BIOGRAPHICAL SKETCH

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NAME: Jiho Shin

eRA COMMONS USER NAME (credential, e.g., agency login): JIHO_SHIN

POSITION TITLE: Assistant Professor, Department of Chemical Engineering, Texas A&M University (TAMU)

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Cornell University, Ithaca, NY, USA	B.S.	05/2010	Chemical Engineering
Seoul National University, Seoul, South Korea	Visiting Scholar	08/2013	Chemical Engineering
University of Illinois at Urbana-Champaign, Urbana, IL, USA	Ph.D.	05/2018	Chemical Engineering
Massachusetts Institute of Technology, Cambridge, MA, USA	Postdoctoral Associate	05/2024	Mechanical Engineering

A. Personal Statement

My research focuses on developing implantable and wearable bioelectronics using novel semiconductor nanomaterials and devices for disease diagnosis, therapy, and neural interfacing applications. Through doctoral and postdoctoral research, I have authored more than 20 articles in peer-reviewed journals, including first-author publications in *Nature*, *Science*, and *Nature Biomedical Engineering*. During my Ph.D. at the University of Illinois at Urbana-Champaign (UIUC), I developed bioresorbable implantable sensors fabricated from single-crystalline silicon nanomembranes for continuous monitoring of pressure, temperature, blood oxygenation, and Ca^{2+} signals inside the brain [1,2]. These devices undergo complete resorption in biofluids after a pre-defined period of operation, eliminating the need for surgical extraction. As a postdoc at the Massachusetts Institute of Technology (MIT), I developed breathable electronic skins (e-skins) using single-crystalline gallium nitride nanomembrane sensors mounted on perforated adhesive patches for long-term stable wireless monitoring of pulse, UV light, and Na^{+} ions in sweat [3]. This work represents the first demonstration of compound semiconductor nanomembrane-based wireless e-skin, which achieved the highest reported strain sensitivity as well as capability to detect multiple types of stimuli (mechanical, optical, chemical) simultaneously, paving the way towards wearable health monitoring platforms with high performance, versatility, and the ability to conformally adhere on skin without deteriorating skin breathability. Recently, I also developed a novel semiconductor manufacturing technology for producing 3D-integrated chips with more than 1000 times smaller volumes compared to conventional chips [4], which has potential for developing minimally invasive implantable neural interfaces. I believe that my convergent expertise in semiconductor materials, nanofabrication techniques, and *in vivo* application of electronic systems provides a unique perspective to elucidate the knowledge and transform processes required for the development of implantable electronic technologies.

I have been a dedicated instructor and mentor throughout my career. As a teaching assistant/instructor at UIUC and TAMU, I have taught over 500 undergraduate students from diverse backgrounds in various core chemical engineering courses. During my tenure as a research associate and postdoctoral associate at UIUC and MIT, I mentored 5 undergraduates and 3 masters students, who are pursuing doctoral degrees at top-tier universities including MIT; Harvard; University of California, Los Angeles; University of Michigan; and Korea Advanced Institute of Science and Technology. Other graduates under my tutelage are currently working in the semiconductor industry as process engineers. As a principal investigator at TAMU, I am mentoring 1 doctoral student and 2 postdoctoral researchers.

Citations:

1. **Jiho Shin**, *et al.*, "Bioresorbable pressure sensors protected with thermally grown silicon dioxide for the monitoring of chronic diseases and healing processes", ***Nature Biomedical Engineering***, Vol. 3, 37-46 (2019)
2. **Jiho Shin**, *et al.*, "Bioresorbable optical sensor systems for monitoring of intracranial pressure and temperature", ***Science Advances***, Vol. 5, aaw1899 (2019)
3. Yeongin Kim, Jun Min Suh, **Jiho Shin (co-1st),** *et al.*, "Chip-less wireless electronic skins by remote epitaxial freestanding compound semiconductors", ***Science***, Vol. 377, 859-864 (2022)
4. **Jiho Shin**, *et al.*, "Vertical full-colour micro-LEDs via 2D materials-based layer transfer", ***Nature***, Vol. 614, 81-87 (2023)

B. Positions, Scientific Appointments, and Honors

2024 – Present	Assistant Professor, Department of Chemical Engineering, TAMU, College Station, TX
2018 – 2024	Postdoctoral Associate, Research Laboratory of Electronics, MIT, Cambridge, MA
2013 – 2018	Research Associate, Department of Chemical Engineering, UIUC, Urbana, IL
2012 – 2013	Visiting Scholar, Department of Chemical Engineering, SNU, Seoul, South Korea

Other Professional Memberships

2024 – Present	American Institute of Chemical Engineers
2019 – Present	Materials Research Society

Honors

2021	Presentation Award, MIT Mechanical Engineering Research Exhibition (MERE), MIT, Cambridge, MA
2010	Magna Cum Laude, Cornell University, Ithaca, NY
2007 – 2010	Dean's List, Cornell University, Ithaca, NY
2006 – 2010	Full Undergraduate Scholarship, Kwanjeong Educational Foundation, South Korea

Ad Hoc Reviewer (Journals): Nature Communications, ACS Photonics

C. Contributions to Science

1. **Bioresorbable implantable electronics:** Implantable medical devices are used in numerous applications including a wide range of bio-physical and chemical sensing, cardiac pace making, pain/seizure control, hearing aids, and biological research. Conventional implantable electronics consist of non-resorbable materials that must be surgically removed after use, which can involve high costs and health risks including bacterial infection and surgical failure. Bioresorbable electronics are made of materials that undergo complete hydrolysis upon immersion in biofluids with biologically benign end products. These devices can bypass the risks linked to conventional implantable electronics, making them strong contenders for next-generation electronic implants. My past research in this area includes the development of (i) thermally grown silicon dioxide encapsulation strategies to extend the functional lifetime of bioresorbable intracranial pressure and temperature sensors to more than a month, which is a 10-fold improvement compared to previously reported systems, to enable long-term continuous monitoring of the progression of conditions such as traumatic brain injury, hydrocephalus, and cerebral hemorrhage; (ii) bioresorbable optical and photonic devices based on novel transduction mechanisms including photonic crystal cavities, Fabry-Perot interferometry, and distributed Bragg reflectors, which enable implantable pressure, temperature, blood oxygenation, and Ca^{2+} sensors that eliminate the risks of surgical extraction and brain damage due to exposure to strong magnetic fields during MRI scans; and (iii) wireless electrical stimulators based on completely resorbable materials for the treatment of nerve injuries.
   a. **Jiho Shin**, *et al.*, "Bioresorbable pressure sensors protected with thermally grown silicon dioxide for the monitoring of chronic diseases and healing processes", ***Nature Biomedical Engineering***, Vol. 3, 37-46 (2019)

b. **Jiho Shin**, *et al.*, “Bioresorbable optical sensor systems for monitoring of intracranial pressure and temperature”, ***Science Advances***, Vol. 5, aaw1899 (2019)
c. Wubin Bai, **Jiho Shin (co-1st),** *et al.*, “Bioresorbable photonic devices for the spectroscopic characterization of physiological status and neural activity”, ***Nature Biomedical Engineering***, Vol. 3, 644-654 (2019)
d. Jahyun Koo, …, **Jiho Shin**, *et al.*, “Wireless bioresorbable electronic system enables sustained nonpharmacological neuroregenerative therapy”, ***Nature Medicine***, Vol. 24, 1830-1836 (2018)

2. **Electronic skin:** Electronic systems that are as thin and flexible as the epidermis and can stick conformally to the skin are referred to as 'electronic skin (e-skin)'. As next-generation health monitoring platforms, e-skins offer key advantages over conventional rigid electronics, such as reliable data acquisition over extended periods of time and user comfort/wearability due to ultralight weight and low mechanical stiffness. My contributions in this field include the demonstration of: (i) e-skins based on single-crystalline gallium nitride and silicon nanomembranes capable of continuously monitoring strain, pulse, temperature, UV light, and ion concentration in sweat with significantly higher sensitivity and lower power consumption compared with conventional e-skins based on metals or organic semiconductors; (ii) breathable e-skins with sweat pore-inspired perforated skin patch that prevent the trapping of sweat and other skin byproducts between the e-skin/skin interface, which enables reliable health monitoring for significantly longer period of time (over 2 weeks) compared to previously reported systems; and (iii) e-skins integrated with multiple microfluidic channels containing different sets of biosensors for real-time multi-analyte monitoring of perspiration on skin.
   a. Yeongin Kim, Jun Min Suh, **Jiho Shin (co-1st),** *et al.*, “Chip-less wireless electronic skins by remote epitaxial freestanding compound semiconductors”, ***Science***, Vol. 377, 859-864 (2022)
   b. Hanwool Yeon, …, **Jiho Shin**, *et al.*, “Long-term reliable physical health monitoring by sweat pore–inspired perforated electronic skins”, ***Science Advances***, Vol. 7, eabg8459 (2021)
   c. Sung Bong Kim, …, **Jiho Shin**, *et al*., “Soft, Skin-Interfaced Microfluidic Systems with Wireless, Battery-Free Electronics for Digital, Real-Time Tracking of Sweat Loss and Electrolyte Composition”, Small, Vol. 14, 1802876 (2018)
   d. Donghee Son, …, **Jiho Shin**, *et al*., “Multifunctional wearable devices for diagnosis and therapy of movement disorders”, ***Nature Nanotechnology***, Vol. 9, 397-404 (2014)

3. **3D integration of semiconductor device membranes for bioelectronic applications:** Semiconductor devices play key roles in wearable and implantable device technologies including detection of physical and chemical signals, controlled delivery of therapeutic agents, data processing, and wireless communication. Conventional semiconductor chips are bulky and rigid, limiting seamless integration within the body. I have developed novel semiconductor manufacturing techniques based on vertical stacking of ultrathin single-crystalline semiconductor devices obtained via layer transfer technology. These technologies yield semiconductor chips with diverse functionality that are more than 1000 times smaller in volume compared to commercially available chips. This 3D integration method is envisioned to make a profound impact on the development of implantable and wearable systems with reduced invasiveness, enhanced probe density, and mechanical flexibility.
   a. **Jiho Shin**, *et al.*, “Vertical full-colour micro-LEDs via 2D materials-based layer transfer”, ***Nature***, Vol. 614, 81-87 (2023)
   b. Hyunseok Kim, Sangho Lee, **Jiho Shin (co-1st),** *et al.*, “Graphene nanopattern as a universal epitaxy platform for single-crystal membrane production and defect reduction”, ***Nature Nanotechnology***, Vol. 17, 1054-1059 (2022)
   c. Ji-Hoon Kang, …, **Jiho Shin**, *et al.*, “Monolithic 3D integration of 2D materials-based electronics towards ultimate edge computing solutions”, ***Nature Materials***, Vol. 22, 1470-1477 (2023)

Complete list of published work:
https://www.ncbi.nlm.nih.gov/myncbi/jiho.shin.1/bibliography/public/