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Assistant Professor

Department of Chemistry,

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PROFESSIONAL EXPERIENCES

Sep. 2022 –

Assistant Professor,
Department of Chemistry, Incheon National University, Incheon,
Republic of Korea

Mar. 2021 – Aug. 2022

Post-doctoral Researcher (Advisor: Dr. Jin Young Kim),
Hydrogen Fuel Cell Research Center, Korea Institute of Science
and Technology (KIST), Seoul, Republic of Korea

EDUCATION

Ph.D. in Inorganic Chemistry (Mar. 2017 – Feb. 2021)

Korea University, Seoul, Republic of Korea (Advisor: Prof. Kwangyeol Lee);

Thesis: Dopants in noble metal-based electrocatalysts: From structure and phase control of nanocrystal to performance improvement in oxygen electrocatalysis

M.S. in Inorganic Chemistry (Sep. 2015 – Feb. 2017)

Korea University, Seoul, Republic of Korea (Advisor: Prof. Kwangyeol Lee);

Thesis: Synthesis of Binary and Ternary Noble Metal Alloy Hollow Nanostructures

Early graduation (1.5 years)

B.S. in Chemistry (Mar. 2012 – Aug. 2015)

Korea University, Seoul, Republic of Korea

Summa cum laude, Early graduation (3.5 years)

RESEARCH INTERESTS

Materials

- Synthesis, characterization, and phase engineering of noble metal-based alloy nanocrystals.
- Synthesis, characterization, and phase engineering of metal compound nanocrystals, including oxides, chalcogenides, phosphides, metal-organic frameworks (MOFs), and etc.
- Fabrication of reinforced composite membranes for fuel cell, water splitting, and electrochemical flow cell applications.

Applications

- Electrocatalysts: Fuel cell – ORR, MOR / Water splitting – OER, HER / CO₂ electroreduction
- Inorganic radical scavengers in reinforced composite membranes or electrodes for the long-term operation of PEMFC and PEMWE devices
- Membrane electrode assembly (MEA) fabrication for fuel cell (PEMFC), water electrolyzer (PEMWE), and flow electrolysis cell.
- Electrochemical degradation and upcycling of plastic waste – O₃ evolution, EG oxidation, etc.

SERVICES

- Jan. 2025 – Dec. 2025 Steering Committee Member of Electrochemistry Division,
Korean Chemical Society (KCS)
- Jan. 2024 – Dec. 2024 Steering Committee Member of Inorganic Chemistry Division,
Korean Chemical Society (KCS)

JOURNAL PUBLICATIONS

1. Park, Y.; Kim, D.; Kim, J.; Jang, H. Y.; Cha, M.; Lee, S.; Lee, T. K.; Kim, T.; Baik, H.; Choi, J.; **Kwon, T.**; Back, S.*; Yoo, S. J.*; Lee, K.*; *submitted*.
2. Kim, D.; Kundu, J.; Choi, J.; Lee, K.*; Choi, S.-I.*; **Kwon, T.***; “A comprehensive review of mechanism-based catalyst design and applications for electrochemical ozone production”, *J. Mater. Chem. A*, **2026**, 14 (2), 702-735.
3. Kundu, J.; Bhoyar, T.; Kim, J.; Choi, J.; Kim, D.; **Kwon, T.***; Kim, J. Y.*; Lee, K.*; Choi, S.-I.*; “Electrocatalytic Nitrate to Ammonia Conversion: From Mechanistic Insight to Catalyst Engineering for Practical Applications”, *Catal*, **2025**, 1, 10.
4. Choi, Y.; Park, Y.; Kim, J. M.; **Kwon, T.***; Koo, S.*; Kang, D. W.*; “Phthalocyanine-based metal-/covalent organic frameworks and their photo/electrochemical applications”, *Inorg. Chem. Commun.*, **2025**, 182 (3), 115607.
5. Choi, J.; **Kwon, T.***; “Recent advances in ceria-based free radical scavenging nanoparticles for durability enhancement of polymer electrolyte membrane fuel cells”, *CrystEngComm*, **2025**, 27 (31), 5222-5237.
6. Park, Y.[†]; Kim, H. K.[†]; **Kwon, T.**[†]; Jun, M.[†]; (†equal contribution) Kim, D.; Kim, T.; Kim, B.; Baik, H.; Kim, K.-J.; Lee, J. Y.; Kim, J. Y.*; Baik, M.-H.*; Lee, K.*; “Boosting Hydrogen Evolution Reaction on Co₉S₈ in Neutral Media Leveraging Oxophilic CrO_x Mosaic Dopant”, *Adv. Energy Mater.*, **2025**, 15 (6), 2405035.
7. Park, Y.; Jang, H. Y.; Kim, T.; Kim, D.; Kim, D.; Baik, H.; Choi, J.; **Kwon, T.***; Yoo, S. J.*; Back, S.*; Lee, K.*; “Atomic-level Ru-Ir mixing in rutile-type (RuIr)O₂ for efficient and durable oxygen evolution catalysis”, *Nat. Commun.*, **2025**, 16, 579.
8. Kabir, M. H.; Kannan, S.; Veetil, K. A.; **Kwon, T.**; Kim, K. I.; Choi, O.; Hossain, I.; Park, H. B.; Kim, T.-H.; “Plasticization- and Aging-Resistant Phenolphthalein-based Thermally Crosslinked PIM Polyimide Membranes for Efficient CO₂ Separation”, *ACS Appl. Polym. Mater.*, **2025**, 7 (1), 319-330.
9. Kim, J.[†]; **Kwon, T.**[†]; (†equal contribution) Lee, J.; Lee, H. J.; Jun, M.; Ham, H. C.; Ju, H.; Kim, S.; Kim, J. Y.*; “Ultrahigh Electrode Performance of Low-Loaded Iridium Jagged Nanotubes for Water Electrolysis Application”, *Adv. Energy Mater.*, **2024**, 14 (34), 2400999.
10. Kundu, J.[†]; **Kwon, T.**[†]; (†equal contribution) Lee, K.*; Choi, S.-I.*; “Exploration of Metal-free 2D Electrocatalysts toward the Oxygen Electoreduction,” *Exploration*, **2024**, 4, 20220174.
11. Kim, D.; Choi, J.; Lee, K.*; Kang, D. W.*; **Kwon, T.***; “Emerging porous solids for electrocatalytic and photocatalytic seawater splitting,” *Coord. Chem. Rev.*, **2024**, 514, 215935.
12. Cho, J.[†]; Kim, B.[†]; **Kwon, T.**[†]; (†equal contribution) Lee, K.*; Choi, S.-I.*; “Electrocatalytic upcycling of plastic waste,” *Green Chem.*, **2023**, 25 (21), 8444-8458.
13. Park, Y.; Jun, M.; **Kwon, T.***; Kim, J. Y.*; Lee, K.*; “Heterostructured nanocatalysts to boost the hydrogen evolution reaction in neutral electrolyte,” *Chem Catal.*, **2023**, 3 (2), 100499.
14. Yoon, S.[†]; **Kwon, T.**[†]; Kim, S.[†]; Park, S. H.[†]; (†equal contribution) Lim, Y.; Kim, J.; Kim, J.; An, K.; Park, S.; Kim, J. Y.*; Son, H. J.*; “Crystallinity-modulated hollow CeO_{2-x} nanorods as free radical

- scavengers for long-term photostability in organic photovoltaics,” *J. Mater. Chem. C*, **2023**, *11* (3), 970-979.
15. Kang, M.; Kang, D. W.; Yun, Y. J.; **Kwon, T.**; Lee, D.; Lim, K. S.*; Hong, C. S.*; “High single Zn-ion conductive porous organic conductors decorated with dense acidic groups via double post-synthetic sulfonations” *Chem. Eng. J.*, **2023**, *470*, 144245.
 16. Jun, M.; Kim, D.; Kim, M.; Kim, M.; **Kwon, T.***; Lee, K.*; “Polymer-Covered Copper Catalysts Alter the Reaction Pathway of the Electrochemical CO₂ Reduction Reaction,” *ACS Omega*, **2022**, *7* (47), 42655-42663.
 17. **Kwon, T.**[†]; Lim, Y.[†]; Cho, J.[†]; Lawler, R.[†]; (†equal contribution) Min, B. J.; Goddard III, W. A.*; Jang, S. S.*; Kim, J. Y.*; “Antioxidant technology for durability enhancement in polymer electrolyte membranes for fuel cell applications,” *Mater. Today*, **2022**, *58*, 135-163.
 18. **Kwon, T.**[†]; Park, S. H.[†]; Min, B. J.[†]; (†equal contribution) Park, S.; Ramadhani, S.; Lim, Y.; Jang, S. S.; Jeong, H.*; Son, H. J.*; Kim, J. Y.*; “Ce(III)-based Coordination Complex Based Efficient Radical Scavenger for Exceptional Durability Enhancement of Polymers Applications in Proton Exchange Membrane Fuel Cells and Organic Photovoltaics,” *Adv. Energy Sustainable Res.*, **2022**, *3* (7), 2200011.
 19. Jun, M.[†]; **Kwon, T.**[†]; (†equal contribution) Son, Y.; Lee, K.*; “Chemical Fields: Directing Atom Migration in the Multiphasic Nanocrystal,” *Acc. Chem. Res.*, **2022**, *55* (7), 1015-1024.
 20. Ruqia, B.[†]; Tomboc, G. M.[†]; **Kwon, T.**[†]; (†equal contribution) Kundu, J.; Kim, J. Y.*; Lee, K.*; Choi, S.-I.*; “Recent Advances in the Electrochemical CO Reduction Reaction towards Highly Selective Formation of C_x Products (X = 1~3),” *Chem. Catal.*, **2022**, *2* (8), 1961-1988.
 21. Jin, H.; Choi, S.; Bang, G.; **Kwon, T.**; Kim, H. S.; Lee, S. J.; Hong, Y.; Lee, D. W.; Park, H. S.; Baik, H.; Jung, Y.*; Yoo, S. J.*; Lee, K.*; “Safeguarding RuO₂ phase against lattice oxygen oxidation during acidic water electrooxidation,” *Energy Environ. Sci.*, **2022**, *15* (3), 1119-1130.
 22. Yook, S. H.; Kim, H. Y.; Kim, S. J.; Choi, S.; **Kwon, T.**; Cho, H.; Kim, J. M.; Yoon, K. R.; Jo, S.; Lee, S. Y.; Kim, H.-J.; Son, H. J.; Chae, K. H.; Kim, J.; Lee, K. Y.; Kim, J. Y.*; “Boosting Antioxidation Efficiency of Nonstoichiometric CeO_x Nanoparticles via Surface Passivation Toward Robust Polymer Electrolyte Membrane Fuel Cells,” *Chem. Eng. J.*, **2022**, *432*, 134419.
 23. Joo, J.; Park, Y.; Kim, J.; **Kwon, T.**; Jun, M.; Ahn, D.; Baik, H.; Jang, J. H.; Kim, J. Y.*; Lee, K.*; “Mn-dopant differentiating the Ru and Ir oxidation states in catalytic oxides toward durable oxygen evolution reaction in acidic electrolyte,” *Small Methods*, **2022**, *6* (1), 2101236.
 24. Kang, D. W.; Jun, M.; Kim, J.; Yang, H.; **Kwon, T.**; Joo, J.; Kim, H.; Kang, M.; Kim, J. Y.*; Lee, K.*; Hong, C. S.*; “Double Hypercrosslinked Porous-Organic-Polymer-Derived Electrocatalysts for a Water Splitting Device,” *ACS Appl. Energy Mater.*, **2022**, *5* (3), 3269-3274.
 25. **Kwon, T.**[†]; Kim, T.[†]; (†equal contribution) Son, Y.; Lee, K.*; “Dopants in the Design of Noble Metal Nanoparticle Electrocatalysts and their Effect on Surface Energy and Coordination Chemistry at the Nanocrystal Surface,” *Adv. Energy Mater.*, **2021**, *11* (22), 2100265.
 26. **Kwon, T.**[†]; Yang, H.[†]; (†equal contribution) Jun, M.; Kim, T.; Joo, J.; Kim, J.; Baik, H.; Kim, J. Y.; Lee, K.*; “Interfacing RuO₂ with Pt to induce efficient charge transfer from Pt to RuO₂ for highly efficient and stable oxygen evolution under acidic media,” *J. Mater. Chem. A*, **2021**, *9* (25), 14352-14362.
 27. Kim, T.[†]; Kim, B.[†]; **Kwon, T.**[†]; Kim, H. Y.[†]; (†equal contribution) Lee, K.*; Kim, J. Y.*; “Multimetallic nanostructures for electrocatalytic oxygen evolution reaction in acidic media,” *Mater. Chem. Front.*, **2021**, *5* (12), 4445-4473.
 28. Jo, S.; Yoon, K. R.; Lim, Y.; **Kwon, T.**; Kang, Y. S.; Sohn, H.; Choi, S. H.; Son, H. J.; Kwon, S. H.; Lee, J. H.; Lee, S. G.; Jang, S. S.; Lee, S. Y.; Kim, H.-J.; Kim, J. Y.*; “Single-step Fabrication of Polymeric Composite Membrane via Centrifugal Colloidal Casting for Fuel Cell Applications,”

- Small Methods*, **2021**, 5 (8), 2100285.
29. Jun, M.; Yang, H.; Kim, D.; Bang, G. J.; Kim, M.; Jin, H.; **Kwon, T.**; Baik, H.; Sohn, J.-H.; Jung, Y.*; Kim, H.*; Lee, K.*; "Pd₃Pb Nanosponges for Selective Conversion of Furfural to Furfuryl Alcohol under Mild Condition," *Small Methods*, **2021**, 5 (7), 2100400.
 30. Kim, J.; Min, B. J.; **Kwon, T.**; Kim, T.; Song, H. C.; Ham, H. C.; Baik, H.; Lee, K.*; Kim, J. Y.*; "Facile one-step synthesis of Ru doped NiCoP nanoparticles as highly efficient electrocatalysts for oxygen evolution reaction," *Chem. Asian J.*, **2021**, 16 (22), 3630-3635.
 31. **Kwon, T.**[†]; Jun, M.[†]; (†equal contribution) Lee, K.*; "Catalytic Nanoframes and Beyond," *Adv. Mater.*, **2020**, 32 (33), 2001345.
 32. **Kwon, T.**[†]; Jun, M.[†]; (†equal contribution) Bang, G. J.; Yang, H.; Joo, J.; Kim, T.; Kim, J.; Kim, J. M.; Baik, H.; Jung, Y.*; Kim, J. Y.*; Lee, K.*; "Dopant-assisted control of the crystallite domain size in hollow ternary Ir alloy octahedral nanocages toward the oxygen evolution reaction," *Cell Rep. Phys. Sci.*, **2020**, 1 (12), 100260.
 33. **Kwon, T.**[†]; Lim, S.[†]; (†equal contribution) Jun, M.; Kang, M.; Joo, J.; Oh, A.; Baik, H.; Hong, C. S.; Lee, K.*; "Pt²⁺-exchanged ZIF-8 nanocube as a solid-state precursor for L1₀-PtZn intermetallic nanoparticles embedded in a hollow carbon nanocage," *Nanoscale*, **2020**, 12 (2), 1118-1127.
 34. Kim, H. Y.[†]; **Kwon, T.**[†]; Ha, Y.[†]; (†equal contribution) Jun, M.; Baik, H.; Jeong, H. Y.; Kim, H.*; Lee, K.*; Joo, S. H.*; "Intermetallic PtCu Nanoframes as Efficient Oxygen Reduction Electrocatalysts," *Nano Lett.*, **2020**, 20 (10), 7413-7421.
 35. Tomboc, G. M.[†]; **Kwon, T.**[†]; (†equal contribution) Joo, J.; Lee, K.*; "High entropy alloy electrocatalysts: A critical assessment of fabrication and performance," *J. Mater. Chem. A*, **2020**, 8 (30), 14844-14862.
 36. Tomboc, G. M.; Choi, S.; **Kwon, T.**; Hwang, Y. J.*; Lee, K.*; "Potential Link between Cu Surface and Selective CO₂ Electroreduction: Perspective on Future Electrocatalyst Designs," *Adv. Mater.*, **2020**, 32 (17), 1908398.
 37. Choi, S.; Park, J.; Kabiraz, M. K.; Hong, Y.; **Kwon, T.**; Kim, T.; Oh, A.; Baik, H.; Lee, M.; Paek, S.-M.; Choi, S.-I.*; Lee, K.*; "Pt dopant: Controlling the Ir Oxidation States Toward Efficient and Durable Oxygen Evolution Reaction in Acidic Media," *Adv. Funct. Mater.*, **2020**, 30 (38), 2003935.
 38. Jeon, S.; Kim, T.; Park, J.; **Kwon, T.**; Baik, H.; Lee, K.*; "Pseudo-Epitaxial Growth of CdTe/CdS Nanoplate via Intraparticle Migration of CdTe on CdS," *Chem. Mater.*, **2020**, 32 (23), 10104-10112.
 39. Kim, J.; **Kwon, T.**; Yu, S.; Chun, S. Y.; Oh, A.; Kim, J. M.; Baik, H.; Ham, H. C.; Kim, J. Y.*; Kwak, K.*; Lee, K.*; "IrCo nanocacti on Co_xS_y nanocage as a highly efficient and robust electrocatalyst for oxygen evolution reaction in acidic media," *Nanoscale*, **2020**, 12 (32), 17074-17082.
 40. Tomboc, G. M.; Yu, P.; **Kwon, T.**; Lee, K.*; Li, J.*; "Ideal design of air electrode – a step closer towards robust rechargeable Zn-air battery," *APL Mater.*, **2020**, 8 (5), 050905.
 41. **Kwon, T.**[†]; Jun, M.[†]; (†equal contribution) Joo, J.; Lee, K.*; "Nanoscale hetero-interfaces between metal and metal compound for electrocatalytic application," *J. Mater. Chem. A*, **2019**, 7 (10), 5090-5110.
 42. Park, J.[†]*; Lim, S.[†]; **Kwon, T.**[†]; (†equal contribution) Jun, M.; Oh, A.; Baik, H.; Lee, K.*; "Longitudinal Strain Engineering of Cu_{2-x}S by the Juxtaposed Cu₅FeS₄ phase in the Cu₅FeS₄/Cu_{2-x}S/Cu₅FeS₄ Nanosandwich," *Chem. Mater.*, **2019**, 31 (21), 9070-9077.
 43. **Kwon, T.**[†]; Jun, M.[†]; Kim, H. Y.[†]; (†equal contribution) Oh, A.; Park, J.; Baik, H.; Joo, S. H.*; Lee, K.*; "Vertex-Reinforced PtCuCo Ternary Nanoframes as Efficient and Stable Electrocatalysts for the Oxygen Reduction Reaction and the Methanol Oxidation Reaction," *Adv. Funct. Mater.*, **2018**, 28 (13), 1706440.
 44. Park, J.[†]; **Kwon, T.**[†]; Kim, J.[†]; Jin, H.[†]; (†equal contribution) Kim, H. Y.; Kim, B.; Joo, S. H.*; Lee, K.*; "Hollow nanoparticles as emerging electrocatalysts for renewable energy conversion reactions,"

Chem. Soc. Rev., **2018**, 47 (22), 8173-8202.

45. Hwang, H.[†]; **Kwon, T.[†]**; Kim, H. Y.[†]; ([†]equal contribution) Park, J.; Oh, A.; Kim, B.; Baik, H.; Joo, S. H.*; Lee, K.*; “Ni@Ru and NiCo@Ru Core-Shell Hexagonal Nanosandwiches with a Compositionally Tunable Core and a Regioselectively Grown Shell,” *Small*, **2018**, 14 (3), 1702353.
46. Park, J.; Kim, H. J.; Oh, A.; **Kwon, T.**; Baik, H.; Choi, S.-I.*; Lee, K.*; “RuO_x-decorated multimetallic hetero-nanocage as highly efficient electrocatalyst toward the methanol oxidation reaction,” *Nanoscale*, **2018**, 10 (45), 21178-21185.
47. **Kwon, T.[†]**; Hwang, H.[†]; Sa, Y. J.[†]; ([†]equal contribution) Park, J.; Baik, H.; Joo, S. H.*; Lee, K.*; “Cobalt Assisted Synthesis of IrCu Hollow Octahedral Nanocages as Highly Active Electrocatalysts toward Oxygen Evolution Reaction,” *Adv. Funct. Mater.*, **2017**, 27 (7), 1604688.
48. Park, J.; Sa, Y. J.; Baik, H.; **Kwon, T.**; Joo, S. H.*; Lee, K.*; “Iridium-based Multimetallic Nanoframe@Nanoframe Structure: An Efficient and Robust Electrocatalyst toward Oxygen Evolution Reaction,” *ACS Nano*, **2017**, 11 (6), 5500-5509.
49. **Kwon, T.[†]**; Park, J.[†]; ([†]equal contribution) Baik, H.; Back, S.; Błasiak, B.; Cho, M.; Jung, Y.*; Lee, K.*; “Unexpected solution phase formation of hollow PtSn alloy nanoparticles from Sn deposition on Pt dendritic structures,” *CrystEngComm*, **2016**, 18 (32), 6019-6023.

PATENTS

1. **Kwon, T.**; Choi, J.; Yu, S.; “Electrochemical method for evaluating the radical scavenging efficiency of antioxidant additives for polymer electrolyte membrane-based electrochemical devices”
Korea Patent Appl. 10-2026-0005225 (12-Jan-2026)
2. **Kwon, T.**; Choi, J.; Kwon, D.; “Antioxidant for polymer electrolyte membrane fuel cell, manufacturing method thereof and membrane-electrode assembly comprising the same”
Korea Patent Appl. 10-2025-0068580 (26-May-2025)
3. Kim, J. Y.; Son, H. J.; Jeong, H.; **Kwon, T.**; Park, S.; Min, B. J.; Lim, Y.; Ramadhani, S.; Jang, J. H.; “Antioxidant, polymer electrolyte membrane for fuel cell comprising same, organic photovoltaics comprising same and manufacturing method thereof”
Korea Patent 10-2761756 (24-Jan-2025)
4. Kim, J. Y.; Lim, Y.; **Kwon, T.**; Min, B.-J.; Seo, B.; Park, H.-Y.; Lee, S. Y.; Park, H. S.; Yoo, S. J.; Kim, H.-J.; Jang, J. H.; “Multilayer reinforced composite electrolyte membrane and method of making same”
Korea Patent 10-2672550 (31-May-2024)
US Patent Appl. US20250019847A1 (16-Jan-2025)
5. Kim, J. Y.; **Kwon, T.**; Min, B. J.; Lim, Y.; Son, H. J.; Jang, J. H.; “Antioxidant for perfluorinated sulfonic acid ionomer and manufacturing method thereof”
Korea Patent 10-2504264 (22-Feb-2023)
6. Joo, S. H.; Lee, K.; Kim, H. Y.; **Kwon, T.**; “Intermetallic compound nanoframe and method for manufacturing the same”
Korea Patent 10-2501408 (15-Feb-2023)
7. Kim, J. Y.; Lim, Y.; Kim, J. M.; **Kwon, T.**; Jang, J. H.; “Asymmetric membrane-electrode assembly, fuel cell comprising the same and manufacturing method thereof”
Korea Patent Appl. 10-2022-0154811 (17-Nov-2022)

AWARDS AND HONORS

<i>Nov. 2025</i>	Miwon Commercial Co. Ltd. Young Scientist Award (19 th) Korean Society of Industrial and Engineering Chemistry (KSIEC)
<i>Aug. 2023</i>	Excellent Lectureship Award in 2023 Spring Semester Incheon National University
<i>May. 2023</i>	Best Paper Award (Oral Presentation), 2023 Spring Conference, Korean Hydrogen & New Energy Society
<i>Sep. 2020</i>	Chemistry Fellowship, Brain Korea 21 plus, Department of Chemistry, Korea University
<i>Jun. 2019</i>	Student Travel Award, 6 th Nano Today Conference, Elsevier
<i>Jul. 2017</i>	Best Poster Award, 2017 Summer Symposium, KCS Division of Materials Chemistry
<i>Aug. 2015</i>	<i>Summa cum laude</i> , B.S. in Chemistry, Korea University

SCHOLARSHIPS AND FUNDINGS

<i>Mar. 2022 –</i>	Sejong Science Fellowship, National Research Foundation (NRF) of Korea
<i>May. 2022 – Aug. 2022</i>	KIST Post-doc. Support Project, Korea Institute of Science and Technology (KIST)
<i>Mar. 2014 – Aug. 2015</i>	Admission Scholarship, Boheon Scholarship Foundation, Korea University
<i>Sep. 2013 – Feb. 2014</i>	Admission Scholarship, Department of Chemistry Alumni Association, Korea University