Jong Seung Lee

Massachusetts Institute of Technology

Department of Mechanical Engineering

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PROFESSIONAL EXPERIENCES

Research Scientist

2025.9. – present

Massachusetts Institute of Technology

Department of Mechanical Engineering (Advisor: Prof. Giovanni Traverso)

Post-doc

2021.9. – 2025.8.

Massachusetts Institute of Technology

Department of Mechanical Engineering (Advisor: Prof. Giovanni Traverso)

2021.3. – 2021.8.

Yonsei University

Department of Biotechnology (Advisor: Prof. Seung-Woo Cho)

RESEARCH INTEREST

- **Brain–Machine Interfaces & Neurotechnology:** Bioelectronic interfaces and sensing technologies for decoding biological signals and restoring communication between living systems and engineered devices.
- **AI-Driven Generative Biology & Stem Cell Engineering:** AI-enabled prediction and engineering of stem-cell fate, differentiation, multicellular organization, and tissue-level behavior for programmable biological systems.
- **Virtual Cells & In Silico Biology:** Predictive computational models and biological digital twins for simulating cellular and organism-level responses and enabling in silico experimentation.
- **Translational & Regenerative Medicine:** Engineering stem cells, biomaterials, and medical devices into clinically relevant therapeutic platforms that bridge fundamental discoveries with patient needs.

RESEARCH EXPERIENCE

2021.3 – Postdoctoral Associate / Research Scientist

Massachusetts Institute of Technology, Cambridge, MA, USA

- Development of translational platforms for cell therapy
- Engineering of biomaterial-based delivery systems
- Development of AI-powered smart medical devices

2014.2. – 2021.2. Graduate Research Assistant

Stem Cell and Biomaterials Engineering Laboratory (PI: Seung-Woo Cho), Yonsei University, Seoul, Republic of Korea

- Developing biomedical platform to manipulate stem cell and tissue engineering (Intra/extracellular electrical stimulation; Photoactivated system; Magnetic control)
- Organ on a chip system development (Artificial skin with neuronal interface; Organoid culture system)
- Development of functionalized scaffolds for tissue regeneration (Natural/synthetic polymer; Hydrogel)

2012.8. – 2013.7. Undergraduate Researcher

Nanobiotech Laboratory (PI: Prof. Hyung-il Jung), Yonsei University, Seoul, Republic of Korea

- Design and control of microneedle fabrication and application
- Drug delivery using microneedle on the mouse skin

EDUCATION

2014.3. – 2021.2.

- Yonsei University
- Ph.D. in College of Life Science & Biotechnology

2010.3. – 2014.2.

- Yonsei University
- B.S. in College of Life Science & Biotechnology

TEACHING EXPERIENCES

- **2025 – MIT Kaufman Teaching Certificate Program**
- **2026 – MIT Professional Development Research Mentoring Program**

AWARDS & SCHOLARSHIP

1. Empowering Global Excellence, Nurturing Creative Superiority Scholarship – Yonsei University (2019)
2. Best Presenting Award, The 15th Annual Meeting of Korean Society for Alternative to Animal Experiments (KSAAE) (2108)
3. Best Poster Presentation Award, The Korean Biochip Society Spring Conference (2018)

PUBLICATIONS (INTERNATIONAL)

2025

1. Lim D, Park S, **Lee JS**, Gwon HJ, Nam Y, Choi S, Kim J, Kim Y, Park G, Pyun WY, Park HW, Cho SW, Ahn HS. Longitudinal transformation of mitochondrial metabolism during neurogenesis. PNAS 2025;122(47):e2517961122.
2. Jeon IY, Jeon YM, Choi JH, Lee S, Kim M, Kim JH, **Lee JS**, Hwang J, Jeong D, Carroll GA, Wentworth A, Yang K, Park S, Raskin KA, Jang WY, Traverso G, Lee JS. In situ printing of biodegradable implant for healing critical-sized bone defect. Device 2025;3:100873.
3. Kim J, **Lee JS**, Noh S, Seo E, Lee J, Kim T, Cho SW, Kim G, Kim SS, Park J. Cellular level cryo-neuromodulation using rapid and localized cooling device combined with microelectrode array. Biosensors and Bioelectronics 2025;277:117257.

2022

4. **Lee JS***, Kim J*, Cui B, Kim SK, Cho SA, An S, Cho SW. Hybrid skin chips for toxicological evaluation of chemical drugs and cosmetic compounds. Lab on a Chip 2022;22:343-353.
5. Lee JS, Choi YS, **Lee JS**, Jeon EJ, An S, Lee MS, Yang HS, Cho SW. Mechanically-Reinforced and Highly Adhesive Decellularized Tissue-Derived Hydrogel for Efficient Tissue Repair. Chemical Engineering Journal 2022;427:130926.

2021

6. Kwon J*, **Lee JS***, Lee J, Na J, Sung J, Lee HJ, Kwak H, Cheong E, Cho SW, Choi HJ. Vertical Nanowire Electrode Array for Enhanced Neurogenesis of Human Neural Stem Cells via Intracellular Electrical Stimulation. Nano Letters 2021;21:6343-6351.
7. Kim J, Lee KT, **Lee JS**, Shin J, Cui B, Yang K, Choi YS, Choi N, Lee SH, Lee JH, Bahn YS, Cho SW. Fungal Brain Infection Modelled in a Human-Neurovascular-Unit-on-a-Chip with a Functional Blood-Brain Barrier. Nature Biomedical Engineering 2021;5:830-846.

2020

8. Choi S, **Lee JS**, Shin J, Lee MS, Kang D, Hwang NS, Lee H, Yang HS, Cho SW. Osteoconductive Hybrid Hyaluronic Acid Hydrogel Patch for Effective Bone Formation. Journal of Controlled Release 2020;327:571-583.
9. Baek J, Cho Y, Park H-J, Choi G, **Lee JS**, Lee M, Yu SJ, Cho SW, Lee E, Im SG. A Surface-tailoring Method for Rapid Non-thermosensitive Cell Sheet Engineering via Functional Polymer Coatings. Advanced Materials 2020;32(16):1907225.

2019

10. Jin Y, Lee J, Chung E, Yang K, Kim J, Kim JW, **Lee JS**, Cho AN, Oh T, Lee JH, Cho SW, Cheon J. Magnetic Control of Axon Navigation in Reprogrammed Neurons. Nano Letters 2019;19(9):6517-6523.

11. Yang K, **Lee JS**, Han S, Jin Y, Cho AN, Chang GE, Cheong E, Yang JH, Chung S, Cho SW. Endothelial-Neurosphere Crosstalk in Microwell Arrays Regulates Self-Renewal and Differentiation of Human Neural Stem Cells. Journal of Industrial and Engineering Chemistry 2019;74:148-157.

2018

12. Ko E*, **Lee JS***, Kim H, Yang SY, Yang D, Yang K, Lee J, Shin J, Yang HS, Ryu WH, Cho SW. Electrospun Silk Fibroin Nanofibrous Scaffolds with Two-Stage Hydroxyapatite Functionalization for Enhancing the Osteogenic Differentiation of Human Adipose-Derived Mesenchymal Stem Cells. ACS Applied Materials & Interfaces 2018;10(9):7614-7625.

2017

13. Yang K, Yu SJ, **Lee JS**, Lee HR, Chang GE, Seo J, Lee T, Cheong E, Im SG, Cho SW. Electroconductive Nanoscale Topography for Enhanced Neuronal Differentiation and Electrophysiological Maturation of Human Neural Stem Cells. Nanoscale 2017;9:18737-18752.

14. **Lee JS**, Jin Y, Park HJ, Yang K, Lee MS, Yang HS, Cho SW. *In Situ* Bone Tissue Engineering with an Endogenous Stem Cell Mobilizer and Osteoinductive Nanofibrous Polymeric Scaffold. Biotechnology Journal 2017;12(12):1700062.

15. Yang K, Oh JY, **Lee JS**, Jin Y, Chang GE, Chae SS, Cheong E, Baik HK, Cho SW. Photoactive Poly(3-hexylthiophene) Nanoweb for Optoelectrical Stimulation to Enhance Neurogenesis of Human Stem Cells. Theranostics 2017;7(18):4591-4604.

16. Lee JS, **Lee JS**, Lee MS, An S, Yang K, Lee K, Yang HS, Lee H, Cho SW. Plant Flavonoid-Mediated Multifunctional Surface Modification Chemistry: Catechin Coating for Enhanced Osteogenesis of Human Stem Cells. Chemistry of Materials 2017;29(10):4375–4384.

17. Kim J, Yang K, **Lee JS**, Hwang YH, Park HJ, Park KI, Lee DY, Cho SW. Enhanced Self-Renewal and Accelerated Differentiation of Human Fetal Neural Stem Cells Using Graphene Oxide Nanoparticles. Macromolecular Bioscience 2017;17(8):1600540.

2016

18. Kim H, Yang K, Jeong W, Choi S, **Lee JS,** Cho AN, Chang G-E, Cheong E, Cho SW, Lim Y. Photoactivation of Noncovalently Assembled Peptide Ligands on Carbon Nanotubes Enables the Dynamic Regulation of Stem Cell Differentiation. ACS Applied Materials & Interfaces 2016;8(16):26470-26481.

19. Shin J, Cho JH, Jin Y, Yang K, **Lee JS,** Park HJ, Han HS, Lee J, Jeon H, Shin H, Cho SW. Mussel Adhesion-Inspired Reverse Transfection Platform Enhances Osteogenic Differentiation and Bone Formation of Human Adipose-Derived Stem Cells. Small 2016;12(45):6266-6278.

20. Ko E, Alberti K, **Lee JS,** Yang K, Jin Y, Shin J, Yang HS, Xu Q, Cho SW. Nanostructured Tendon-Derived Scaffolds for Enhanced Bone Regeneration by Human Adipose-Derived Stem Cells. ACS Applied Materials & Interfaces 2016;8(35):22819-22829.

21. Yang K, Lee J, **Lee JS,** Kim D, Chang G-E, Seo J, Cheong E, Lee T, Cho SW. Graphene Oxide Hierarchical Patterns for the Derivation of Electrophysiologically Functional Neuron-like Cells from Human Neural Stem Cells. ACS Applied Materials & Interfaces 2016;8(28):17763-17774.

2015

22. Yang K, Park E, **Lee JS,** Kim IS, Hong K, Park KI, Cho SW, Yang HS. Biodegradable Nanotopography Combined with Neurotrophic Signals Enhances Contact Guidance and Neuronal Differentiation of Human Neural Stem Cells. Macromolecular Bioscience 2015;15(10):1348-1356.

23. Yang K, Park HJ, Han S, Lee J, Ko E, Kim J, **Lee JS**, Yu JH, Song KY, Cheong E, Cho SR, Chung S, Cho SW. Recapitulation of *In Vivo*-Like Paracrine Signals of Human Mesenchymal Stem Cells for Functional Neuronal Differentiation of Human Neural Stem Cells in a 3D Microfluidic System. Biomaterials 2015;63:177-188.

2014

24. Yang K, Jung H, Lee HR, **Lee JS**, Kim SR, Song KY, Cheong E, Bang J, Im SG, Cho SW. Multiscale, Hierarchically Patterned Topography for Directing Human Neural Stem Cells into Functional Neurons. ACS Nano 2014;8(8):7809-7822.

PRESENTATION

1. Yang Y, Kang Z, Shalabi N, **Lee JS**, Zhao M, Xia F, Moon I, Woo J, Zhang M, Wang S, Ballinger I, Schneck O, Gierlach A, Shayan M, Su Y, Jastrzebska-Perfect P, Youcef-Toumi K, Scott M, Langer R, Traverso G. Smart Cell Analysis Needle System as a Platform for Real-Time Characterization of Cell Therapies. Smart Cell Analysis Needle System as a Platform for Real-Time Characterization of Cell Therapies. Chemical Biology and Therapeutics Science Program (CBTS) Symposium, Cambridge, USA (February, 2026).

2. **Lee JS**, Epigenetics of Leadership: Lessons from stem cell differentiation. United States-Korea Conference (UKC), Fostering Innovation in Rising Experts (FIRE) Symposium, Atlanta, USA (August, 2025).

3. **Lee JS**, Yang Y, Kang Z, Shalabi N, Zhao M, Xia F, Moon I, Woo J, Zhang M, Wang S, Ballinger I, Schneck O, Gierlach A, Shayan M, Su Y, Jastrzebska-Perfect P, Youcef-Toumi K, Scott M, Langer R, Traverso G. Smart Cell Analysis Needle System as a Platform for Real-Time Characterization of Cell Therapies. The 16th US-JAPAN Symposium on Drug Delivery Systems, Lahaina, Hawaii, USA (December, 2024).

4. **Lee JS**, Kim J, Cho SW. Artificial skin culture platform for toxicological evaluation. 2020 The Korean Biochip Society Fall Conference, Jeju, Korea (November 2020).

5. **Lee JS**, Kwon JY, Choi HJ, Cho SW. Vertical Nanowire Electrode Array Platform for Human Neural Stem Cell Neurogenesis via Intracellular Electrical Stimulation. The 21st Annual Meeting of Korean Tissue Engineering and Regenerative Medicine Society, Online (August, 2020).

6. **Lee JS**, Kim J, Kim JH, Cho SW. Hybrid Organ Platform for Toxicological Evaluation of Topical Agents. 2020 The Korean Biochip Society Biochips in Pandemic Era (COVID-19 Special Session), hybrid conference (Yeosu, Online, July 2020).

7. **Lee JS**, Yang K, Oh JY, Choi S, Cui B, Baik HK, Cho SW. Optoelectrical Stimulation Through Nanopatterned P3HT Substrates for Neurogenesis of Human Neural Stem Cell. The 2020 KSBB Spring Meeting and International Symposium, Online (May, 2020).

8. **Lee JS**, Yang K, Han SY, Chung S, Cho SW. Vascularized Human Neural Stem Cell Culture with 3D Microwell. The 2020 KSBB Spring Meeting and International Symposium, Online (May, 2020).

9. **Lee JS**, Kim J, Chung S, Cho SW. 3D Microfluidic Chip System for Cell Migration Assay. The 2020 KSBB Spring Meeting and International Symposium, Online (May, 2020).

10. Kim J, **Lee JS**, Choi B, Choi S, Cho SW. Brain Tissue-like 3D Microfluidic Brain Chip. Tissue Engineering & Regenerative Medicine International Society – AP Chapter and the 7th Asian Biomaterials Congress (TERMIS-AP), Brisbane, Australia (October 2019).

11. **Lee JS**, Kwon JY, Kim JH, Kim J, Choi H, Cho SW. Vertical Nanowire Electrode Array for Intracellular Electrical Stimulation to Enhance Neurogenesis of Human Neural Stem Cells.

2019 International Brain Research Organization – World Congress (IBRO), Daegu, Korea (September 2019).

12. **Lee JS**, An S, Cho SW. Osteoinductive Extracellular Membranous Nanovesicles for Enhanced Stem Cell Differentiation. 2019 International Symposium & Spring Meeting of the Korean Society for Biomaterials, Gwangju, Korea (March 2019).

13. **Lee JS**, Kwon JY, Kim J, Choi HJ, Cho SW. Vertical Nanowire Electrode Array for Enhanced Neurogenesis of Human Neural Stem Cells via Intracellular Electrical Stimulation. The Korean Biochip Society Fall Conference, Jeju, Korea (November 2018).

14. **Lee JS**, Jin Y, Lee MS, Yang HS, Cho SW. Combination of Endogenous Stem Cell Mobilizer and Osteoinductive Nanofibrous Scaffolds for In Situ Bone Tissue Engineering. The 5th TERMIS World Congress (TERMIS), Kyoto, Japan (September 2018).

15. **Lee JS**, Kim J, Cho SW. Hybrid Organ Culture Platform for Toxicological Evaluation. The 15th Annual Meeting of Korean Society for Alternative to Animal Experiments (KSAAE), Seoul, Korea (August 2018) **Poster Award.**

16. Yang K, Oh JY, **Lee JS**, Min S, Baik HK, Cho SW. Optoelectrical Stimulation of Nanopatterned P3HT Substrates for Enhanced Neuronal Differentiation of Human Neural Stem Cells. 2018 The Korean Biochip Society Spring Conference, Pyeongchang, Korea (May 2018) **Poster Award.**

17. Yang K, **Lee JS**, Yu SJ, Lee H-R, An S, Choi S, Im SG, Cho SW. Electrical Stimulation of Electroconductive Nanopatterns for Enhanced Neuronal Differentiation of Human Neural Stem Cells. The 10th International Symposium on Microchemistry and Microsystems (ISMM 2018), Busan, Korea (June 2018).

18. **Lee JS**, Jin Y, Jeon EJ, Min S, Choi YS, Lee MS, Yang HS, Cho SW. In Situ Bone Tissue Engineering Using Endogenous Stem Cell Mobilization and Nanofibrous Osteoinductive Scaffolds. Korean Society for Stem Cell Research (KSSCR) 2018 Winter Conference, Pyeongchang, Korea (January 2018).

19. **Lee JS**, Jin Y, Park HJ, Yang K, Kim S, Choi S, Lee MS, Yang HS, Cho SW. Synergistic Effect of Endogenous Stem Cell Mobilizer and Osteoinductive Electrospun Nanofibrous Scaffolds for Bone Reconstruction. 2017 International Symposium & Fall Meeting of the Korean Society for Biomaterials, Pangyo, Korea (October 2017).

20. Ko E, **Lee JS**, Yang SY, Ryu W, Cho SW. Combination of Hydroxyapatite-Functionalized Electrospun Silk Fibroin Scaffolds and Genetically-Engineered Stem Cells Promotes Bone Reconstruction. 18th International Meeting of Korean Tissue Engineering and Regenerative Medicine Society (KTERMS 2017), Daegu, Korea (June 2017).

21. Ko E, **Lee JS**, Kim H, Yang SY, Yang K, Shin J, Yang H, Ryu WH, Cho SW. Polydopamine-Mediated Modification of Hydroxyapatite Particles on Electrospun Silk Scaffolds for Bone Regeneration. 2017 Spring Meeting of the Korean Society for Biomaterials, Daejeon, Korea (March 2017).

22. Yang K, **Lee JS,** Lee HR, Yu SJ, Chang G-E, Cheong E, Im SG, Cho SW. Electroconductive Nanopatterned Substrates for Improving Functional Maturation of Human Neural Stem Cells. Electronic Materials and Nanotechnology for Green Environment (ENGE 2016), Jeju Island, Korea (November 2016).

23. Yang K, **Lee JS,** Lee J, Cheong E, Lee T, Cho SW. Graphene Oxide Hierarchical Topography for the Induction of Functional Neuron-like Cells from Human Neural Stem Cells. Electronic Materials and Nanotechnology for Green Environment (ENGE 2016), Jeju Island, Korea (November 2016).

24. Ko E, **Lee JS,** Kim H, Yang K, Ryu WH, Cho SW. Electrospun Silk Fibroin Fibrous Scaffolds with Two-stage Hydroxyapatite for Bone Tissue Engineering. Biomedical Engineering Society (BMES) 2016 Annual Meeting, Minnesota, USA (October 2016).

25. Ko E, **Lee JS,** Kim H, Ryu WH, Cho SW. Electrospun Nanofibrous Silk Scaffolds with Two-Stage Hydroxyapatite for Enhancing Bone Formation by Human Adipose-Derived Stem Cells. 2016 The Korean Society of Industrial and Engineering Chemistry (KSIEC) Spring Meeting, Yeosu, Korea (May 2016).

26. Ko E, **Lee JS,** Alberti K, Yang K, Shin J, Yang HS, Xu Q, Cho SW. Decellularized Nanofibrous Scaffolds for Bone Tissue Engineering. 2016 The Korean Society of Industrial and Engineering Chemistry (KSIEC) Spring Meeting, Yeosu, Korea (May 2016).

27. Yang K, **Lee JS,** Lee J, Cheong E, Lee T, Cho SW. Graphene Oxide Patterned Substrates to Promote Functional Neural Differentiation of Human Neural Stem Cells. The 8th International Conference on Microtechnologies in Medicine and Biology (MMB 2016), Seoul, Korea (April 2016).

28. Ko E, **Lee JS,** Alberti K, Yang K, Shin J, Cho JH, Yang HS, Xu Q, Cho SW. Nanofibrous Tendon-derived Scaffolds for enhanced Osteogenesis of Human Adipose-derived Stem Cells. 2015 Fall Meeting of the Korean Society for Biomaterials, Pangyo, Korea (September 2015).

Patents

1. Langer RS, Traverso CG, Lee S, Murphy M, **Lee JS**. A Retrievable Intravascular Implant and Related Systems and Methods (International Patent Application PCT/US2026/021234, 2026).

2. Traverso CG, Kang Z, Murphy M, Shalabi N, **Lee JS**, Kim BR, Trainor H. Systems and Methods for Encapsulation of Cells and Cell Clusters (International Patent Application PCT/US2026/021229, 2026).

3. Cho S-A, Kim J, **Lee JS**, Cho SW, An S. Forming Apparatus for Artificial Skin, Producing Method of Artificial Skin and Artificial Skin (Korean Patent KR102923875B1, 2026).

4. Yoon YJ, Cheong E, Cho SW, Song MC, Beom JY, Jung JA, **Lee JS**, Lee HJ. Compounds, Compositions Containing Same, And Use Thereof for Promoting Hair Growth (US Patent 12011497B2, 2024).

5. Kim GH, Kim TS, Noh SY, Park JY, Lee JC, Kim JH, Cho SW, **Lee JS**. Cell Experiment Method, Device, and System for Measuring Signal of Cell in Conjunction with Rapid and Precise Cooling (Korean Patent KR102277511B1, 2021).