

INSEOK CHAE

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PROFESSIONAL EXPERIENCE

- 2025- present **Assistant Professor, Texas Tech University**, Lubbock, TX
Department of Chemical Engineering
- 2020-25 **Postdoctoral Researcher, University of California**, Berkeley, CA
Department of Bioengineering (Prof. Seung-Wuk Lee's Lab)
Lawrence Berkeley National Laboratory
Biological Systems and Engineering

EDUCATION

- 2020 **Ph.D. Pennsylvania State University**, University Park, PA
Department of Chemical Engineering (Prof. Seong H. Kim's Lab)
Thesis: Understanding polar ordering and piezoelectric properties of noncentrosymmetric crystalline biopolymers
- 2015 **MSc. University of Alberta**, Edmonton, Canada
Department of Chemical and Materials Engineering (Prof. Thomas Thundat's Lab)
Thesis: Development of an electronic nose for detection of volatile organic compounds using nanoporous microcantilevers and photothermal spectroscopy
- 2013 **BS. Yonsei University**, Seoul, South Korea
Department of Chemical Engineering (Advisor: Prof. Hansung Kim)
Exchange Student, University of Alberta, Edmonton, Canada (2010-11)

SPECIALTIES

Biohydrometallurgy, critical minerals, stimuli-responsive biomaterials, biomineralization, energy conversion, supramolecular assembly, optical spectroscopy

PUBLICATIONS

- 2025 Choi, J., Kwansa, A. L., **Chae, I.**, Yingling, Y. G., Kim, S., DFT-based calculation of the vibrational sum frequency generation spectrum of noncentrosymmetric domains interspersed in an amorphous matrix. *The Journal of Physical Chemistry B*, DOI: [10.1021/acs.jpcb.5c00590](https://doi.org/10.1021/acs.jpcb.5c00590)
- 2025 Lee, J., Ryu J., Choi J., **Chae, I.**, Kim, S., Vibrational sum frequency generation (SFG) spectroscopy study of nano-to-meso scale polarity and orientation of crystalline biopolymers in natural materials. *Annual Review of Physical Chemistry*, 76:405-430. DOI: [10.1146/annurev-physchem-082423-125535](https://doi.org/10.1146/annurev-physchem-082423-125535)
- 2024 **Chae, I.**, Shivkumar, A., Doyle, F. M., Lee, S.-W., Virus-based separation of rare earth elements. *Nano Letters*, 24, 32, 9946-9952. DOI: [10.1021/acs.nanolett.4c02510](https://doi.org/10.1021/acs.nanolett.4c02510)
- 2024 **Chae, I.**, Chung, W.-J., Jin, H.-E., Kim, H., Lim, B., Yang, J. R., Lee, H., Kim, S.-Y., Lee, S.-W., Evolutionary design of self-templated supramolecular fibrils using M13 bacteriophage for tissue engineering. *Nano Letters*, 24, 33, 10388-10395 DOI: [10.1021/acs.nanolett.4c03231](https://doi.org/10.1021/acs.nanolett.4c03231)
- 2023 Kim, H., Okada, K., **Chae, I.**, Lim, B., Ji, S., Kwon, Y., Lee, S.-W., Virus-based Pyroelectricity, *Advanced Materials*, 2305503. DOI: [10.1002/adma.202305503](https://doi.org/10.1002/adma.202305503)
- 2023 **Chae, I.**, Paniagua-Guerra, L., Pitcher, M., Koshani, R., Yuan, M., Lin, Y., Lee, J., Perini,

- S., Sheikhi, A., Ramos-Alvarado, B., Lanagan, M., Kim, S., Relaxation dynamics of water in the vicinity of cellulose nanocrystals. *Cellulose*, 30, 8051-8061. DOI: [10.1007/s10570-023-05361-y](https://doi.org/10.1007/s10570-023-05361-y)
- 2023 Lim, B., Kim, J., Desai, M., Wu, W., **Chae, I.**, Lee, S.-W., Elastic fluorescent protein based down-converting optical films for flexible display. *Biomacromolecules*, 24, 118-131. DOI: [10.1021/acs.biomac.2c00957](https://doi.org/10.1021/acs.biomac.2c00957)
- 2022 **Chae, I.**, Han, A., Sundaram J., Lee, S., Recombinant factor VIII protein aggregation and adsorption at the liquid-solid interface. *Journal of Colloid and Interface Science*, 628 (Part A), 820-828. DOI: [10.1016/j.jcis.2022.07.161](https://doi.org/10.1016/j.jcis.2022.07.161)
- 2021 **Chae, I.**, Zu, R., Meddeb, A., Ogawa, Y., Dong, B., Gopalan, V., Ounaies, Z., Kim, S., Electric field-induced polarization responses of noncentrosymmetric crystalline biopolymers in different frequency domains – A case study with unidirectionally-aligned β -chitin crystals. *Biomacromolecules*, 22, 5, 1901-1909. DOI: [10.1021/acs.biomac.0c01799](https://doi.org/10.1021/acs.biomac.0c01799)
- 2021 **Chae, I.**, Bokhari, S., Chen, X., Zu, R., Liu, K., Borhan, A., Gopalan, V., Catchmark, J., Kim, S., Shear-induced unidirectional deposition of bacterial cellulose microfibrils using rising bubble stream cultivation. *Carbohydrate Polymers*, 255, 117328. DOI: [10.1016/j.carbpol.2020.117328](https://doi.org/10.1016/j.carbpol.2020.117328)
- 2020 Meddeb, A., **Chae, I.**, Scurti, F., Schwartz, J., Kim, S., Ounaies, Z., From a cholesteric non-aqueous cellulose nanocrystal suspension to a highly ordered film. *MRS Advances*, 5 (64), 3547-3554. DOI: [10.1557/adv.2020.404](https://doi.org/10.1557/adv.2020.404)
- 2020 Meddeb, A., **Chae, I.**, Han, A., Kim, S., Ounaies, Z., Magnetic field effects on cellulose nanocrystal ordering in a non-aqueous solvent. *Cellulose*, 27, 7901-7910. DOI: [10.1007/s10570-020-03320-5](https://doi.org/10.1007/s10570-020-03320-5)
- 2020 **Chae, I.**, Ngo, D., Chen, Z., Meddeb, A., Kwansa, A., Xing, Chen., Podraza, N., Yingling, Y., Ounaies, Z., Kim, S., Anisotropic optical and frictional properties of Langmuir-Blodgett film consisting of uniaxially-aligned rod-shaped cellulose nanocrystals. *Advanced Materials Interfaces*, 7, 1902169. DOI: [10.1002/admi.201902169](https://doi.org/10.1002/admi.201902169)
- 2019 **Chae, I.**, Ngo, D., Makarem, M., Ounaies, Z., Kim, S., Compression-induced topographic corrugation of air/surfactant/water interface: effect of nanoparticles adsorbed beneath the interface. *Journal of Physical Chemistry C*, 123, 42, 25628-25634. DOI: [10.1021/acs.jpcc.9b05220](https://doi.org/10.1021/acs.jpcc.9b05220)
- 2019 Farell, M., Wetherington, M., Shankla, M., **Chae, I.**, Subramanian, S., Kim, S., Sksimientiev, A., Robinson, J., Kumar, M., Characterization of lipid structure and fluidity on epitaxial graphene and their correlation to graphene features. *Langmuir*, 35, 13, 4726-4735. DOI: [10.1021/acs.langmuir.9b00164](https://doi.org/10.1021/acs.langmuir.9b00164)
- 2019 Makarem, M., Lee, C., Kafle, K., Huang, S., **Chae, I.**, Yang, H., Kubicki, J., Kim, S., Probing cellulose structures with vibrational spectroscopy. *Cellulose*, 26, 1, pp 35-79. DOI: [10.1007/s10570-018-2199-z](https://doi.org/10.1007/s10570-018-2199-z)
- 2019 Yoon, Y., **Chae, I.**, Thundat, T., Lee, J., Hydrogel microelectromechanical system (MEMS) resonators: beyond cost-effective sensing platform, *Advanced Materials Technologies*, 1800597. DOI: [10.1002/admt.201800597](https://doi.org/10.1002/admt.201800597)
- 2018 **Chae, I.**, Jeong, C., Ounaies, Z., Kim, S., Review on electromechanical coupling properties of biomaterials. *ACS Applied Bio Materials*, 1, 4, 936-953. DOI: [10.1021/acsabm.8b00309](https://doi.org/10.1021/acsabm.8b00309)
- 2017 **Chae, I.**, Ahmed, S., Atitallah, H., Luo, J., Wang, Q., Ounaies, Z., Kim, S., Vibrational sum frequency generation (SFG) analysis of ferroelectric response of PVDF-based copolymer and terpolymer. *Macromolecules*, 50, 2838-2844.

DOI: [10.1021/acs.macromol.7b00188](https://doi.org/10.1021/acs.macromol.7b00188)

- 2017 Liu, X., **Chae, I.**, Miriyala, N., Lee, D., Thundat, T., Kim, S. Broadband mid-infrared stand-off reflection-absorption spectroscopy using a pulsed external cavity quantum cascade laser. *Applied Spectroscopy*, 71 (7), 1494-1505. DOI: [10.1177/0003702817693233](https://doi.org/10.1177/0003702817693233)
- 2017 Lee, D., **Chae, I. (co-first author)**, Kwon, O., Lee, K., Kim, C., Kim, S., Thundat, T., Plasmonic absorbers with optical cavity for the enhancement of photothermal/optocalorimetric infrared spectroscopy. *Applied Physics Letters*, 110, 011901. DOI: [10.1063/1.4973591](https://doi.org/10.1063/1.4973591)
- 2016 **Chae, I.**, Khan, F., Song, J., Lee, J., Lee, J., Thundat, T., Standoff mechanical resonance spectroscopy based on infrared-sensitive hydrogel microcantilevers. *Analytical Chemistry*, 88, 9678–9684. DOI: [10.1021/acs.analchem.6b02540](https://doi.org/10.1021/acs.analchem.6b02540)
- 2015 Rahimi, M., **Chae, I.**, Hawk, J., Mitra, S., Thundat, T. Methane sensing at room temperature using photothermal cantilever deflection spectroscopy. *Sensors & Actuators: B. Chemical*, 221, 564-569. DOI: [10.1016/j.snb.2015.07.006](https://doi.org/10.1016/j.snb.2015.07.006)
- 2015 **Chae, I.**, Lee, D., Kim, S., & Thundat, T. Electronic nose for recognition of volatile vapor mixtures using a nanopore-enhanced opto-calorimetric spectroscopy. *Analytical Chemistry*, 87 (14), 7125-7132. DOI: [10.1021/acs.analchem.5b00915](https://doi.org/10.1021/acs.analchem.5b00915)
- 2014 Lee, D., Kim, S., **Chae, I.**, Jeon, S., & Thundat, T., Nanowell-patterned TiO₂ microcantilevers for calorimetric chemical sensing. *Applied Physics Letters*, 104 (14), 141903. DOI: [10.1063/1.4870535](https://doi.org/10.1063/1.4870535)
- 2014 Bagheri, M., **Chae, I.**, Lee, D., Kim, S., & Thundat, T., Selective detection of physisorbed hydrocarbons using photothermal cantilever deflection spectroscopy. *Sensors and Actuators B: Chemical*, 191, 765–769. DOI: [10.1016/j.snb.2013.10.078](https://doi.org/10.1016/j.snb.2013.10.078)
- 2012 Yun, M., Kim, S., Lee, D., Jung, N., **Chae, I.**, Jeon, S., & Thundat, T., Photothermal cantilever deflection spectroscopy of a photosensitive polymer. *Applied Physics Letters*, 100 (20), 204103. DOI: [10.1063/1.4719521](https://doi.org/10.1063/1.4719521)

The full list of publications and citations can be also found in Google Scholar [[link](#)].

Forthcoming publications

Chae, I., Park, J., Lee, I. S., Jin H.-E., Doyle, F. M., Lee, S.-W., Virus-based thermoresponsive separation of rare earth elements. *Submitted*.

Chae, I., Lim, B., Doyle, F. M., Lee, S.-W., Elastin-based hydrogel to separate rare earth elements. *Manuscript in preparation*.

Jung, J., **Chae, I.**, Lim B., Pyun, J.-C., Lee, S.-W., Biomining of rare earth elements using stimuli-responsive living material. *Manuscript in preparation*.

CONFERENCES & INVITED TALKS

- 2025 The Minerals, Metals & Materials Society (TMS 2025) meeting, Las Vegas, NV
Paper: **Chae, I.**, Doyle, F., Lee, S.-W., Rare earth elements recovery using thermo-responsive virus. The Minerals, Metals & Material Series, Rare Metal Technology 2025. pp 1139-1148. Springer. DOI: [10.1007/978-3-031-80748-0_100](https://doi.org/10.1007/978-3-031-80748-0_100)
- 2024 The American Institute of Chemical Engineers, Annual Meeting, San Diego, CA
Oral: Virus-based selective and sustainable rare earth element separation
Oral: Biomimetic design and assembly of functional materials using bacteriophage
Poster: Bioinspired design of structural bionanomaterials for sustainable future
- 2024 Biological Research Information Center (BRIC) Webinar, South Korea
Oral: Bioinspired design of functional materials using bacteriophage

- YouTube ink: https://www.youtube.com/watch?v=Ss_S5JKqYzg
- 2024 Biological Nanostructures Facility Meeting at Molecular Foundry, LBNL, Berkeley, CA
Oral: Virus-based biomineralization and biomineralization.
 - 2024 The Minerals, Metals & Materials Society (TMS 2024) meeting, Orlando, FL
Paper: Chae, I., Doyle, F., Lee, S.-W., Bacteriophage-based sorption of rare earth elements from dilute aqueous solutions. Rare Metal Technology 2024. pp161-170. Springer. DOI: [10.1007/978-3-031-50236-1_17](https://doi.org/10.1007/978-3-031-50236-1_17)
 - 2023 Materials Research Society (MRS) spring meeting & exhibit, San Francisco, CA
Oral: Virus-based biomimetic collagen supramolecular structure and function.
 - 2022 Berkeley-Stanford Soft Matter Workshop, Berkeley, CA
Poster: M13 Bacteriophage based collagen-like tissue engineering materials
 - 2018 American Society of Mechanical Engineering (ASME)-SMASIS, San Antonio, TX
Paper: Chae, I., Meddeb, A., Ounaies, Z., Kim, S., Tailoring and characterization of the liquid crystalline structure of cellulose nanocrystals for opto-electro-mechanical multifunctional applications, SMASIS2018-8016, DOI: [10.1115/SMASIS2018-8016](https://doi.org/10.1115/SMASIS2018-8016)
 - 2018 American Chemical Society (ACS) National Meeting, Boston, MA
Oral and poster: Critical discussion of electromechanical coupling properties of cellulose
 - 2018 ACS Colloid & Surface Science Symposium, University Park, PA
Oral: Phase and Orientation control of cellulose nanocrystals by Langmuir-Blodgett Assembly
 - 2017 Air Force Office of Scientific Research (AFOSR) Student Research Day, Arlington, VA
Poster: Design of new piezoelectric composites using nanocellulose.
 - 2016 Micro Electro Mechanical Systems (MEMS) conference, Shanghai, China
Paper: Chae, I., Khan, F., Song, J., Lee, J., Lee, J., Thundat, T., Standoff infrared spectroscopy on energetic materials using hydrogel microcantilevers, IEEE-MEMS, DOI: [10.1109/MEMSYS.2016.7421543](https://doi.org/10.1109/MEMSYS.2016.7421543)
 - 2015 International Symposium on Micro and Nano Technology (ISMNT), Calgary, Canada
Oral: Development of an electronic nose based on nanoporous microcantilevers.
 - 2015 SPIE. International Society for Optics and Photonics Conference, Baltimore, MD
Paper: Chae, I., Van Neste, C., Thundat, T., Ozone alteration for background references using QCL-based mid infrared standoff spectroscopy, SPIE 9467, DOI: [10.1117/12.2178606](https://doi.org/10.1117/12.2178606)
 - 2014 Institute for Oil Sands Innovation Conference, Edmonton, Canada
Poster: Real-time detection of naphtha using photothermal cantilever deflection Spectroscopy
 - 2014 Alberta Nanotechnology Symposium, Edmonton, Canada
Poster: Study of the crystal growth and morphology of energetic material RDX nanorod

AWARDS AND HONORS

- 2015 Top-up offer in admission, Pennsylvania State University
- 2013 Captain Thomas Farrell Greenhalgh memorial scholarship, University of Alberta
- 2006-12 University assigned scholarship (4 times), Yonsei University
- 2010 Excellence award (Top 10% GPA in Chemical Engineering), Yonsei University
- 2010 Mirae Asset global exchange scholarship, Mirae Asset financial group

TEACHING

- 2022-25 Guest lecturer (7 times), Bioengineering, University of California, Berkeley, CA
Course: Functional biomaterials development and characterization (BIOE111)
Title: Understanding dynamic light scattering and its applications in bioengineering
Title: Bioseparation of rare earth elements
Course: Bionanoscience and bionanotechnology (BIOE150)
Title: M13 virus-based biomining and biomineralization
Title: Scanning Probe Microscopy (SPM)
- 2016-25 Mentored 19 undergraduates and graduate students
Students: Elisabeth Young, Zubin Havewala, Hunter Joerg, Brian Wu, Irene Lee, Humayd Zameer, Dylan Chang, Noelle Humphrey, Robert J. Yang, Arjun Shivkumar, Stefanny Cachia, Venkata Alapati, Darian Flore, Lina Dong, Naruemon Tunsakul, Safira Asih, Jinzhen Hu, Amy Tomasko, Natalie Rome
- 2019 Teaching assistant, Pennsylvania State University, University Park, PA
Course: Process Fluid Mechanics. Led discussion, held office hours and graded exam
- 2013 Teaching assistant, University of Alberta, Edmonton, Canada
Course: Mass Transfer. Graded assignments and exams

VOLUNTEERING

- 2024 Science outreach, Ellerhorst Elementary School, Pinole, CA
Introduced concepts of bioengineering and biomining to 5th grade students and demonstrated bioleaching process using hydroxyapatite crystals
- 2023 Bioengineering Day, University of California, Berkeley, CA
Participated in the workshop for local high school students. Led laboratory tours and introduced bioengineering research on campus
- 2018 ACS Colloid & Surface Science Symposium, University Park, PA
Photography volunteering and social networking media organization
- 2014 Hospital volunteering, Seoul, South Korea
Provided language translation service and physical assistance for international workers having economic difficulties
- 2014 Mentoring high school student from a low-income family, Seoul, South Korea
Taught Mathematics and English
- 2006-07 Yonsei Global (student organization), Yonsei University, Seoul, South Korea
Organized language exchange programs and global events for international students

ADDITIONAL EXPERIENCE

- 2012 Summer Internship, Hyundai Engineering Co. Ltd, Seoul, South Korea
Gained experience in process flow diagrams, and piping and instrumentation diagrams of chemical process plants
- 2011 Research Assistant, University of Alberta, Edmonton, Canada
Analyzed desorption kinetics of explosives from nanoporous microcantilevers (Prof. Thomas Thundat's Lab)
- 2007-09 Military Service, Seoul, South Korea
Developed leadership and communication skills through the role of squad commander

PATENTS

Forthcoming

- 2024 Lee, S.-W., Doyle, F., **Chae, I.**, Elastin-based hydrogel to separate rare earth elements.
Submitted IPIRA.
- 2024 Lee, S.-W., Doyle, F., **Chae, I.**, Virus-based selective separation of rare earth elements.
Submitted IPIRA.

REFERENCES

1. **Prof. Seung-Wuk Lee** (Postdoc supervisor)
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Department of Bioengineering
Faculty Scientist, Lawrence Berkeley National Laboratory
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Phone: 510-664-5193
2. **Prof. Seong H. Kim** (Ph.D. advisor)
Professor. Pennsylvania State University
Department of Chemical Engineering and Materials Research Institute
N-323 Millennium Science Complex, University Park, PA, 16802
E-mail: shk10@psu.edu
Phone: 814-863-4809
3. **Prof. Fiona M. Doyle** (Co-investigator)
Professor. University of California, Berkeley
National Academy of Engineering
Department of Materials Science and Engineering
480 Hearst Mining Building, Berkeley, CA 94710
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Phone: 510-333-1693
4. **Prof. Zoubaida Ounaies** (Ph.D. committee)
Professor. Pennsylvania State University
Department of Mechanical Engineering and Materials Research Institute
157B Hammond Building, University Park, PA, 16802
E-mail: zxo100@psu.edu
Phone: 814-867-4443
5. **Prof. Thomas Thundat** (MSc. advisor)
Professor. University at Buffalo (The State University of New York)
Department of Chemical and Biological Engineering
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