochemistry and Interfacial Catalysis**
Keywords: Electrical double layer, Interfacial field, Local pH gradients, Electrochemical promotion of interfacial catalysis
- @ KIST **Nanomaterial Synthesis for Electrocatalysis**
Keywords: Nanoparticle synthesis, Fuel cell, Water splitting
- @ KAIST **Organometallic Catalysis**
Keywords: Direct C-H amination, Direct C-C coupling reactions, Organic transformation

HONORS AND AWARDS

- 2023 POSCO Science Fellowship, POSCO TJ Park Foundation
- 2021 *Alan Davison* Best Thesis Prize, Department of Chemistry, MIT
- 2019 IPMI Student Award, International Precious Metal Institute (IPMI)
- 2016-2022 Samsung PhD Scholarship, Samsung Foundation
- 2015 The Excellent Research Team Award, KIST
- 2012 The Best Poster Award, 110th Korean Chemical Society (KCS) National Meeting
- 2011-2012 Global PhD Fellowship, National Research Foundation (NRF) in Korea
- 2011 Shim Hong-Ku Award, Department of Chemistry, KAIST
- 2011 Commendation from Minister of Education, Science and Technology of Korea
for graduation with the highest academic standing (*nominated as a valedictorian*)
- 2010 Nominated as National Delegate for Stockholm International Youth Science Seminar (SIYSS)
Invited to the Nobel Prize Ceremony, Nobel Foundation & SIYSS
- 2009 Honor Student, KAIST
- 2008-2011 Dean's List, KAIST
- 2007-2011 National Science and Technology Scholarship, NRF in Korea
- 2007 Presidential Award, KAIST

PUBLICATIONS

1. **Ryu, J.**; Bryan, K.; Rieth, A.; Gordon, J. B.; Nocera, D. G. "Polarization-Induced Inversion of Singlet and Triplet Excited States"– *TBD*
2. Veroneu, S. S.; Hartnett, A. C.; **Ryu, J.**; Nocera, D. G. "Resolving Hyperlocal pH Environments in Three-Dimensional Electrocatalysts during Oxygen Evolution Reaction"– *TBD*
3. Han, S.; Ryu, J. H.; Lee, W. B.; **Ryu, J.**; Yoon, J. Translating the Optimized Durability of Co-Based Anode Catalyst into Sustainable Anion Exchange Membrane Water Electrolysis
Small **2024** (*accepted*)
<https://doi.org/10.1002/sml.202311052>
4. Lee, W. H.; Yoon, C.-K.; Park, H.; Park, G.-H.; Jeong, J. H.; Cha, G. D.; Lee, B.-H.; Lee, J.; Lee, C. W.; Bootharaju, M. S.; Sunwoo, S.-H.; **Ryu, J.**; Lee, C.; Cho, Y.-J.; Nam, T.-W.; Ahn, K. H.; Hyeon, T.; Seok, Y.-J.; Kim, D.-H., Highly Efficient Nitrogen-Fixing Microbial Hydrogel Device for Sustainable Solar Hydrogen Production
Advanced Materials **2024**, *35*, 2306092
5. Lee, C. W.; Lee, B.-H.; Park, S.; Jung, Y.; Han, J.; Heo, J.; Lee, K.; Ko, W.; Yoo, S.; Bootharaju, M. S.; **Ryu, J.**; Nam, K. T.; Kim, M.; Hyeon, T. "Photochemical tuning of dynamic defects for high-performance atomically dispersed catalysts"
Nature Materials **2024** (*accepted*)
<https://doi.org/10.1038/s41563-024-01799-y>
6. Lodaya, K.; Tang, B.; Bisbey, R.; Weng, S.; Westendorff, K.; Toh, W. J.; **Ryu, J.**; Surendranath, Y. "An Electrochemical Approach for Designing Thermochemical Bimetallic Nitrate Hydrogenation Catalysts"
Nature Catalysis **2024** (*accepted*)
<https://doi.org/10.1038/s41929-023-01094-0>
7. **Ryu, J.**; Bregante, D.; Howland, W., Bisbey, R., Kaminsky, C.; Surendranath, Y. "Thermochemical Aerobic Oxidation Catalysis in Water Can be Analysed as Two Coupled Electrochemical Half Reactions"
Nature Catalysis **2021**, *4*, 742.
– *Highlighted in Joule*
– *Featured by MIT Energy Futures*
8. Wuttig, A.; **Ryu, J.**; Surendranath, Y. "Electrolyte Competition Controls Surface Binding of CO Intermediates to CO₂ Reduction Catalysts"
J. Phys. Chem. C **2021**, *125*, 17042.
9. **Ryu, J.**; Surendranath, Y. "Polarization-Induced Local pH Swing Promotes Pd-catalyzed CO₂ Hydrogenation"
J. Am. Chem. Soc. **2020**, *142*, 13384.
10. **Ryu, J.**; Surendranath, Y. "Tracking Interfacial Field Strength at Pt/H₂O during Hydrogen Catalysis"
J. Am. Chem. Soc. **2019**, *141*, 15524.
11. **Ryu, J.**; Wuttig, A.; Surendranath, Y. "Quantification of Interfacial pH Variation at Molecular Length Scales Using a Concurrent Non-Faradaic Reaction"
Angew. Chem. Int. Ed. **2018**, *57*, 9300.
12. Wuttig, A.; Yoon, Y.; **Ryu, J.**; Surendranath, Y. "Bicarbonate is Not a General Acid in Au-Catalyzed CO₂ Electroreduction"
J. Am. Chem. Soc. **2017**, *139*, 17109.
13. **Ryu, J.**; Jung, N.; Jang, J. H.; Kim, H.-J.; Yoo, S. J. "In Situ Transformation of Hydrogen-Evolving CoP Nanoparticles: Toward Efficient Oxygen Evolution Catalysts Bearing Dispersed Morphologies with Co-oxo/hydroxo Molecular Units"
ACS Catal. **2015**, *5*, 4066.
"Featured as the Most Read and Cited Article from *ACS Catalysis*"
14. Jung, N.; Bhattacharjee, S.; Gautam, S.; Park, H.-Y.; **Ryu, J.**; Chung, Y.-H.; Lee, S.-Y.; Jang, I.; Jang, J.-H.; Park, S.-H.; Chung, D. Y.; Sung, Y.-E.; Chae, K.-H.; Waghmare, U. V.; Lee, S.-C.; Yoo, S. J. "Electronic Ensemble Effect of Organic/inorganic Hybrid Surface on PtCo Nanoparticles for Oxygen Reduction Reactions"
NPG Asia Materials **2016**, *8*, e237.
15. **Ryu, J.**[†]; Choi, J.[†]; Lim, D.-H.; Seo, H.-L.; Lee, S.-Y.; Sohn, Y.; Park, J.-H.; Jang, J. H.; Kim, H.-J.; Hong, S. A.; Kim, P.; Yoo, S. J. "Morphology-Controlled Synthesis of Ternary Pt-Pd-Cu Alloy Nanoparticles for Efficient Electrocatalytic Oxygen Reduction Reactions"
Appl. Catal. B: Environ. **2015**, *174*, 526. ([†]: Equally contributed)
16. Park, H.-Y.; Jang, I.; Jung, N.; Chung, Y.-H.; **Ryu, J.**; Cha, I. Y.; Kim, H.-J.; Jang, J. H.; Yoo, S. J. "Green Synthesis of Carbon-Supported Nanoparticle Catalysts by Physical Vapor Deposition on Soluble Powder Substrates"

- Sci. Rep.* **2015**, *5*, 14245.
17. Lee, J. H.; Park, M.; Jung, J. H.; **Ryu, J.**; Cho, E.; Nam, S. W.; Kim, J. Y.; Yoon, C. W. "Facile Synthesis of Hollow Fe-N-C Hybrid Nanostructures for Oxygen Reduction Reactions"
Inorg. Chim. Acta **2014**, *442*, 3. "Special Issue: Dedicated to Don Tilley"
 18. Lee, S.-Y.; Jung, N.; Cho, J.; Park, H.-Y.; **Ryu, J.**; Jang, I.-J.; Kim, H.-J.; Cho, E.; Park, Y.-H.; Ham, H. C.; Jang, J. H.; Yoo, S. J. "Surface-Rearranged Pd₃Au/C Nanocatalysts by Using CO-Induced Segregation for Formic Acid Oxidation Reactions"
ACS Catal. **2014**, *4*, 2402.
 19. Jung, N.[†]; Chung, D. Y.[†]; **Ryu, J.**; Sung, Y.-E.; Yoo, S. J. "Pt-based Nanoarchitecture and Catalyst Design for Fuel Cell Applications"
Nano Today **2014**, *9*, 433. (†: Equally contributed)
 20. Lee, J. H.; **Ryu, J.**; Kim, J. Y.; Nam, S. W.; Lim, T.-H.; Yoon, C. W. "Carbon Dioxide Mediated, Reversible Chemical Hydrogen Storage Using a Pd Nanocatalyst Supported on Mesoporous Graphitic Carbon Nitride"
J. Mater. Chem. A **2014**, *2*, 9490. "Featured in Front Cover"
 21. **Ryu, J.**[†]; Jung, N.[†]; Lim, D.-H.; Shin, D. Y.; Park, S. H.; Ham, H. C.; Jang, J. H.; Kim, H.-J.; Yoo, S. J. "P-Modified and Carbon Shell Coated Co Nanoparticles for Efficient Alkaline Oxygen Reduction Catalysis"
Chem. Comm. **2014**, *50*, 15940.
 22. Jung, N.; Chung, Y.-H.; Chung, D. Y.; Choi, K.-H.; Park, H.-Y.; **Ryu, J.**; Lee, S.-Y.; Kim, M.; Sung, Y.-E.; Yoo, S. J. "Chemical Tuning of Electrochemical Properties of Pt-skin Surface for Highly Active Oxygen Reduction Reactions"
Phys. Chem. Chem. Phys. **2013**, *15*, 17079. "Featured in Back Cover"
 23. Shin, K.; **Ryu, J.**; Chang, S. "Orthogonal Reactivity of Acyl Azides in C-H Activation: Dichotomy Between C-C and C-N Amidations Based on Catalyst Systems"
Org. Lett. **2014**, *16*, 2022.
 24. Park, S. H.[†]; Kwak, J.[†]; Shin, K.; **Ryu, J.**; Park, Y.; Chang, S. "Mechanistic Studies of the Rhodium-Catalyzed Direct C-H Amination Reactions Using Azides as the Nitrogen Source"
J. Am. Chem. Soc. **2014**, *136*, 2492. (†: Equally contributed)
 25. Kim, H. J.; A, Manjaly.; Lee, Y.; **Ryu, J.**; Kim, J.; Lee, Y.; Jung, Y.; Chang, S. "Hydrogen-Bond-Assisted Controlled C-H Functionalization via Adaptive Recognition of a Purine Directing Group"
J. Am. Chem. Soc. **2014**, *136*, 1132.
 26. **Ryu, J.**[†]; Kwak, J.[†]; Shin, K.; Lee, D.; Chang, S. "Ir(III)-Catalyzed Mild C-H Amidation of Arenes and Alkenes: An Efficient Usage of Acyl Azides as the Nitrogen Source"
J. Am. Chem. Soc. **2013**, *135*, 12861. (†: Equally contributed)
"Selected Paper in Cheminform"
 27. **Ryu, J.**; Shin, K.; Park, S. H.; Kim, J. Y.; Chang, S. "Rhodium-Catalyzed Direct Amination of Benzamides with Aryl Azides: A Synthetic Route to Diarylamines"
Angew. Chem., Int. Ed. **2012**, *51*, 9904.
"Selected Paper in Cheminform"
 28. Kim, J. Y.[†]; Park, S. H.[†]; **Ryu, J.**; Cho, S. H.; Kim, S. H.; Chang, S. "Rhodium-Catalyzed Intermolecular Amidation of Arenes with Sulfonyl Azides via Chelation-Assisted C-H bond Activation"
J. Am. Chem. Soc. **2012**, *134*, 9110. (†: Equally contributed)
 29. **Ryu, J.**; Cho, S. H.; Chang, S. "A Versatile Rh(I) Catalyst System Enabling the Addition of Heteroarenes to both Alkenes and Alkynes by a C-H Bond Activation Pathway"
Angew. Chem., Int. Ed. **2012**, *51*, 3677.
"Selected as Hot Paper" "Selected Paper in Cheminform"

PATENTS

1. "Non-precious metal based water electrolysis catalyst for oxygen evolution and hydrogen evolution"
(*US Patent*, **9751078**)
2. "Reversible fuel cell oxygen electrode, reversible fuel cell including the same, and method for preparing the same"
(*US Patent*, **10601052**)
3. "Catalyst for of oxygen reduction reaction and preparation method of the same" (*US Patent*, **10144993**)
4. "Ultra-low loading of Pt-decorated Ni electrocatalyst" (*US Patent*, **10669640**)
5. "Complex apparatus of reversible electrodialysis equipment and desalination plant"
(*US Patent Application Publication* **2015/0266762**, *KR Patent* **10-1661597**)

6. "Catalyst comprising Co-P core and carbon shell for alkaline oxygen reduction and its preparation method"
(***KR Patent 10-1702929***)
7. "Complex catalyst for oxygen reduction reaction comprising metal catalyst coated with zwitterionic molecules, and its preparation method" (***KR Patent 10-1808304***)
8. "Preparation method of HT-PEMFC catalyst adsorbed surfactants" (***KR Patent 10-1742799***)
9. "Alkaline anion exchange membrane water electrolyzer using Ni electrodeposited hydrophilic porous carbon material"
(***KR Patent 10-1584725***)
10. "Polymer electrolyte membrane water electrolysis anode using IrO electrodeposited porous carbon material
(***KR Patent Application Publication, 10-2016-0127535***)
11. "Method for synthesis of Nb-TiO₂ catalyst supports using electrospinning"
(***KR Patent Application Publication, 10-2015-0028529***)
12. "Process for the preparation of arylamide and enamide derivatives using organic azide and iridium"
(***KR Patent 10-1521092***)
13. "Process for the preparation of arylamines via rhodium-catalyzed intermolecular C-N cross coupling"
(***KR Patent 10-1416077***)

INVITED SEMINARS AND CONFERENCE TALKS

1. Understanding and Controlling Charge Transfer Phenomena at Molecules, Materials, and Interfaces for Advanced Catalysis, 2024, Special Seminar, Department of Chemical and Biomolecular Engineering, KAIST, Korea
2. Tuning Heterogeneous Catalysis Using Interfacial Polarization, 2023, Department Seminar, Department of Chemistry, POSTECH, Korea
3. Tuning Heterogeneous Catalysis Using Interfacial Polarization, 2023, Special Seminar, Department of Chemistry, Seoul National University, Korea
4. Understanding and Controlling Charge Transfer Phenomena at Molecules, Materials, and Interfaces for Advanced Catalysis, 2022, Special Seminar, Department of Chemistry, KAIST, Korea
5. Tuning Heterogeneous Catalysis Using Interfacial Polarization, 2022, Young Researcher Symposium, School of Chemical and Biological Engineering, Seoul National University, Korea
6. Understanding and Controlling of the Polarization-Induced Local Environments during Heterogeneous Catalysis, 2021, Department Seminar, Department of Chemistry, MIT, US
7. Thermochemical Aerobic Oxidation Catalysis in Water Proceeds via Coupled Electrochemical Half Reactions, 2021, Chemistry Student Seminar, MIT, US
8. Polarization-Induced Local pH Swing to Promote Pd-Catalyzed CO₂ hydrogenation, 2020, *ACS Fall National Meeting*, US
9. Tracking Interfacial Fields at Pt/H₂O Interface During Hydrogen Catalysis, 2020, *Electrochemistry Gordon Research Seminar (GRS)*, Ventura, US (**Selected as a Student Speaker**)
10. Tracking Interfacial Fields at Pt/H₂O Interface During Hydrogen Catalysis, 2020, *Electrochemistry Gordon Research Conference (GRC)*, Ventura, US
11. Exploring the Precious Metal/H₂O Interface under Electrochemical Polarization, 2019 *International Precious Metal Institute (IPMI) conference*, Reno, US (**Nominated as a Student Award Recipient**)
12. Tracking Interfacial Fields at Pt/H₂O Interface During Hydrogen Catalysis, 2019, *Special Seminar, Fuel Cell Research Center*, KIST, South Korea
13. Tracking Interfacial Fields at Pt/H₂O Interface During Hydrogen Catalysis, 2019 *MURI conference*, Emory University, US
14. Quantifying Interfacial pH Variation during Electrocatalysis Using a Non-Faradaic Reaction, 2018 *Inorganic Supergroup Conference*, Harvard University, Cambridge, US
15. In-Situ Metamorphosis of Cobalt Phosphide (CoP) Nanoparticles toward Efficient and Robust Oxygen Evolution Catalyst, 2015, *ACS National Meeting*, Boston, US
16. Novel Aspects of Nanoparticulate Cobalt Phosphide in Oxygen Evolution Reaction, 2014, *MRS Fall Meeting*, Boston, US
17. Rhodium-Catalyzed C-N Bond Formation with Azides via Chelation-Assisted C-H Bond Activation, *IKCOC 2012*, Kyoto, Japan
18. Rh-Catalyzed Direct Amination of Benzamides with Aryl Azides: Novel Synthetic Route to Diarylamines, *110th Korean Chemical Society National Meeting*, Busan, Korea (**The best poster award**)
19. A Versatile Rh(I) Catalyst System Enabling the Addition of Heteroarenes to both Alkenes and Alkynes via C-H Bond Activation Pathway", *8th Workshop on Organic Chemistry for Junior Chemists*, Daejeon, Korea

20. A Versatile Rh(I) Catalyst System Enabling the Addition of Heteroarenes to both Alkenes and Alkynes via C-H Bond Activation Pathway, *Oral Presentation for Young Organic Chemist, 109th Korean Chemical Society National Meeting*, Ilsan, Korea
21. Total Synthesis of PDE4 Inhibitor via Novel Coupling with Rhodium Catalyst, *Stockholm International Youth Science Seminar 2010*, Stockholm, Sweden **(Invited to the Nobel Prize Ceremony)**