

Seungbeom “Moses” Noh, Ph.D.

Postdoctoral Fellow
Electrical and Computer Engineering, University of Utah

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Last updated: 01/31/2024

EDUCATION

- Ph.D.** Electrical and Computer Engineering, University of Utah, Salt Lake City, UT May. 2021
“Development of in-air electrochemical impedance spectroscopy (EIS) sensor”
Advisor: Prof. Hanseup Kim
- M.S.** Mechanical Engineering, POSTECH, Pohang, South Korea Feb. 2006
“Real time PCR technique using thermal conductivity”
Advisor: Prof. Geunbae Lim
- B.S.** Mechanical Engineering, Hanyang University, Seoul, South Korea Feb. 2003
“Structure and characterization of a micro flow system”
Advisor: Prof. Joo-sung Maeng

RESEARCH/WORK EXPERIENCE

- Research Assistant Professor**, Electrical and Computer Engineering, University of Utah 2022 – current
- 1) Development of low power sensor network to detect plant damages
 - Development of the integrated sensor prototype allowing in situ and near real-time monitoring volatile organic chemicals in the air
 - In-lab and in-field characterization of the nanogap gas sensors detecting green leaf volatiles and gas chemicals
 - 2) Development of in vitro blood-brain barrier (BBB) model for suspended BBB layers
 - Design/fabrication of the suspended extracellular matrix to enable direct contacts between BBB cells across the membrane
 - Characterization of the in vitro BBB model and established in vitro BBB layers
- Postdoctoral Fellow**, Electrical and Computer Engineering, University of Utah 2020 – 2021
Advisor: Prof. Hanseup Kim
- 1) Development of in vitro blood-brain barrier (BBB) model for suspended BBB layers
 - Design/fabrication of the suspended extracellular matrix to enable direct contacts between BBB cells across the membrane
 - Characterization of the in vitro BBB model and established in vitro BBB layers
 - 2) Development of low power sensor network to detect plant damages
 - Development of the integrated sensor prototype allowing in situ and near real-time monitoring volatile organic chemicals in the air
 - In-lab and in-field characterization of the nanogap gas sensors detecting green leaf volatiles and gas chemicals
 - 3) Development of graphene-based thermal conductivity (TCD) gas sensor
 - Characterization of the graphene sensor fabrication and the sensor performance.
- Graduate Researcher**, Electrical and Computer Engineering, University of Utah 2012 – 2019
Advisor: Prof. Hanseup Kim
- 1) Development of cell-population sensor and cell-chip
 - Design/fabrication of cell-population sensor by patterning thin Au layer selectively on a thin polycarbonate membrane.
 - Design/fabrication of in vitro cell chip integrating with the cell-population sensor
 - Characterization of cultured lung cells in the chip and evaluation of the developed sensor using the lung cells
 - 2) Development of blood-brain barrier (BBB) chip
 - Culturing BBB cells in the developed chips.
 - Evaluating intercellular and intracellular properties and responses at chemical application.
 - 3) Development of nanogap sensor to detect diamine gases
 - Initial characterization of the nanogap sensor’s performance regarding the linker coating and VOC capturing

- 4) Development of flow sensor
 - Design/fabrication of flow sensor via a) deposition of dielectric layer by LPCVD, b) patterning metal layer by sputtering, c) forming a free-standing structure of the sensor by dry etching and DRIE, and d) sealing the channel by covering with PDMS channel.
 - Evaluation of the developed flow sensor measuring electrical resistance changes.
- 5) Development of energy harvesting simulator
 - Design/fabrication of the simulator to produce a periodic motion

Research Engineer, SINDOH, South Korea 2009 – 2010

- 1) Design and development of a toner cartridge unit and a paper exit unit for printer and MFP (multi-functional printer)
 - Long-term operating product for a high volume and continuous toner supply
 - Long-term operating product for a functionality of the paper exit
- 2) Technical support for products and manufacturing of printer and MFP

Assistant Research Engineer, SINDOH, South Korea 2006 – 2008

- 1) Design and development of a toner cartridge unit and a paper exit unit for printer and MFP (multi-functional printer)
 - Long-term operating system for a high volume and continuous toner supply
 - Long-term operating system for a functionality of the paper exit

Graduate Researcher, Mechanical Engineering, POSTECH, Pohang, South Korea 2004 – 2006

Advisor: Prof. Geunbae Lim

- 1) Development of a method of an in-situ quantification of synthesized DNA strands toward a development of a micro polymerase chain-reaction (PCR) system by measuring thermal conductivity of DNA solution
 - Fabrication of the Pt hot-wire sensor.
 - Validation of the sensor by measuring an electrical time-constant change at different concentration of DNA strands
 - Amplification of DNA strands utilizing polymerase chain reaction (PCR) process.

TEACHING EXPERIENCE

University of Utah, Salt Lake City, UT 2014 – 2019

Taught classes of 1) Introduction of MEMS, 2) Microsensors, 3) Microactuators, 4) Micromachining, and 5) Electrical engineering (Circuit).

POSTECH, South Korea 2004 – 2005

Taught a class of 1) Sensor and Measurement and 3) Machine Design (volunteered).

Highlight of Accomplishments:

First time wake-up gas sensor that consumes the operation power of <10 nW.

First time in-field demonstration of plant damages using the smart agriculture wake-up gas sensor in sorghum fields.

First time in-air EIS sensor working at air/liquid interface.

Chip and machine design in nano/micro/macroscale with recent focus on development of nanogap sensor, cell-chips and sensors and flow sensor operating for gas and liquid monitoring.

Skills:

Core competencies: (1) micro-fabrication and device development from mask to packaging, (2) modeling/design and simulation in micro/macro scale (SolidWorks, Comsol), (3) testing and analysis (LabView, Python, Matlab), (4) cell culture, testing, and analysis, (5) idea generation and proof-of-concept demonstrations and (6) training.

PEER-REVIEWED JOURNAL PUBLICATIONS

1. Sayali Tope, **Seungbeom Noh**, Rana Dalapati, Ling Zang, and Hanseup Kim, "Development of a sub-10-ppm Limit of Detection Lateral Nanogap Gas Sensor," vol. 7, no. 9, pp. 1-4, Sept. 2023, Art no. 4502707, doi: 10.1109/LSENS.2023.3307120.
2. Shakir-ul Haque Khan, Aishwaryadev Banerjee, Samuel Broadbent, **Seungbeom Noh**, Kyeong Heon Kim, Ashrafuzzaman Bulbul, Ryan Looper, Carlos Mastrangelo and Hanseup Kim, "Characterization of a Wake-up Nano-gap Gas Sensor for Ultra Low Power Operation", Journal of Microelectromechanical Systems, 2022, 31:5, pp. 791-801.
3. A. Banerjee, S.H. Khan, S. Broadbent, A. Bulbul, K.H. Kim, **S. Noh**, R. Looper, C.H. Mastrangelo, H. Kim "Molecular Bridge-Mediated Ultralow-Power Gas Sensing" Nature Microsystems and Nanoengineering, 2021.
4. **Seungbeom Noh** and Hanseup Kim, "In-air EIS sensor for in situ and real-time monitoring of in vitro epithelial cells under air exposure", Lab Chip, 2020, 20, 1751-1761, *Backside Cover Featured*.
5. Ross Booth, **Seungbeom Noh** and Hanseup Kim, "A multiple-channel, multiple-assay platform for characterization of full-range shear stress effects on vascular endothelial cells," Lab-on-Chips, 2014.

6. **Seungbeom Noh**, Jinsang Lee, Jang-Kyoo Shin and Geunbae Lim, “Real-Time PCR Sensing by Thermal Conductivity Monitoring, Electroanalysis”, Vol.18, Issue 19-20, pp1989–1993, Oct. 2006
7. **Seungbeom Noh**, Kenneth L. Monson, Vladimir Hlady and Hanseup Kim “In vitro tri-culture Blood-Brain Barrier (BBB) model enabling direct intercellular contacts between BBB cells”, under preparation
8. Steven Tran, Ashraf Bulbul, **Seungbeom Noh**, DoKyoung Lee, Carlos Mastrangelo, Hanseup Kim, “UV-based, low power, wireless, in-situ soil carbon measurement system”, under preparation
9. Shakir-ul Haque Khan, Sayali Tope, Mohit Karkhanis, Bryan Hatasaka, **Seungbeom Noh**, Rana Dalapati, Ravi V. Mural, Ashrafuzzaman Bulbul, Kyeong Heon Kim, Aishwaryadev Banerjee, James C. Schnable, Mingyue Ji, Carlos H. Mastrangelo, Ling Zang, and Hanseup Kim, “Listening to the Scream of Plants Through Gas Sensing within a Small Nanometer Sized Gap”, under preparation

PEER-REVIEWED CONFERENCE PUBLICATIONS

1. M. R. Hasan, A. Nikeghbal, A. Deshpande, M. U. Karkhanis, E. Pourshaban, A. Banerjee, **S. Noh**, H. Kim and C. H. Mastrangelo et al. “High-Responsivity Vacuumless Microbolometer Arrays Microfabricated on Thermally Isolated Suspended Membranes”, 2024 IEEE MEMS, Austin, Texas
2. Farhan Sadik Sium, Steven Tran, **Seungbeom Noh** and Hanseup Kim, “A fire detection system empowered by plant wearable patch,” 2023 PowerMEMS, Abu Dhabi, UAE
3. Sayali Tope, **Seungbeom Noh**, Rana Dalapati, Ling Zang, and Hanseup Kim, “Development of a sub-10-ppm Limit of Detection Lateral Nanogap Gas Sensor,” 2023 IEEE Sensors, Vienna, Austria
4. M. R. Hasan, A. Nikeghbal, A. Deshpande, M. U. Karkhanis, E. Pourshaban, M. G. Dastagir, A. Banerjee, **S. Noh**, H. Kim and C. H. Mastrangelo, “Mid-Infrared Computational Spectrometry with Wavelength-Skewed Microbolometer Arrays”, 2023 IEEE Sensors, Vienna, Austria
5. Steven Tran, **Seungbeom Noh**, and Hanseup Kim, “Low-power CO₂ gas sensor based on electrolysis-induced bubbles,” 2023 IEEE Transducers, Kyoto, Japan
6. **Seungbeom Noh**, Sayali Tope, Farhan Sadik Sium, Shakir-ul Haque Khan, Mohit Karkhanis, Leo Wang, Adwait Deshpande, Rana Dalapati, Ravi V. Mural, Carlos H. Mastrangelo, Mingyu Ji, Ling Zang, James C. Schnable, and Hanseup Kim, “Localization of crop damages utilizing a wake-up gas sensor network,” Transducers, 2023
7. Steven Michael Tran, **Seungbeom Noh**, and Hanseup Kim, “Low-power CO₂ gas sensor based on electrolysis-induced bubbles,” Transducers, 2023
8. Sayali Tope, **Seungbeom Noh**, and Hanseup Kim, “Wafer-level fabrication of conformal sub 10-nm nanogaps,” IEEE MEMS, 2023
9. Khandaker Reaz Mahmud, Ashrafuzzaman Bulbul, **Seungbeom Noh**, Carlos Mastrangelo, and Hanseup Kim, “asymmetric wireless power transfer with a flexible contact lens inductor,” 21st International Conference on Micro and Nanotechnology for Power Generation and Energy Conversion Applications (PowerMEMS), Salt Lake City, UT, USA, 2022, pp. 54-57.
10. Farhan Sadik Sium, Shakir-ul Haque Khan, **Seungbeom Noh**, Rana Dalapati, Ling Zang, Carlos Mastrangelo, and Hanseup Kim, “Ultra-low power gas sensor based on a 3D array of nanogaps,” 21st International Conference on Micro and Nanotechnology for Power Generation and Energy Conversion Applications (PowerMEMS), Salt Lake City, UT, USA, 2022, pp. 67-70.
11. **Seungbeom Noh**, Kenneth L. Monson, Vladimir Hlady and Hanseup Kim, “In vitro tri-culture blood-brain barrier (BBB) model enabling direct intercellular contact at a suspended layer,” Hilton Head Workshop 2022: A Solid-State Sensors, Actuators and Microsystems Workshop
12. Shakir-ul Haque Khan, Mohit Karkhanis, Bryan Hatasaka, Sayali Tope, **Seungbeom Noh**, Rana Dalapati, Ashrafuzzaman Bulbul, Ravi V. Mural, Aishwaryadev Banerjee, KyeongHeon Kim, James C. Schnable, Mingyue Ji, Carlos H. Mastrangelo, Ling Zang, and Hanseup Kim, “Early Detection of Simulated Herbivore Attacks in Sorghum Fields Through the Deployment of Very-Low-Power Gas Sensor Network,” Hilton Head Workshop 2022: A Solid-State Sensors, Actuators and Microsystems Workshop
13. Farhan Sadik Sium, Shakir ul Khan, **Seungbeom Noh**, and Hanseup Kim, “Theoretical and experimental validation on the tuning capability of a percolation-based gas sensor,” Hilton Head Workshop 2022: A Solid-State Sensors, Actuators and Microsystems Workshop
14. Steven Tran, Ashrafuzzaman Bulbul, **Seungbeom Noh**, Rabiul Hasan, Carlos Mastrangelo, and Hanseup Kim, “In-situ soil carbon measurement system,” Hilton Head Workshop 2022: A Solid-State Sensors, Actuators and Microsystems Workshop
15. Shakir-ul Haque Khan, Mohit Karkhanis, Bryan Hatasaka, Sayali Tope, **Seungbeom Noh**, Rana Dalapati, Ashrafuzzaman Bulbul, Ravi V. Mural, Aishwaryadev Banerjee, KyeongHeon Kim, James C. Schnable, Mingyue Ji, Carlos H. Mastrangelo, Ling Zang and Hanseup Kim, “field deployment of a nanogap gas sensor for crop damage detection,” IEEE MEMS, 2022
16. Aishwaryadev Banerjee, Chayanjit Ghosh, Shakir-ul Haque Khan, Adwait Deshpande, Erfan Pourshaban, Mohit U. Karkhanis, **Seungbeom Noh**, Hanseup Kim, and Carlos H. Mastrangelo, “A zero-power capacitive ethylene sensor using potassium permanganate/polyimide composite thin-films,” MicroTAS, 2021
17. Shakir-ul Haque Khan, Sayali Tope, Rana Dalapati, Kyeong Heon Kim, **Seungbeom Noh**, Ashrafuzzaman Bulbul, Ravi V. Mural, Aishwaryadev Banerjee, James C. Schnable, Mingyue Ji, Carlos H. Mastrangelo, Ling Zang and Hanseup Kim, “Development of a gas sensor for green leaf volatile detection,” Transducers, 2021
18. Aishwaryadev Banerjee, Chayanjit Ghosh, Shakir-ul Haque Khan, Adwait Deshpande, Erfan Pourshaban, Mohit U. Karkhanis, **Seungbeom Noh**, Hanseup Kim and Carlos H. Mastrangelo, “Chemocapacitive Detection of Ethylene Using Potassium Permanganate/Polyimide Composite Thin-Films,” Transducers, 2021
19. Yunhao Peng, Ashrafuzzaman Bulbul, **Seungbeom Noh**, Shakir-ul Haque Khan, Kyeong Heon Kim, and Hanseup Kim, “A graphene-based thermal conductivity detector for low power gas detection,” IEEE MEMS, 2021

20. **Seungbeom Noh** and Hanseup Kim, “Development of in-air eis sensor enabling to distinguish impedance of cell population and tight-junction formation at air-liquid interface”, MicroTAS, 2019
21. M. M. Rahman, **S. Noh**, K.H. Kim, and H. Kim, “Heating performance by an insole energy harvester”, PowerMEMS, 2018
22. **Seungbeom Noh** and Hanseup Kim, “Development of in-plane sensor monitoring formation of lung cells”, MicroTAS, 2017
23. C. Ghosh, S.H. Khan, S. J. Broadbent, H.C. Hshieh, **S. Noh**, A. Banerjee, N. Farhoudi, C. H. Mastrangelo, R. Loooper and H. Kim, “Nano-gap Vapor Sensor”, IEEE Sensors, 2017
24. **Seungbeom Noh** and Hanseup Kim, “A micro lung chip to asses air pollutant effects”, IEEE MEMS, 2017
25. **Seungbeom Noh**, Po Ki Yuen, Vasily N. Goral and H. Kim, "An induced-flow kidney-breast cancer in vitro model for study of cancer suppression by vitamin D3 derivatives," Hilton Head Workshop 2014: A Solid-State Sensors, Actuators and Microsystems Workshop.
26. Ross H. Booth, **Seungbeom Noh**, and Hanseup Kim, “A high-throughput permeability assay platform for shear stress characterization of endothelial cells,” IEEE MEMS, 2014.
27. **Seungbeom Noh**, Jonggan Hong, Dongsik Kim, Joosung Kim and Geunbae Lim, “Thermal conductivity study of real-time PCR”, International Conference on Nanoscience and Technology, 2006

PATENT

1. U7331 “Gas sensor network for monitoring the stresses of plant crops”
 - Submitted
 - Provision 1: Reliable low power gas sensor incorporating a laterally formed nanogap structure
 - Provision 2: Localization of plant damages caused by herbivores in an early-stage utilizing a low power gas sensor network
 - Both provisional patents have been approved.
 - Both patent files have been submitted.
2. U7349 “UV-based, in-situ soil carbon measurement system and near zero power gas sensors”
 - The provisional patent has been approved.
 - The patent file has been submitted.

FUNDRAISING EXPERIENCE

1. “SEAFloor Self-Sustaining CO₂ Assessment Probe Edge (SEASCAPE)”
 - ARPA-E
 - Co-PI: Prof. Seungbeom Noh (PI: Prof. Hanseup Kim)
 - 2024.Jan-2026.Dec, \$2.0M
 - My role: Initial ideation with PI and co-PI, preparation of materials for proposal submission, and development of high pressure, waterproof package to operate at 1km ocean depth
2. “Development of a deformable, suspended-cell tri-culture to mimic blood-brain barrier mechanobiology”
 - NIH
 - PI: Prof. Seungbeom Noh (co-PIs: Prof. Hanseup Kim and Prof. Kenneth Monson)
 - Pending
 - My role: Initial ideation with co-PIs, preparation of materials for proposal submission
3. “Development of a computation model for unmanned and real-time localization of weed/herbivore stressors in biofuel sorghum fields by minimizing the number of distributed near-zero-power sensors”
 - DOE SBIR/STTR
 - PI: Prof. Seungbeom Noh
 - 2023.Feb-2024.Feb, \$150k (Total: \$250k, University of Utah: \$150k, Afflo Sensors: \$100k)
 - My role: Initial ideation with the co-PI, and preparation of material for the proposal submission.
4. “Low cost wireless chemical sensor networks”
 - ARPA-E
 - PI: Prof. Hanseup Kim
 - 2019-2022, \$2.2M
 - My role: Initial ideation with the PI, and preparation of material for the proposal submission.
5. “Soil Organic Carbon Networked Measurement System (SOCNET)”
 - ARPA-E
 - PI: Prof. Hanseup Kim
 - 2020-2023, \$1.9M
 - My role: Initial ideation with the PI, and preparation of material for the proposal submission.
6. “Enabling the in-situ real-time detection of COVID-19 viruses via a quantum tunneling-based nanogap sensor”
 - Seed Grant, U of Utah
 - PI: Prof. Hanseup Kim
 - 2020, \$25k
 - My role: Initial ideation with the PI, and preparation of material for the proposal submission.
7. Multiple NIH proposals
 - Under review

- My role: Initial ideation with the PIs, and helping to write the NIH proposals in preparation.

COMMITTEE SERVICE

1. PhD committee
 - Sayali Tope, ECE, The University of Utah
 - Steven Tran, ECE, The University of Utah
 - Farhan Sadik Sium, ECE, The University of Utah
 - Khansdaker Reaz Mahmud, ECE, The University of Utah

SERVICE

1. UAC Summer Research Showcase Program
 - Jul. 23th – Aug. 5st, 2023
2. UAC Summer Research Showcase Program
 - Jul. 17th – Aug. 1st, 2022