DOYOON KIM, Ph.D.

Room 1-180, 77 Massachusetts Ave. Cambridge, MA, 02139
Mobile: +1-314-761-7049 | Email: doyoonk@mit.edu

PROFESSIONAL EXPERIENCE

Massachusetts Institute of Technology, MA, USA
Postdoctoral research associate, Civil and Environmental Engineering ***2019 – Present***
Laboratory for Advanced Biopolymers (PI: Professor Benedetto Marelli)

National Institute of Environmental Research, Incheon, South Korea
Research assistant, Soil and Groundwater Research Division ***2011 – 2012***

EDUCATION

Washington University in St. Louis, MO, USA
Ph.D. in Energy, Environmental & Chemical Engineering ***2012 – 2018***
Dissertation: Mechanisms of Calcium Phosphate Mineralization on Biological Interfaces and its Environmental Applications (Advisor: Professor Young-Shin Jun)

Hanyang University, Seoul, South Korea
M.S. in Environmental Engineering ***2009 – 2011***
Thesis: Modification of Activated Carbon Surface for the Stabilization of Contaminated Sediments (Advisor: Professor Jae-Woo Park)
B.S. in Civil Engineering, Summa Cum Laude ***2002 – 2009***

RESEARCH EXPERIENCE

Massachusetts Institute of Technology, MA, USA
Postdoctoral Research Associate ***2019 – Present***

- ***Led a collaboration project*** with the Department of Mechanical Engineering, "Printed silk-based colorimetric sensors for food spoilage prevention and supply chain authentication," Funded by Abdul Latif Jameel Water and Food Systems Lab at MIT
- **Ongoing research projects**: "Epitaxial growth of structural proteins into hierarchical mesostructured materials (Funded by Office of Naval Research)" and "Silk Technology for a More Resilient AgriFood System (Funded by Singapore-MIT Alliance for Research and Technology Centre."
- Developed edible coating technology for food security and seed coating for sustainable agriculture.
- ***Significantly contributed to a funding proposal,*** "Precise fish vaccine injection using silk-based biomaterials," Awarded Seed Grant by Abdul Latif Jameel Water and Food Systems Lab at MIT (September, 2021 – August 2023, **Total cost: $150,000**)

Washington University in St. Louis, MO, USA
Graduate Research Assistant ***2012 – 2018***

- ***Significantly contributed to a funding proposal and actively led the project,*** "Nucleation of calcium phosphate biomaterials," Collaborative Research, Biomaterials Program, Division of Materials Research, the National Science Foundation, (September 1, 2016 – August 31, 2019. **Total cost: $390,000**).
- Active member of Wash U Biomineralization Discussion Group (Multidisciplinary team consisting of graduate students, postdoctoral researchers, and faculty members in Department of Energy, Environmental & Chemical Engineering; Department of Mechanical Engineering and Materials Science; Department of Earth & Planetary Science; and the School of Medicine).
- ***Developed a bioinspired phosphorus removal strategy*** using hydrogel beads with seed minerals.

National Institute of Environmental Research, Incheon, South Korea

Research assistant, Soil and Groundwater Research Division ***2011 – 2012***

- Investigated ***the tracking groundwater pollution sources*** by analyzing amino acids in leakage.

Hanyang University, Seoul, South Korea

Graduate Research Assistant ***2009 – 2011***

- ***Develop surface-modified activated carbon*** materials for removal of co-existing heavy metal and polyaromatic hydrocarbons in sediments.
- Evaluated ***biaoccumulations of heavy metals in earthworms*** exposed to contaminated sediments.

TEACHING EXPERIENCE

Massachusetts Institute of Technology, MA, USA

Postdoctoral Teaching Fellow ***2019***

- Contributed to developing a new course material for first-year students (CEE 1.008: Engineering Solutions to Societal Challenges, Instructor: Prof. Saurabh Amin)

Guest Lecturer (CEE 1.008, Engineering Solutions to Societal Challenges)

- Provided an in-class lecture and a lab-session (CEE for sustainable food supply chain) ***2019***
- Developed and led a virtual experimental session; Contributed to a virtual lecture (Innovations in Biomaterials for Agriculture and Food Safety) ***2020***

Washington University in St. Louis, MO, USA

Guest Lecturer (EECE 505, Aquatic Chemistry)

- Organized software training session for Thermodynamic Simulations using MINEQL+ and Visual MINTEQ ***2013 – 2018***
- Provided lectures on thermodynamics with non-ideal effects and kinetic reactions ***2017 – 2018***

Guest Lecturer for Lab Class (EECE 534, Environmental Nanochemistry)

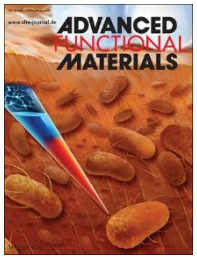
- Demonstrated synthesis and analysis of magnetite nanoparticles ***2016 – 2018***

Graduate Teaching Assistant ***2013 – 2014***

- Aquatic Chemistry (EECE 505, Fall 2013)
- Atmospheric Science and Climate (EECE 547, Spring 2014)
- Engineering Economics, Analytics, and Policy Analysis Tools (EECE 382, Fall 2014)
- Certificate for participating TA-Training Workshop (August, 2013)

PUBLICATIONS (Google Scholar Profile citation: 255, h-index: 8)

Peer-Review Journal Articles (*Corresponding author; #Equally contributed)
Published/Accepted (first/co-first author)



10. ***Kim, D.***, Lee, B., Marshall, B., Thomopoulos, S., and Jun, YS.* **(2021)** Cyclic Strain Enhances Calcium Phosphate Nucleation and the Elastic Modulus of Collagen Matrices at the Early Stages of Mineralization. ***Biomaterials Science***, DOI: 10.1039/D1BM00884F.
9. ***Kim, D***., Cao, Y., Mariappan, D., Bono Jr., M. S., Hart, A. J., and Marelli, B.* **(2021)** A Microneedle Technology for Sampling and Sensing Bacteria in the Food Supply Chain. ***Advanced Functional Materials***, DOI: 10.1002/adfm.202005370. (Featured on the front cover of Vol. 31, Issue 1. Top 5% Altmetric attention Score. Highlighted in >22 news outlets including *MIT News* and *Daily Mail.com*)
8. Ruggeri, E.,# ***Kim, D***.,# Cao, Y., Fare, S., De Nardo, L., and Marelli, B.* **(2020)** A Multilayered Edible Coating to Extend Produce Shelf-life. ***ACS Sustainable Chemistry & Engineering***, DOI: 10.1021/acssuschemeng.0c03365.
7. ***Kim, D.***, Lee, B., Marshall, B., Eunyoung Jang, Thomopoulos, S., and Jun, YS.* **(2020)** Pulsed Electrical Stimulation Enhances Body Fluid Transport for Collagen Biomineralization, ***ACS Applied Bio Materials***, DOI: 10.1021/acsabm.9b00979.
6. ***Kim, D.***, Lee, B., Thomopoulos, S., and Jun, YS.* (**2018**) The Role of Confined Collagen Geometry in Decreasing Nucleation Energy Barriers to Intrafibrillar Mineralization, ***Nature Communications***, DOI: 10.1038/s41467-018-03041-1. Open Access Link (Top 5% Altmetric attention Score. Highlighted in >7 news outlets, including *the Source* and *NSF news*.)
5. ***Kim, D.***, Wu, T., Cohen M., Jeon, I., and Jun, YS.* (**2018**) Designing the Crystalline Structure of Calcium Phosphate Seed Minerals in Organic Templates for Sustainable Phosphorus, ***Green Chemistry***, DOI: 10.1039/C7GC02634J.
4. ***Kim, D.***, Lee, B., Thomopoulos, S., and Jun, YS.* (**2016**) *In situ* Evaluation of Calcium Phosphate Nucleation Kinetics and Pathways during Intra-and Extrafibrillar Mineralization of Collagen Matrices. ***Crystal Growth & Design***, DOI: 10.1021/acs.cgd.6b00864.
3. ***Kim, D.***, Min, J., Yoo, Y., and Park, J. -W.* (**2014**) *Eisenia fetida* Growth Inhibition by Amended Activated Carbon Causes Less Bioaccumulation of Heavy Metals. ***Journal of Soils and Sediments***, DOI: 10.1007/s11368-014-0934-0.
2. ***Kim, D.***, Kim, C. -K., Chun, B., and Park, J. -W.* (**2012**) Enhanced Heavy Metal Sorption by Surface-Oxidized Activated Carbon Does Not Affect the PAH Sequestration in Sediments, ***Water, Air, & Soil Pollution***, DOI: 10.1007/s11270-012-1101-0.
1. ***Kim, D.***, Jung, Y. -W., Kwon, S. -J., and Park, J. -W.* (**2011**) Adsorption of Cadmium (Ⅱ) from Aqueous Solutions by Thiol-functionalized Activated Carbon, ***Water Science and Technology: Water Supply***, DOI: 10.2166/ws.2011.009.

Published/Accepted (co-author)

16. Jun, YS.*, Zhu, Y., Wang, Y., Ghim, D., Wu, X., ***Kim, D.,*** and Jung, H. (**2022**) Classical and Nonclassical Nucleation and Growth Mechanisms for Understanding Nanoparticle Formation, the ***Annual Review of Physical Chemistry*** (Accepted).

15. Zhu, Y., Li, Q., ***Kim, D.***, Min, Y., Lee, B., and Jun, YS.* (**2021**) Sulfate-Controlled Heterogeneous $CaCO_3$ Nucleation and Its Non-linear Interfacial Energy Evolution. ***Environmental Science & Technology***, DOI: 10.1021/acs.est.1c02865.
14. Zvinavashe, A.T., Laurent, J., Sun, H., ***Kim, D***., Effa Fouda, H.M., and Marelli, B.* (**2021**) Programmable Design of Seed Coating Function Induces Water-stress Tolerance in Semi-arid Regions. ***Nature Food***, DOI: 10.1038/s43016-021-00315-8.
13. Neil, C., Wu, X., ***Kim, D.***, Jung, H., Zhu, Y., Ray, J. and Jun, YS.* (**2020**) Arsenite Oxyanions Affect CeO_2 Nanoparticle Dissolution and Colloidal Stability. ***Environmental Science: Nano***, DOI: 10.1039/d0en00970a.
12. Wu, X., Burnell, S., Neil, C., ***Kim, D***., Zhang, L., Jung, H., and Jun, YS.* (**2020**) Effects of Phosphate, Silicate, and Bicarbonate on Arsenopyrite Dissolution and Secondary Mineral Precipitation, ***ACS Earth and Space Chemistry,*** DOI: 10.1021/acsearthspacechem.9b00273.
11. Wu, X., Bower, B., ***Kim, D***., Lee, B., and Jun, YS.* (**2019**) Dissolved Organic Matter Affects Arsenic Mobility and Iron(III) (hydr)oxides Formation: Implications for Managed Aquifer Recharge, ***Environmental Science & Technology***, DOI: 10.1021/acs.est.9b04873.
10. Min, Y., ***Kim, D***., and Jun, YS.* (**2018**) Effects of Na^+ and K^+ Exchange in Interlayers on Biotite Dissolution under Geologic CO_2 Sequestration Conditions, ***Environmental Science & Technology***, DOI: 10.1021/acs.est.8b04623.
9. Wu, X., Neil, C., ***Kim, D.,*** Jung, H., Newville, M., and Jun, YS.* (**2018**) Co-effects of UV/H_2O_2 and Natural Organic Matter on the Surface Chemistry of Cerium Oxide Nanoparticles, ***Environmental Science: Nano,*** DOI: 10.1039/C8EN00435H.
8. Zhang, L., ***Kim, D***., and Jun, YS.* (**2018**) Effects of Phosphonate Structures on Brine−Biotite Interactions under Subsurface Relevant Conditions, ***ACS Earth and Space Chemistry***, DOI: 10.1021/acsearthspacechem.8b00075.
7. Zhang, L., ***Kim, D***., and Jun, YS.* (**2018**) The Effects of Phosphonate-Based Scale Inhibitor on Brine−Biotite Interactions under Subsurface Conditions, ***Environmental Science & Technology***, DOI: 10.1021/acs.est.7b05785.
6. Zhang, L., ***Kim, D***., Kim, Y., Wen, J., and Jun, YS.* (**2017**) Effect of Phosphate on Biotite Dissolution and Secondary Precipitation under conditions relevant to engineered subsurface processes, ***Physical Chemistry Chemical Physics***, DOI: 10.1039/C7CP05158A.
5. Hui, Y.,[#] Jung, H., ***Kim, D.***,[#] and Jun, YS.* (**2017**) Kinetics of α-MnOOH Nanoparticle Formation through Enzymatically-catalyzed Bio-mineralization inside Apoferritin, ***Crystal Growth & Design***, DOI: 10.1021/acs.cgd.7b00568.
4. Jung, H., Chandha, T.S., ***Kim, D.,*** Biswas, P., and Jun, YS.* (**2017**) Photochemically-Assisted Fast Oxidation of Manganese and Formation of δ-MnO_2 Nanosheet in Nitrate Solution, ***Chemical Communications***, DOI: 10.1039/C7CC00754J**.**
3. Jun, YS.,* ***Kim, D***., and Neil, CW. (**2016**) Heterogeneous Nucleation and Growth of Nanoparticles at Environmental Interfaces, ***Accounts of Chemical Research***, DOI: 10.1039/C7CC00754J. Open Access Link
2. Lee, J., ***Kim, D.***, Park, J. –W.* (**2011**) Long-Term Effect of Consolidation on Contaminant Transport, ***Journal of the Korean Geotechnical Society***, DOI: 10.7843/kgs.2011.27.1.035.

1. Yeo, I. H., ***Kim, D.***, Paik, J. H., Lee, Y. J., Shin, M. C., and Park, J. –W.* (**2010**) Modeling of Blades to Enhance Self-power Generation in Pipe Flow, ***Journal of the Korean Society of Water and Wastewater***, 24(3): 277-285.

U.S Patent

1. ***Kim, D.***, and Jun, YS. (2019). Engineered Calcium Alginate and Uses Thereof. U.S. Patent Application No. 16/397,898 (Pending).

PROFESSIONAL PRESENTATIONS

Invited Talks

3. Silk-based Biopolymer Technology for Food Safety and Security, The 6th International Water Industry Conference, Daegu, South Korea, September 23, 2020.
2. Silk-based Microneedle Technology for the Colorimetric Detection of Bacteria for Improved Food Quality Monitoring System, Henry L. Pierce Laboratory Seminar Series, Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, MA, USA, June 9, 2020.
1. Studies of Calcium Phosphate Nucleation to Understand Bone Mineralization and to Develop Sustainable P Management Strategy, Environmental Systems Laboratory, Department of Civil and Environmental Engineering, Hanyang University, Seoul, South Korea, May 17, 2018.

Conference Presentations (* oral presenter, # poster presenter)

16. ***Kim, D.****, Cao, Y., and Marelli, B. **(2021)** Use of Biopolymer-Based Microneedle Technology for the Sustainable Food Supply Chain, ***2021 MRS Spring/Fall Meeting***., Boston, MA, USA (Accepted for upcoming event).
15. ***Kim, D.****, Cao, Y., and Marelli, B. **(2021)** Silk-Based Microneedle Biosensor for Sustainable Food Supply Chain, ***2021 AIChE Annual Meeting***, Boston, MA, USA (Accepted for upcoming event).
14. ***Kim, D.****, Cao, Y., Mariappan, D., Bono Jr., M. S., Hart, A. J., and Marelli, B. **(2020)** Reconstructing Bombyx mori Silk Fibroin into a 3D Porous Microneedle Array for Detection of Food Bacteria, ***2020 Virtual MRS Spring/Fall Meeting***.
13. ***Kim, D.*** **(2020)** Dynamic Control of Nanocrystal Nucleation and Biopolymer Assembly for the Water-Food-Energy Nexus, Meet the New Faculty Candidates - Virtual Session, ***2020 Virtual MRS Spring/Fall Meeting***.
12. ***Kim, D.***# and Marelli, B. **(2020)** Engineering Biopolymer Crystallinity in Microneedles for Improved Food Monitoring System, Meet the Faculty and Post-Doc Candidates Poster Session, ***2020 Virtual AIChE Annual Meeting***, San Francisco, CA, USA.
11. ***Kim, D.****, Lee, B., Thomopoulos, S., and Jun, YS. **(2018)** Thermodynamics of Confined Calcium Phosphate Nucleation in Collagen Fibrils, Special Symposium on "Biomineralization & Bio-compatible Minerals," ***The 255th ACS National Meeting***, New Orleans, LA, USA.
10. ***Kim, D.***#, Cohen, M., Jeon, IH., Burnell, S., and Jun, YS. **(2017)** Utilization of Poorly Crystalline Calcium Phosphate Minerals for Selective Phosphate Recovery and Recycling, ***The 2017 Association of Environmental Engineering and Science Professors Conference***, Ann Arbor, Michigan, USA.

9. ***Kim, D.****, Cohen, M., Gu, M., Jeon, IH., and Jun, YS. **(2017)** Calcium Phosphate Seed Nuclei for Selective Phosphorus Recovery at Neutral pH, ***The 253rd ACS National Meeting***, San Francisco, California, USA.
8. ***Kim, D.****, Lee, B., Thomopoulos, S., and Jun, YS. **(2017)** Nucleation, Growth, and Transformation of Calcium Phosphate Minerals in Multi-scale Nucleation Sites of Collagen Fibrils, ***The 253rd ACS National Meeting, San Francisco***, California, USA.
7. ***Kim, D.****, Wu, T., Cohen, M., and Jun, YS. **(2016)** Calcium Phosphate-Organic Composites for a more Sustainable P Cycle: Learning from Biomineralization, ***The 251st ACS National Meeting***, San Diego, California, USA.
6. ***Kim, D.****, Lee, B., Thomopoulos, S., and Jun, YS. **(2016)** Influence of Biological Interfaces on Nucleation Pathways and Kinetics of Calcium Phosphate Minerals, ***The 251st ACS National Meeting***, San Diego, California, USA.
5. ***Kim, D.****, Wu, T., Cohen, M., and Jun, YS. **(2015)** Remediation Strategy for Phosphorous-rich Aqueous Environments Inspired by Biominerals, ***The 21st Annual Mid-America Environmental Engineering Conference***, Columbia, Missouri, USA.
4. ***Kim, D.****, Lee, B., Thomopoulos, S and Jun, YS. **(2015)** Nucleation and Crystallization Kinetics of Initial Apatite Nanocrystal Formation within Biological Templates, ***The 249th ACS National Meeting, Denver***, Colorado, USA.
3. ***Kim, D.****, Kwon, S. -J., and Park, J. -W. **(2010)** Effects of Surface Oxygen Group of Activated Carbon on Heavy Metal and PAH Adsorption, ***The International Chemical Congress of Pacific Basin Societies***, Honolulu, Hawaii, USA.
2. ***Kim, D.****, Kwon, S. -J., and Park, J. -W. **(2010)** Evaluation of Oxidized Activated Carbon as a Stabilization Agent for Sediments Contaminated with Hydrophobic Organic Chemicals and Heavy Metals, ***The 8th International Symposium on Ecohydraulics***, Seoul, South Korea.
1. ***Kim, D.****, Jung, Y. -W., Kwon, S. -J., and Park, J. -W. **(2009)** Adsorption of Cadmium (II) from Aqueous Solutions by Thiol-functionalized Activated Carbon, ***The 3rd IWA-ASPIRE Conference***, Taipei, Taiwan.

HONORS AND AWARDS

Graduate Research Award, Department of EECE, Washington University in St. Louis ***2019***
Doh Won Suk Memorial Award, U.S. chapter of the Korean Institute of Chemical Engineers (KIChE) ***2018***
Certificate of Merit, Division of Environmental Chemistry, 253rd American Chemical Society Meeting ***2017***
Student Travel Award, Division of Geochemistry, 251st American Chemical Society Meeting ***2016***
Study-abroad Scholarship from Hanyang University ***2012***
Science and Technology Scholarship from Hanyang University ***2009 – 2011***
Korean Society of Environmental Engineers Spring Conference – Outstanding Paper Award ***2010***
Daewoo Engineering funded scholarship ***2010***
Academic scholarship from Hanyang University (4 semesters) ***2003 – 2009***