

## Geun-Ho Han

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### BRIEF INTRODUCTION

- Received Ph. D. (Aug 2021) and B.Sc. (Feb 2016) in Chemical and Biological Engineering at Korea University. Present research career has been advanced in Northwestern University as a postdoc.
- Had experiences in heterogeneous catalyst development, especially for Biomass conversion to biofuel, Natural gas conversion to aromatics, Direct synthesis of hydrogen peroxide, and Propane oxidative dehydrogenation by CO<sub>2</sub> or O<sub>2</sub>.
- Developed high-performance catalytic nanomaterials using Atomically designable synthesis, Characterization skills, and an in-depth understanding of Mechanism/kinetics with knowledge of Computational simulations.
- Had expert in atomic layer deposition and colloidal nanomaterial synthesis (morphologies and compositions) in addition to general synthesis.
- Had broad experiences in material characterizations: XRD, XPS, N<sub>2</sub> physisorption, TPx, FT-IR, TEM/STEM, ICP, ellipsometer, and AFM, and chemical analysis: GC, MS, NMR, and titrations.
- Achieved **25 papers in peer-reviewed journals, 9 patents, 6 awards, and 9 oral/poster presentations**.
- Enthusiastic about impacting sustainable society, and establishing practical approaches in industry.

H-INDEX: 13 (Google Scholar) | 12 (Scopus)

TOTAL CITATION: 449 (Google Scholar) | 427 (Scopus)

### RESEARCH INTEREST

Heterogeneous Catalysis; Nano Synthesis; Atomic Layer Deposition; Hydrogen; Energy Storage (NH<sub>3</sub>); Computational Simulation; Liquid Organic Hydrogen Carriers; Biomass Conversion; Direct Synthesis of Hydrogen Peroxide

### EDUCATION

Ph. D.	<b>Korea University</b> , Chemical and Biological Engineering, Seoul, Korea Dissertation title: <i>Development and Understanding of Bimetallic Nano-Catalyst for Direct Synthesis of Hydrogen Peroxide</i> (Dissertation advisor: Prof. <u>Kwan-Young Lee</u> )	Mar 2016- Aug 2021
B. S.	<b>Korea University</b> , Chemical and Biological Engineering, Seoul, Korea	Mar 2012- Feb 2016

### RESEARCH CAREER

Technical Research Personnel	<b>Alternative military service, Affiliated in Republic of Korea Army</b> , Korea University, Chemical and Biological Engineering, Seoul, Korea	Mar 2019- Feb 2022
Postdoctoral Research Associate	<b>Korea University</b> , Chemical and Biological Engineering, Seoul, Korea (Postdoctoral advisor: <u>Kwan-Young Lee</u> )	Sep 2021- Apr 2022

Postdoctoral  
Researcher

Northwestern University, Chemical and Biological Engineering,  
Evanston, Illinois, 60208, United States  
(Postdoctoral advisor: [Justin M. Notestein](#))

May 2022-  
Present

## RESEARCH PUBLICATIONS

\*Corresponding author

†Co-first author

25. Y. R. Park, **G.-H. Han**, S. Y. Kim, D. H. Kim, Y. G. Hur\*, K.-Y. Lee\*, “Cooperative catalysis of Co-promoted Zn/HZSM-5 catalysts for ethane dehydroaromatization”, *Fuel*, 349 (2023) 128583.  
(JCR Rank **86.97%** | IF 8.035)
24. X. Xiao†, S.-H. Lee†, **G.-H. Han**, K. R. Tag, J. P. Ahn, H.-K. Kim, K.-Y. Lee\*, T. Yu\*, “Effect of structure of Pd@ Fe core-shell cubes on the enhancement of H2 conversion in direct reaction of H2 and O2”, *Journal of Industrial and Engineering Chemistry*, 122 (2023) 285-291.  
(JCR Rank **92.5%** | IF 6.76)
23. H. M. Lee, B. J. Lee, S. Y. Kim, D. H. Kim, **G.-H. Han\***, K.-Y. Lee\*, “Deactivation resistance effect of alkane co-feeding on methane dehydroaromatization and active GaO+ species in Ga/HZSM-5 for BTX production”, *Fuel*, 325 (2022) 124939.  
(JCR Rank **86.97%** | IF 8.035)
22. **J. Yoon†**, **G.-H. Han†**, M. W. Lee, S.-H. Lee, S. H. Lee, K.-Y. Lee\*, “Amine functionalization derived lattice engineered and electron deficient palladium catalyst for selective production of hydrogen peroxide”, *Applied Surface Science*, 604, (2022) 154464.  
(JCR Rank **97.37%** | IF 7.392)
21. M. W. Lee, D. Y. Jo, **G.-H. Han**, K.-Y. Lee\*, “DFT calculations on selectivity enhancement by Br addition on Pd catalysts in the direct synthesis of hydrogen peroxide”, *Catalysis Today*, 397-399, (2022) 232-239.  
(JCR Rank **86.81%** | IF 6.562)
20. **H. W. Lee†**, **E. Jung†**, **G.-H. Han†**, M.-C. Kim, D. Kim, K.-Y. Lee\*, S. S. Han\*, T. Yu\*, “Three-in-One Strategy to Improve Both Catalytic Activity and Selectivity: Nonconcentric Pd–Au Nanoparticles”, *Journal of Physical Chemistry Letters*, 12 (2021) 11098-11105.  
(JCR Rank **87.50%** | IF 6.888)
19. **M.-C. Kim†**, **G.-H. Han†**, X. Xiao†, J. Song†, J. Hong, E. Jung, H.-K. Kim, J.-P. Ahn\*, S. S. Han\*, K.-Y. Lee\*, T. Yu\*, “Anisotropic Growth of Pt on Pd Nanocube Promotes Direct Synthesis of Hydrogen Peroxide”, *Applied Surface Science*, 562 (2021) 150031.  
(JCR Rank **97.37%** | IF 7.392)
18. **H. W. Lee†**, **H. Nam†**, **G.-H. Han†**, Y.-H. Cho, B. C. Yeo, M.-C. Kim, D. Kim\*, K.-Y. Lee\*, S. Y. Lee\*, S. S. Han\*, “Solid-solution alloying of immiscible Pt and Au boosts catalytic performance for H<sub>2</sub>O<sub>2</sub> direct synthesis”, *Acta Materialia*, 205 (2021) 116563.  
(JCR Rank **96.84%** | IF 9.209)
17. **G.-H. Han**, S.-H. Lee, S.-Y. Hwang, K.-Y. Lee\*, “Advanced Development Strategy of Nano Catalyst and DFT Calculations for Direct Synthesis of Hydrogen Peroxide”, *Advanced Energy Materials*, 11 (2021) 2003121.  
(JCR Rank **97.54%** | IF 29.698) - [Inside Front Cover](#)
16. B. J. Lee, J. H. Lee, **G.-H. Han**, Y. G. Hur, K.-Y. Lee\*, “Effect of hydroxyapatite-doping in Na-W-Mn/SiO<sub>2</sub> catalysts on oxidative coupling of methane”, *Korean Journal of Chemical Engineering*, (2021) 1-8.  
(JCR Rank 48.24% | IF 3.146)
15. J. P. Sim, B. J. Lee, **G.-H. Han**, D. H. Kim, K.-Y. Lee\*, “Promotional effect of Au on Fe/HZSM-5 catalyst for methane dehydroaromatization”, *Fuel*, 274 (2020) 117852.  
(JCR Rank **86.97%** | IF 8.035)
14. **G.-H. Han†**, **G. P. Lee†**, K.-Y. Lee\*, “Crystal refinement of rutile by sonochemical method to achieve high

- performance Pd catalysts for direct synthesis of hydrogen peroxide”, *Catalysis Today*, 352 (2020) 262-269. (JCR Rank 86.81% | IF 6.562)
13. [G.-H. Han<sup>†</sup>](#), [K. Y. Kim<sup>†</sup>](#), [H. Nam<sup>†</sup>](#), [H. Kim<sup>†</sup>](#), J. Yoon, J.-H. Lee, H.-K. Kim, J.-P. Ahn\*, S. Y. Lee\*, K.-Y. Lee\*, T. Yu\*, “Facile Direct Seed-Mediated Growth of AuPt Bimetallic Shell on the Surface of Pd Nanocubes and Application for Direct H<sub>2</sub>O<sub>2</sub> Synthesis”, *Catalysts*, 10 (2020) 650. (JCR Rank 57.36% | IF 4.501)
  12. Y.-H. Cho, [G.-H. Han](#), S. S. Han, M.-g. Seo\*, K.-Y. Lee\*, “Effects of varying amounts of Na on Pd/TiO<sub>2</sub> for the direct synthesis of H<sub>2</sub>O<sub>2</sub>: Identification of the Pd dispersion and catalytic activity enhancement by changing the surface electronic states”, *Molecular Catalysis*, 484 (2020) 110732. (JCR Rank 61.04% | IF 5.089)
  11. M. J. Kim, [G.-H. Han](#), S. H. Lee, H. W. Jung, J. W. Choung, C. H. Kim, K.-Y. Lee\*, “CeO<sub>2</sub> promoted Ag/TiO<sub>2</sub> catalyst for soot oxidation with improved active oxygen generation and delivery abilities”, *Journal of hazardous materials*, 384 (2020) 121341. (JCR Rank 96.95% | IF 14.224)
  10. [G.-H. Han<sup>†</sup>](#), [X. Xiao<sup>†</sup>](#), [J. Hong<sup>†</sup>](#), K.-J. Lee, S. Park, J.-P. Ahn\*, K.-Y. Lee\*, T. Yu\*, “Tailored Palladium–Platinum Nanoconcave Cubes as High Performance Catalysts for the Direct Synthesis of Hydrogen Peroxide”, *ACS applied materials & interfaces*, 12 (2020) 6328-6335. (JCR Rank 85.94% | IF 10.383)
  9. [G.-H. Han](#), S.-H. Lee, M.-g. Seo, K.-Y. Lee\*, “Effect of polyvinylpyrrolidone (PVP) on palladium catalysts for direct synthesis of hydrogen peroxide from hydrogen and oxygen”, *RCS Advances*, 10 (2020) 19952-19960. (JCR Rank 58.38% | IF 4.036)
  8. [G.-H. Han](#), M. W. Lee, S. Park, H. J. Kim, J.-P. Ahn, M.-g. Seo\*, K.-Y. Lee\*, “Revealing the factors determining the selectivity of guaiacol HDO reaction pathways using ZrP-supported Co and Ni catalysts”, *Journal of Catalysis*, 377 (2019) 343-357. (JCR Rank 87.68% | IF 8.047)
  7. J.-S. Kim, H.-K. Kim, S.-H. Kim, I. Kim, T. Yu, [G.-H. Han](#), K.-Y. Lee, J.-C. Lee\*, J.-P. Ahn\*, “Catalytically Active Au Layers Grown on Pd Nanoparticles for Direct Synthesis of H<sub>2</sub>O<sub>2</sub>: Lattice Strain and Charge-Transfer Perspective Analyses”, *ACS Nano*, 13 (2019) 4761-4770. (JCR Rank 94.35% | IF 18.027)
  6. S. Quon<sup>†</sup>, D. Y. Jo<sup>†</sup>, [G.-H. Han](#), S. S. Han, M.-g. Seo\*, K.-Y. Lee\*, “Role of Pt atoms on Pd (111) surface in the direct synthesis of hydrogen peroxide: Nano-catalytic experiments and DFT calculations”, *Journal of Catalysis*, 368 (2018) 237-247. (JCR Rank 87.68% | IF 8.047)
  5. [A. Cho<sup>†</sup>](#), [G.-H. Han<sup>†</sup>](#), J. S. Kim, J.-C. Lee, J.-P. Ahn, K.-Y. Lee\*, T. Yu\*, “Aqueous-phase synthesis of Pd/TiO<sub>2</sub>/Fe<sub>3</sub>O<sub>4</sub> hybrid nanostructures and their enhanced catalytic properties”, *Chemical Physics Letters*, 712 (2018) 13-19. (JCR Rank 48.61% | IF 2.719)
  4. I. Kim<sup>†</sup>, M.-g. Seo<sup>†</sup>, C. Choi<sup>†</sup>, J. S. Kim<sup>†</sup>, E. Jung, [G.-H. Han](#), J.-C. Lee, S. S. Han, J.-P. Ahn\*, Y. Jung\*, K.-Y. Lee\*, T. Yu\*, “Studies on catalytic activity of hydrogen peroxide generation according to Au shell thickness of Pd/Au nanocubes”, *ACS applied materials & interfaces*, 10 (2018) 38109-38116. (JCR Rank 85.94% | IF 10.383)
  3. G. Jeong, C. H. Kim, Y. G. Hur, [G.-H. Han](#), S. H. Lee\*, K.-Y. Lee\*, “Ni-Doped MoS<sub>2</sub> Nanoparticles Prepared via Core–Shell Nanoclusters and Catalytic Activity for Upgrading Heavy Oil”, *Energy & Fuels*, 32 (2018) 9263-9270. (JCR Rank 68.66% | IF 4.654)
  2. [Z. Tang<sup>†</sup>](#), [G.-H. Han<sup>†</sup>](#), E. Jung, M.-g. Seo, K.-Y. Lee\*, W.-S. Kim\*, T. Yu\*, “Synthesis of Cu-Pd nanoplates and their catalytic performance for H<sub>2</sub>O<sub>2</sub> generation reaction”, *Molecular Catalysis*, 452 (2018) 117-122. (JCR Rank 61.04% | IF 5.089)
  1. [G.-H. Han<sup>†</sup>](#), [M.-g. Seo<sup>†</sup>](#), Y.-H. Cho, S. S. Han, K.-Y. Lee\*, “Highly dispersed Pd catalysts prepared by a sonochemical method for the direct synthesis of hydrogen peroxide”, *Molecular Catalysis*, 429 (2017) 43-50. (JCR Rank 61.04% | IF 5.089)

**PATENTS**

9. **G.-H. Han**, T. Yu, J. Kim, H. Jeong, J. P. Ahn, K.-Y. Lee, K. Kim, H. K. Kim, J. Song, J.-S. Kim, J. Yoon, X. Xiao, E. Jung, Y.-H. Cho, S.-H. Lee, “A MANUFACTURING METHOD OF A PALLADIUM-NOBLE METAL CORE-SHELL NANOPARTICLES AND A CATALYST FOR SYNTHESIS OF HYDROGEN PEROXIDE”, *Republic of Korea* (2021) granted number; 10-2341105.
8. **G.-H. Han**, M.-g. Seo, J.-H. Yoon, S. S. Han, and K.-Y. Lee, “Method of preparing Cs-Pd catalyst for synthesis of hydrogen peroxide, and Method of preparing hydrogen oxide using the Cs-Pd catalyst”, *Republic of Korea* (2021) granted number; 10-2255171.
7. **G.-H. Han**, K.-Y. Lee, S. S. Han, T. Yu, X. Xiao, and M.-C. Kim, “Pd-Pt Core-shell Catalyst, Preparing Method thereof, and Synthesis of Hydrogen Peroxide using the same”, *Republic of Korea* (2021) granted number; 10-2247835.
6. **G.-H. Han**, Y.-H. Cho, J.-H. Yoon, S. S. Han, and K.-Y. Lee, “Method of preparing rutile titania supported Pd catalyst for synthesis of hydrogen peroxide, and Method of preparing hydrogen oxide using the Pd catalyst”, *Republic of Korea* (2021) granted number; 10-2233648.
5. Y.-H. Cho, **G.-H. Han**, J.-H. Yoon, S. S. Han, and K.-Y. Lee, “Method of preparing Pd catalyst for synthesis of hydrogen peroxide using alkali metal, and Method of preparing hydrogen oxide using the Pd catalyst”, *Republic of Korea* (2019) granted number; 10-1990025.
4. **G.-H. Han**, M.-g. Seo, M. S. Kin, and K.-Y. Lee, “NON-NOBLE METAL-SUPPORTED ZIRCONIUM PHOSPHATE CATALYST FOR GENERATING CYCLIC HYDROCARBON, AND METHOD FOR PREPARING CYCLIC HYDROCARBON BY USING SAME”, *U.S.A.* (2019) granted number; 10,232,349.
3. M.-g. Seo, **G.-H. Han**, I. Kim, T. Yu, S. S. Han, and K.-Y. Lee, “Catalyst for preparing hydrogen peroxide having core-shell structure and method for preparing hydrogen peroxide using the same”, *Republic of Korea* (2018) granted number; 10-1825907.
2. M.-g. Seo, **G.-H. Han**, J. Y. Kim, S. W. Nam, and K.-Y. Lee, “NANOPARTICLE CATALYSIS FOR SYNTHESIS OF HYDROGEN PEROXIDE AND METHOD OF SYNTHESIS OF HYDROGEN PEROXIDE USING THE SAME”, *Republic of Korea* (2017) granted number; 10-1804659.
1. **G.-H. Han**, M.-g. Seo, Y.-H. Cho, M. S. Kin, and K.-Y. Lee, “Non-noble metal/zirconium phosphate catalyst for cyclic-hydrocarbon production and Method for cyclic-hydrocarbon using the same”, *Republic of Korea* (2017) granted number; 10-1804625.

**PATENT APPLICATIONS**

8. **G.-H. Han**, J.-H. Yoon, S. H. Lee, S.-Y. Hwang, and K.-Y. Lee, “Method of preparing silica catalyst for synthesis of hydrogen peroxide, and Method of preparing hydrogen oxide using the silica catalyst”, *Republic of Korea* (2020) application number; 10-2020-0167826
7. S. H. Lee, **G.-H. Han**, S.-Y. Hwang, and K.-Y. Lee, “Method of preparing palladium catalyst for synthesis of hydrogen peroxide with rhombohedral indium oxide, and Method of preparing hydrogen oxide using the palladium catalyst”, *Republic of Korea* (2020) application number; 10-2020-0156287
6. S. H. Lee, **G.-H. Han**, S.-Y. Hwang, and K.-Y. Lee, “Method of preparing palladium alumina catalyst for synthesis of hydrogen peroxide, and Method of preparing hydrogen oxide using the palladium alumina catalysts”, *Republic of Korea* (2020) application number; 10-2020-0156284
5. T. Yu, J. W. Kim, H. Jeong, J. P. Ahn, K.-Y. Lee, K. Y. Kim, H. K. Kim, J. Song, J.-S. Kim, **G.-H. Han**, J.-H. Yoon, X. Xiao, E. Jeong, Y.-H. Cho, and S. H. Lee, “A MANUFACTURING METHOD OF A PALLADIUM-NOBLE METAL CORE-SHELL NANOPARTICLES AND A CATALYST FOR SYNTHESIS OF HYDROGEN PEROXIDE”, *Republic of Korea* (2020) application number; 10-2020-0045491
4. **G.-H. Han**, K.-Y. Lee, Y.-H. Cho, J.-H. Yoon, and S. S. Han, “Method of preparing rutile titania supported Pd catalyst for synthesis of hydrogen peroxide, and Method of preparing hydrogen oxide using the Pd catalyst”, *PCT* (2018) application number; PCT/KR2018/016334
3. K.-Y. Lee, S. S. Han, S. Quon, M.-g. Seo, Y.-H. Cho, and **G.-H. Han**, “Pd octahedron nano catalysts with noble metal doping by galvanic replacement method and method for direct synthesis of hydrogen peroxide using the

catalysts”, PCT (2017) application number; PCT/KR2017/015194

2. K.-Y. Lee, M.-g. Seo, **G.-H. Han**, S. Quon, Y.-H. Cho, and S. S. Han, “Pd octahedron nano catalysts with noble metal doping by galvanic replacement method and method for direct synthesis of hydrogen peroxide using the catalysts”, Republic of Korea (2016) application number; 10-2016-0175321
1. K.-Y. Lee, Y.-H. Cho, **G.-H. Han**, M. S. Kim, and M.-g. Seo, “Non-noble metal/zirconium phosphate catalyst for cyclic-hydrocarbon production and Method for cyclic-hydrocarbon using the same”, PCT (2015) application number; PCT/KR2015/009846

## AWARDS

- 2020 KU Graduate Student Achievement Award (Korea University) 2020
- Best Paper Award (Korea University) 2020
- Young Scientists Award (The International Association of Catalysis Societies, IACS) 2020
- Best Oral Presentation Award (Fall Meeting and International Symposium, The Korean Institute of Chemical Engineers) 2018
- Best Poster Award (Fall Meeting and International Symposium, The Korean Institute of Chemical Engineers) 2016
- Best Poster Award (Nano Korea 2016, Nano Korea) 2016

## INVITED PRESENTATIONS

1. 5<sup>th</sup> Catalysis and Chemical Engineering, Virtual presentation, February 24, 2021. (**Invited Speaker**)

## PRESENTATIONS

10. NAM28: The 28th North American Catalysis Society Meeting, Rhode Island, the United States, June 20, 2022 (**Oral**)
9. The 5th International Conference on Molecular Simulation, South Korea, November 3, 2019 (Poster)
8. KICHe Fall Meeting and International Symposium, South Korea, October 23, 2019 (Poster)
7. The 8<sup>th</sup> Asia-Pacific Congress on Catalysis, Bangkok, Thailand, August 7, 2019 (**Oral**)
6. KICHe Fall Meeting and International Symposium, South Korea, October 25, 2018 (**Oral**)
5. KICHe Fall Meeting and International Symposium, South Korea, October 24, 2017 (Poster)
4. NANO KOREA, South Korea, July 12, 2017. (Poster)
3. International Symposium of Green Chemistry, La Rochelle, France, May 17, 2017 (**Oral**)
2. KICHe Fall Meeting and International Symposium, South Korea, October 19, 2016 (Poster)
1. NANO KOREA, South Korea, July 13, 2016. (Poster)

## TEACHING EXPERIENCE

1. **Chemical & Biological Process Experiments II, Undergraduate Course:** Spring 2016 (student 110)