Seunghyun (Seu) Sim, Ph. D.

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I. PROFESSIONAL EXPERIENCE

2020–present **Assistant Professor**
Department of Chemistry
Biomedical Engineering and Chemical and Biomolecular Engineering (joint appointments)
University of California Irvine

2017–2020 **Postdoctoral Researcher**
Helen Hay Whitney Postdoctoral Fellow
Division of Chemistry and Chemical Engineering, California Institute of Technology
Academic Advisor: Professor David A. Tirrell

II. EDUCATION

2017 **Ph.D. Chemistry and Biotechnology**
Japan Society for the Promotion of Science (JSPS) Fellow
School of Engineering, The University of Tokyo, Japan
Academic Advisor: Professor Takuzo Aida

2014 **M.Eng. Chemistry and Biotechnology**
MERIT Fellow
School of Engineering, The University of Tokyo, Japan
Academic Advisor: Professor Takuzo Aida

2012 **B.S. Chemistry**
B.S. Biological Science
School of Natural Sciences, Seoul National University, South Korea
summa cum laude

III. SELECTED AWARDS & HONORS

- Distinguished Early Career Faculty Award in Research, UC Irvine Academic Senate, 2024
- NIH Maximizing Investigator's Research Award (MIRA), 2023
- NSF CAREER Award, 2023
- Scialog Fellow in Advancing Bioimaging, 2021
- Helen Hay Whitney Postdoctoral Fellowship, 2019–2020
- Global Outstanding Student Award in Polymer Science and Engineering, American Chemical Society, 2019
- PMSE Future Faculty Scholars, American Chemical Society, 2018
- Japan Society for the Promotion of Science (JSPS) Graduate Fellowship for Young Scientists, 2015–2017

- BASF Ph.D. Rising Star Award, BASF, 2014
- MERIT Fellowship, The University of Tokyo, 2013–2015

IV. FUNDING (2020-CURRENT, >$3M)

- NIH R35GM150770 ($1,833,619), Role: PI, 08/2023 – 07/2028
- RCSA SA-ABI-2023-045a ($55,000), Role: PI, 08/2023 – 07/2024
- NSF MCB02316730 ($745,760 ~50% share), Role: Co-PI, 07/2023 – 06/2026
- NSF CAREER: DMR-2237344 ($522,895), Role: PI, 06/2023 – 05/2028
- RCSA SA-ABI-2022-034 ($55,000), Role: PI, 08/2022 – 07/2023
- NSF MRSEC ($18,000,000 PI share ~$352,980), Role: participating PI (current: IRG-2 co-lead), 09/2022 – 08/2026
- NSF MRSEC Seed Funding ($55,000), Role: PI, 06/2021 – 05/2022

V. SELECTED AWARDS & HONORS OF STUDENT TRAINEES

- American Institute of Chemist Award, Ju-An Kim (undergraduate), 2024
- NSF Graduate Research Fellowship, Alexis Medina (undergraduate), 2024
- NSF Graduate Research Fellowship Honorable Mention, Ryan Koenig (graduate), 2024
- American Institute of Chemist Award, Alexis Medina (undergraduate), 2023
- NSF Graduate Research Fellowship Honorable Mention, Lucas Korbanka (graduate), 2023
- DoD National Defense Science and Engineering Graduate Fellowship, Marc Kawada (graduate), 2022
- NSF Graduate Research Fellowship, Esteban Bautista Garcia (graduate), 2022

VI. PUBLICATION

** indicates corresponding authorship* & *# denotes equal contribution*

Pre-print/Under Review

- A. Bartnik, L. Zeinalvand, D. Kodira, P. R. Prasad, J. Patterson, **S. Sim**,* "Redox-enabled Pathway Complexity in Supramolecular Hydrogels" *ChemRxiv* **2024**, under review

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Independent Publication

(17) E. Bautista, E. Estrada, J. Deyell, M. Sun, A. R. La Spada, **S. Sim**,* "Antibacterial Polymers Based on Two Orthogonal Binding Motifs Coalesce with Bacterial Matter" *ACS Applied Bio Materials* **2025**, *8*, 2377–2385.

(16) Z. Cui, M. Kawada, Y. Hui, **S. Sim**,* "Programming Aliphatic Polyester Degradation by Engineered Spores" *Biomacromolecules* **2025**, *26*, 1882–1891.

(15) L. Korbanka, J.-A. Kim, **S. Sim**,* "Macroscopic Assembly of Materials with Engineered Bacterial Spores via Coiled-Coil Interaction" *ACS Synthetic Biology* **2024**, *13*, 3668–3676.

(14) H. Jo, **S. Sim**,* "Elastic Network of Droplets for Underwater Adhesives" *Journal of the American Chemical Society* **2023**, *145*, 27022–27029.

(13) M. Kawada, H. Jo, A. M. Medina, **S. Sim**,* "Catalytic Materials Enabled by a Programmable Assembly of Synthetic Polymers and Engineered Bacterial Spores" *Journal of the American Chemical Society* **2023**, *145*, 16210–16217.

- Featured in *JACS Spotlights*, "Programming Bacterial Spores to Become Polymers Chemists"

(12) **S. Sim**,* N. Hosono, Z. Wei, D. Jiang, Y. Yamamoto, "Professor Takuzo Aida – A Visionary Leader in Polymer Science" *Journal of Polymer Science* **2023**, *61*, 859–860.

(11) H. Jo, S. Selmani, Z. Guan, **S. Sim**,* "Sugar-Fueled Dissipative Living Materials" *Journal of the American Chemical Society* **2023**, *145*, 1811–1817.

(10) Y. Hui, Z. Cui, **S. Sim**,* "Stress-Tolerant, Recyclable, and Renewable Biocatalyst Platform Enabled by Engineered Bacterial Spores" *ACS Synthetic Biology* **2022**, *11*, 2857–2868.

(9) H. Jo, **S. Sim**,* "Programmable Living Materials Constructed with Dynamic Covalent Interface between Synthetic Polymers and Engineered *B. subtilis*" *ACS Applied Materials & Interfaces* **2022**, *14*, 20729–20738.

(8) **S. Sim,*** "Network Formation of Engineered Proteins and Their Bioactive Properties" *Engineered Living Materials*, In Srubar III W.V. (eds) Engineered Living Materials, pp. 1-26. Springer, Cham, **2022**.

Mentored Publication

(7) **S. Sim**,# Y. Hui,# D. A. Tirrell,* "3D-printable cellular composites for production of recombinant proteins" *Biomacromolecules*, **2022**, 23, 4687–4695.

(6) D. Kashiwagi,# H. Shen,# **S. Sim**, T. Niwa, H. Taguchi, T. Aida,* "Molecularly Engineered "Janus GroEL": Application to Supramolecular Copolymerization with a Higher Level of Sequence Control" *Journal of the American Chemical Society* **2020**, *142*, 13310–13315.

(5) D. Kashiwagi, **S. Sim**,* T. Niwa, H. Taguchi, T. Aida,* "Protein Nanotube Selectively Cleavable with DNA: Supramolecular Polymerization of "DNA-Appended Molecular Chaperones" *Journal of the American Chemical Society* **2018**, *140*, 26−29.

(4) **S. Sim**, T. Aida,* "Swallowing a Surgeon: Toward Clinical Nanorobots" *Accounts of Chemical Research* **2017**, *50*, 492–497.

(3) **S. Sim**, T. Niwa, H. Taguchi, T. Aida,* "Supramolecular Nanotube of Chaperonin GroEL: Length Control for Cellular Uptake Using Single-Ring GroEL Mutant as End-Capper" *Journal of the American Chemical Society* **2016**, *138*, 11152−11155.

(2) **S. Sim**, D. Miyajima,* T. Niwa, H. Taguchi, T. Aida,* "Tailoring Micrometer-Long High-Integrity 1D Array of Superparamagnetic Nanoparticles in a Nanotubular Protein Jacket and Its Lateral Magnetic Assembling Behavior" *Journal of the American Chemical Society* **2015**, *137*, 4658–4661.

(1) **S. Sim**, Y. Kim, T. Kim, S. Lim, M. Lee,* "Directional Assembly of α-Helical Peptides Induced by Cyclization" *Journal of the American Chemical Society* **2012**, *134*, 20270-20272.

VII. PATENTS

- **S. Sim**, H. Jo, "Viscoelastic materials based on microstructured liquids" *U.S. Patent Application* 18/905,109, filed on Oct 2, 2024.
- M. Daigo, T. Takeuchi, **S. Sim**, T. Aida, I. Aoki, "Nanoparticle, contrast agent for magnetic resonance imaging containing same, and ligand compound" *U.S. Patent* 11,389,550, issued July 19, 2022.

VIII. SERVICE

1. Service to the Department

- Admissions Committee, 2020–current
- Organic Seminar Committee Co-chair, 2020–2022
- Student-hosted Seminar Co-chair, 2023–current

2. Service to the UCI Campus

- IRG-2 Co-lead, NSF MRSEC Center for Complex and Active Materials (CCAM), 2024–current
- Steering Committee, NSF MRSEC Center for Complex and Active Materials (CCAM), 2024–current
- Founder and faculty mentor of the Polymer Science Club (PSC): 2022–current
- ACCESS outreach for community college and transfer students: 2023–current
- Core member of the Center for Synthetic Biology (CSB), 2024–current
- Participation in on-campus outreach activities: LEAPS, EmpowHer, SoCal Undergraduate Research Symposium
- Member of the Synthetic and Chemical Biology Club (SCBC): 2020–current
- Faculty Search Committee in the CBE Department: 2024–2025

3. Service to the Scientific Community

- Peer-review: *Journal of the American Chemical Society*, *Chemical Sciences, Nature Communications*, *Advanced Materials, Advanced Functional Materials, ACS Synthetic Biology*, *ACS Applied Materials & Interfaces*, *Chemistry – A European Journal*, *European Journal of Organic Chemistry*, *ACS Omega*, *Aggregates, Trends in Biotechnology*
- Ad hoc and panel reviewer of the US National Science Foundation
- Reviewer of the Swiss National Science Foundation
- Reviewer of the National Science Center, Poland
- Contributor of the Engineering Biology Research Consortium Roadmap for the intersection of materials science and biological engineering (2020)
- Co-chair at the Materials Research Society Fall Meeting, Engineering Biomaterials with Synthetic Biology (2022)
- Tosoh Polymer Conference, discussion leader (2022)
- Mentor in the Future Faculty Workshop: Texas A&M University (2023), University of Minnesota (2024)

IX. UNIVERSITY SEMINARS

- Department of Chemistry, Johns Hopkins University, MD, Sep 9, 2025 *forthcoming*

- Frontiers in Nanotechnology Program, Northwestern University, IL, April 17, 2025 *forthcoming*
- School of Molecular Engineering, University of Chicago, IL, April 16, 2025 *forthcoming*
- Department of Chemistry, University of California Los Angeles, CA, April 8, 2025 *forthcoming*
- Department of Chemical Engineering and Materials Science, University of Minnesota, MN, April 1, 2025 *forthcoming*
- Department of Chemical Engineering, University of Virginia, VA, March 20, 2025
- Department of Chemistry, Texas A&M University, TX, February 27, 2025
- Department of Chemistry, University of Missouri – St. Louis, MO, February 10, 2025 (virtual)
- Department of Chemical Engineering, California Institute of Technology, CA, January 23, 2025
- MSE-KKS-CBE-ME-EE Joint Symposium on Advanced Materials & Technologies, Korea University, South Korea, January 22, 2025 (virtual)
- Department of Materials Science, University of California Santa Barbara, CA, January 17, 2025
- Department of Chemistry and Biochemistry, University of California San Diego, CA, January 13, 2025
- Department of Chemical Engineering, Columbia University, NY, September 16, 2024
- Department of Polymer Science and Engineering, University of Massachusetts Amherst, MA, September 13, 2024
- Department of Chemistry, Boston College, MA, September 11, 2024
- Program in Polymer and Soft Matter, Massachusetts Institute of Technology, MA, September 10, 2024
- Le laboratoire de Chimie de la Matière Condensée de Paris (LCMCP, CNRS), Sorbonne Université, France, June 24, 2024
- Department of Chemistry (Mid-Career Seminar), University of California Irvine, CA, September 27, 2023
- School of Chemical and Biological Engineering, Seoul National University, South Korea, August 31, 2023
- Department of Chemistry, Seoul National University, South Korea, August 30, 2023
- Department of Chemistry and Biochemistry, California State University Long Beach, CA, April 5, 2023
- Freshmen Seminar, School of Comprehensive Studies, University of Tsukuba, June 17, 2021
- Department of Chemical and Biomolecular Engineering, University of California Irvine, CA, May 14, 2021.
- Department of Biomedical Engineering, University of California Irvine, CA, Oct 30, 2020.
- The Engineering Biology Research Consortium (EBRC) Virtual Seminar, July 7, 2020.
- Department of Chemistry and Biochemistry, Georgia Institute of Technology, GA, Feb 27, 2020.
- Department of Chemical and Biological Engineering, University of Colorado Boulder, CO, Feb 20, 2020.
- Department of Materials Science and Engineering, University of Illinois Urbana Champaign, IL, Feb 17, 2020.
- Department of Chemical Engineering and Materials Science, University of Minnesota, MN, Feb 11, 2020.
- Department of Chemical and Biological Engineering, Northwestern University, IL, Feb 4, 2020.
- Department of Chemical and Biological Engineering, University of Wisconsin Madison, WI, Jan 29, 2020.
- Department of Chemistry, University of California Irvine, CA, Jan 21, 2020.
- Department of Chemistry, Princeton University, NJ, Jan 6, 2020.
- Department of Chemistry and Biotechnology, University of Tokyo, Japan, Sep 6, 2019.

X. PRESENTATION AT PROFESSIONAL MEETINGS

- "Molecular assembly of living materials" The US Engineering Living Materials Conference, Rice University, Houston TX, postponed from April to Oct 2025 (invited keynote)
- "Molecular assembly of living and lifelike materials" Division of Polymeric Materials Science and Engineering, American Chemical Society National Meeting & Exposition, San Diego, CA, March 2025 (contributed)
- "Molecular assembly of living and lifelike materials" ACS Division of Organic Chemistry - Empowering Women of Organic Chemistry virtual symposium, January 2024 (invited)
- "Molecular assembly of living materials" CEMSupra Workshop (hosted by RIKEN) 2024, Manza, Japan, December 2024 (invited)
- "Molecular assembly of living materials" Engineered Living Materials 2024, Saarbrücken, Germany, September 2024 (invited)
- "Molecular assembly of living materials" Gordon Research Conference in Bioinspired Materials 2024, Les Diablerets, Switzerland, June 2024 (invited)
- "Molecular assembly of living materials (poster presentation)" Gordon Research Conference in Bioinspired Materials 2024, Les Diablerets, Switzerland, June 2024 (contributed)
- "Molecular assembly of living materials" Synthetic Biology Young Speaker Series (SYNBYSS), virtual seminar, March 2024 (invited)
- "Elastic network of droplets for underwater adhesives" Division of Polymer Chemistry, American Chemical Society National Meeting & Exposition, New Orleans LA, March 2024 (invited)
- "Self-assembled living materials with dynamic polymer networks" Division of Polymeric Materials Science and Engineering, American Chemical Society National Meeting & Exposition, New Orleans LA, March 2024 (invited)
- "Sugar-Fueled Dissipative Living Materials" Systems Chemistry Virtual Symposium, July 2023 (invited)
- "Programming Synthetic Living Materials with Engineered Bacteria" Empowering Women in Organic Chemistry (EWOC) Meeting, Thousand Oaks CA, June 2023 (invited)
- "Programming Living Materials with Synthetic Polymers and Engineered Bacteria" Synthetic Biology: Engineering, Evolution & Design (SEED) Meeting, Los Angeles CA, May 2023 (contributed)
- "Programming Responsive Living Materials" SF01 Smart Functions of Stimuli-Responsive Materials, Materials Research Society Fall Meeting, Boston MA, December 2022 (contributed)
- "Programmable Living Materials with Engineered Spore-Forming Bacteria and Synthetic Macromolecules" SB11 Engineering Biomaterials with Synthetic Biology, Materials Research Society Fall Meeting, Boston MA, November 2022 (contributed)
- "Living Materials: Programming Synthetic Materials with Engineered Living Bacteria" Frontiers in Soft Matter and Macromolecular Networks Symposium, San Diego, CA, September 2022 (invited)
- "Programmable living materials constructed with dynamic covalent interface between synthetic polymers and engineered *B. subtilis*" Biomaterials & Biointerfaces, Division of Colloid and Surface Chemistry, American Chemical Society National Meeting & Exposition, Chicago IL, August 2022 (contributed)

- "Stress-tolerant, recyclable, and autonomously renewable biocatalyst platform enabled by engineered bacterial spores" Early Career Investigators Symposium, Division of Biological Chemistry, American Chemical Society National Meeting & Exposition, Chicago IL, August 2022 (contributed)
- "Living composite materials of cells, polymeric scaffolds, and artificial proteins" Biomaterials and Life Science Engineering: Faculty Candidates, American Institute of Chemical Engineers (AIChE), Orlando FL, November 2019 (contributed)
- "3D-Engineering of Functional Living composite Materials (poster presentation)" Meet the Faculty Candidate Poster Session, American Institute of Chemical Engineers (AIChE), Orlando FL, November 2019 (contributed)
- "Engineered living material reinforced by artificial protein assembly *in situ* (poster presentation)" Greater LA (GALA) Chemical Biology Meeting, Los Angeles CA, June 2019 (contributed)
- "Engineering Self-assembly of Protein Polymers for Functional Materials" ACS NASA Symposium: Chemistry for Humanity's Next Giant Leap, American Chemical Society National Meeting & Exposition, Orlando FL, April 2019 (invited)
- "Genetically Encoded, Chemically Elaborated Polymeric Materials" PMSE Future Faculty Symposium, American Chemical Society National Meeting & Exposition, Boston MA, August 2018 (invited)
- "Engineered Protein GroEL for Controlling 1D to 3D Nanostructural Assembly" Japan Chemical Society 97th Annual Meeting, Yokohama, Japan, March 2017 (contributed)
- "Engineered Protein Cargo for Controlling 1D to 3D Assembly" Nature Inspires Creativity Engineers (NICE) 2016, Nice, France, October 2016 (contributed)
- "Utilizing Engineered Protein Cargo for Controlling Hierarchical 3D Assembly (poster presentation)" The International Chemical Congress of Pacific Basin Societies (PacifiChem), Honolulu HI, December 2015 (contributed)
- "Functional Protein Supramolecular Structures Based on GroEL (poster presentation)" SysChem 2015, Kerkrade, Netherlands, May 2015 (contributed)
- "ATP-responsive Biomaterials Using Chaperonin Proteins (poster presentation)" 8th ECNP International Conference on Nanostructured Polymers and Nanocomposites, Dresden, Germany, September 2014 (contributed)
- "ATP-responsive Biomaterials Using Chaperonin Proteins (poster presentation)" TSRC Workshop on Molecular Motors, Rotors and Switches, Telluride CO, June 2014 (contributed)
- "ATP-responsive Biomaterials Using Chaperonin Proteins" SPSJ 63th Annual Meeting, Nagoya, Japan, May 2014 (contributed)
- "Development of Novel Bio-inorganic Hybrid Materials based on GroEL (poster presentation)" CEMS ISSC&FM, Tokyo, Japan, December 2013 (contributed)
- "1D Self-assembly Utilizing Peptide and Protein as a Building Block: Toward the Novel Drug Delivery Vehicle (poster presentation)" Gordon Research Conference in Self-assembly and Supramolecular Chemistry, Les Diablerets, Switzerland, May 2013 (contributed)

- "Directional Assembly of α-Helical Peptides Induced by Cyclization" Japan Chemical Society 93th Annual Meeting, Shiga, Japan, March 2013 (contributed)
- "Small Peptide α-Helix Triggered by Cyclization (poster presentation)" IUPAC MACRO2012 World Polymer Congress, Blacksburg VA, June 2012 (contributed)

XI. TEACHING

- Chem225 Polymer Chemistry (Graduate)
- Chem51A Organic Chemistry (Undergraduate)