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RESEARCH SUMMARY

Ph.D. candidate (Seoul National University / KIST) developing chalcogenide-based neuromorphic devices — Sb–Te-doped GeSe Ovonic threshold switches (OTS) and Ag-doped GeTe conductive-bridge memristors (CBRAM) — for brain-inspired computing. First-authored a cover article in *Nano Letters* (2026) demonstrating universal Boolean logic and energy-efficient, dendrite-like computing in a single two-terminal OTS device. Experimental expertise spans thin-film device fabrication, wafer-level packaging, and automated electrical characterization, in active collaboration with Prof. Suhas Kumar (NTU). Seeking a postdoctoral position to advance scalable neuromorphic and in-memory computing systems.

EDUCATION

Seoul National University	Seoul, South Korea
Ph.D. in Materials Science and Engineering (in progress)	Expected Feb 2027
- Dissertation: “Chalcogenide-based neuromorphic devices for advanced computing” (Advisor: Prof. Sangbum Kim) - Doctoral research conducted at the Korea Institute of Science and Technology (KIST), Advanced Computing Devices Lab. (Dr. Suyoun Lee), under a joint SNU–KIST arrangement.	
Korea University	Seoul, South Korea
M.S. in Advanced Materials Engineering	Feb 2023
Thesis: “Transfer-free and catalyst-free graphene thin films produced by plasma electron annealing at low temperatures” (Advisor: Prof. Sang Ho Lim) [Thesis]	
Seoul National University of Science and Technology	Seoul, South Korea
B.S. in Chemical Engineering	Feb 2021

PUBLICATIONS

† equal contribution *corresponding author

Journal Articles — First Author

1. **[Featured on Cover] U. Kang**, J. Lee, S. Oh, H. Song, J. Park, J. Kim, S. Park, H.J. Jang, S. Kim, S. Yi, S. Kumar*, S. Lee*, “Ovonic switches enable energy-efficient dendrite-like computing,” *Nano Letters* 26 (2), 699–706 (2026) [\[Cover\]](#) [\[DOI\]](#)
2. **U. Kang**, S.H. Lim, S. Han*, et al., “Transfer-free and catalyst-free graphene thin films produced by plasma electron annealing at low temperatures,” *Vacuum* 218, 112665 (2023) [\[DOI\]](#)

Journal Articles — Co-author

1. S. Oh, **U. Kang**, C. Kim, S. Lee*, et al., “Optimizing reservoir connectivity: a path to high-performance liquid state machines,” *Neurocomputing* 663, 132037 (2026) [\[DOI\]](#)
2. S. Kim, **U. Kang**, T. Seong, S. Lee*, et al., “Artificial multimodal neuron with associative learning capabilities: acquisition, extinction, and spontaneous recovery,” *ACS Applied Materials & Interfaces* 16 (28), 36519–36526 (2024) [\[DOI\]](#)
3. M. Cho, **U. Kang**, S.H. Lim, S. Han*, et al., “ α -phase tantalum film deposition using bipolar high-power impulse magnetron sputtering technique,” *Thin Solid Films* 767, 139668 (2023) [\[DOI\]](#)
4. S. Min, **U. Kang**, S.H. Lim, S. Han*, et al., “Low-resistivity cobalt and ruthenium ultra-thin film deposition using bipolar HiPIMS technique,” *ECS Journal of Solid State Science and Technology* 11, 033006 (2022) [\[DOI\]](#)

Manuscripts in Preparation

1. **U. Kang**, S. Oh, S. Kim, S. Lee*, "Spike-based ternary XOR encryption with true random key generation using Ovonic threshold switches," (in preparation)
2. †H.Y. Jeong, †**U. Kang**, H.J. Lee*, S. Lee*, "Multi-modal sensory neurons using Ovonic threshold switches," (in preparation)
3. †M.S. Oh, †**U. Kang**, H.J. Lee*, S. Lee*, "Robotics with artificial sensory neurons," (in preparation)
4. **U. Kang**, S. Oh, S. Kim, S. Lee*, "Hardware-aware Hopfield neural network," (in preparation)

RESEARCH EXPERIENCE

Doctoral Researcher — Advanced Computing Devices Lab., KIST

2023 – Present

Principal Investigator: [Dr. Suyoun Lee](#)

- Designed and fabricated Sb–Te-doped GeSe Ovonic threshold switching (OTS) devices for neuromorphic computing, achieving low leakage current and high endurance ($> 10^8$ cycles).
- Developed Ag-doped GeTe conductive-bridge memristors (CBRAM) as artificial synapses for multi-level analog weight storage, enabling emulation of synaptic plasticity in hardware neural networks.
- Designed and demonstrated self-selective RRAM devices incorporating an insulator-based tunneling barrier layer, integrated into a 24×24 OT1R array.
- Demonstrated single-device universal Boolean and XOR logic and dendrite-like computing in OTS devices (*Nano Letters* 2026, featured on cover).
- Developed automated measurement systems and custom hardware: PCB design, MCU firmware (C/C++), Python (PyVISA, Pandas), and LabVIEW, enabling high-throughput device characterization.

Graduate Researcher — Plasma Immersion Ion Implantation Lab., KIST

2021 – 2023

Principal Investigator: [Dr. Seunghee Han](#)

- Developed low-temperature, transfer-free direct graphene growth on SiO₂ wafers via Plasma Electron Annealing (PEA), inspired by Plasma Immersion Ion Implantation and Deposition (PIID).
- Thin-film deposition and processing: High-Power Impulse Magnetron Sputtering (HiPIMS), Rapid Thermal Annealing (RTA), and dry/wet etching.
- Hands-on operation of KIST characterization facilities: SEM, EDS, Raman, FIB, XRD, AFM, UV-Vis, and ellipsometry.

RESEARCH FUNDING

As Principal Investigator (Student)

- Multi-Channel Analog Signal Generator and Reader — KIST Institutional Program, Jul–Nov 2023.
- Bipolar HiPIMS Modulator — KIST Institutional Program, Sep–Nov 2021.

As Participant

- High-Capacity Hopfield Network Memory for Next-Generation Generative AI — National Research Foundation of Korea (NRF), Sep 2025–Aug 2028.
- Autonomous Tactile–Visual Synchronized Neuromorphic Learning System for IoT — Ministry of Science and ICT (MSIT), Jul 2024–Jun 2029.
- Ultra-Fast Ultra-Low-Power Stochastic Computing Semiconductor — Ministry of Science and ICT (MSIT), Jun 2024–May 2029.
- Multimodal Neuron–Synapse Neuromorphic System — KIST Institutional Program, Jan 2022–Dec 2025.
- Oscillator-Based Ising Machine — Ministry of Science and ICT (MSIT), Jan 2023–Jul 2024.
- Cerebellum-Inspired OTS Neuron and Memristor Synapse System — Ministry of Science and ICT (MSIT), Jan 2023–Jun 2024.
- Ultra-Low-Power Spiking Neuron Array — Ministry of Science and ICT (MSIT), Jan 2023–Feb 2024.

PATENTS

Granted

- Method and Apparatus for Manufacturing Graphene Film — KR, granted Feb 2025.
- Manufacturing Method of Low-Resistance Film for Interconnects — KR, granted Apr 2024.
- Method for Manufacturing Ferromagnetic Films — KR, granted Aug 2022.

Filed / Pending

- Ion-Based Adaptive Somatosensory Neuron Device & Circuit — PCT (2025) and KR (2025).
- Binary Logic Operation Artificial Neuron Device — PCT (2025) and KR (2025).
- Method and Apparatus for Manufacturing Graphene Film — US (2022).
- Manufacturing Method of Refractory Metal Protective Film — KR (2022).

HONORS & AWARDS

- Best Oral Paper Award — Korean Conference on Semiconductors (KCS), 2026.
- Outstanding Researcher Award — Post-Silicon Semiconductor Institute (PSI), KIST, 2024.
- Best Poster Award — Intl. Conf. on Electronic Materials and Nanotechnology for Green Environment (ENGE), 2024.
- Oral Presentation Award — KIST–Academia Conference on Research Collaboration, 2024.
- Poster Presentation Award — Korean Conference on Semiconductors (KCS), 2024.
- Excellence Award, Start-up Commercialization Idea Incubation — KIST, 2023.
- Excellence Award, Idea Bubbling Contest — KIST, 2021.

INVITED & SELECTED PRESENTATIONS

Invited Talk

- **U. Kang**, “Brain-Inspired Electronics and Their Applications,” Korean Physical Society (KPS) Fall Meeting, Focus Session, Gwangju, Korea (Oct 2025).

Selected Oral Presentations

- **U. Kang**, S. Lee, “Artificial Neural Logic Operators for Energy-Efficient Dendritic Computing,” KCS, Jeongseon, Korea (Jan 2026).
- **U. Kang**, S. Kim, S. Yi, S. Kumar, S. Lee, “Neuromorphic Boolean Logic Implementation Using Ovonic Threshold Switch Devices,” MRS Spring Meeting, Seattle, WA, USA (Feb 2025).
- **U. Kang**, S. Lee, “An Artificial Multimodal Neuron with Associative Learning Capabilities,” KIST–Academia Conference on Research Collaboration, Seoul, Korea (Jul 2024).
- **U. Kang**, E. Jung, S. An, J. Yoon, S.H. Lim, S. Han, “Transfer-Free and Catalyst-Free Graphene Thin Film Produced by Plasma Electron Annealing at Low Temperatures,” Korean Vacuum Society (KVS), Hoengseong, Korea (Feb 2023).
- **U. Kang**, E. Jung, S. An, S. Han, “Revolutionary Simple Production Method of Transfer-free, Low-Temperature, Conductive Graphene Film,” KVS, Jeju, Korea (Aug 2022).
- **U. Kang**, M. Cho, S. Jeon, S. Han, “Transfer-Free and Low-Temperature Graphene Production,” KVS, Hoengseong, Korea (Feb 2022).

Selected Poster Presentations

- **U. Kang**, S. Lee, “Artificial Neural Logic Operators for Energy-Efficient Dendritic Computing,” KIST–Academia Conference on Research Collaboration, Seoul, Korea (Jul 2025).
- **U. Kang**, S. Oh, J. Kim, J. Hwang, J. Bang, Y. Lee, S. Lee, “An Artificial Multimodal Neuron with Associative Learning Capabilities,” ENGE, Jeju, Korea (Nov 2024).
- **U. Kang**, S. Kim, Y.W. Lee, S. Oh, J. Kim, J. Hwang, S. Lee, “An Artificial Multimodal Neuron with Associative Learning Capabilities,” KCS, Gyeongju, Korea (Feb 2024).

TECHNICAL SKILLS

- **Device Fabrication & Integration:** thin-film device fabrication, wafer-level packaging, HiPIMS, RTA, dry/wet etching, plasma and vacuum processing (PEA, PIID).
- **Characterization:** electrical characterization (I–V, endurance, retention), SEM, EDS, Raman, FIB, XRD, AFM, UV-Vis, ellipsometry.
- **Hardware & Programming:** PCB design, MCU firmware (C/C++), Python (PyVISA, Pandas), LabVIEW, 3D modeling.

PROFESSIONAL MEMBERSHIPS & LANGUAGES

- **Memberships:** Korean Physical Society (KPS); Korean Vacuum Society (KVS); Materials Research Society (MRS, USA).
- **Languages:** English (fluent); Korean (native); Chinese (intermediate).

REFERENCES

Dr. Suyoun Lee · *Ph.D. research advisor*

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