

Ikjun Hong

Optical Sensing Engineer | Photonics Characterization Engineer | ML characterization with Automation

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Google Scholar: <https://scholar.google.com/citations?user=PxxFrSsAAAAJ>

SUMMARY

5th year Ph.D. candidate in Electrical and Computer Engineering with hands-on experience **designing, fabricating, and characterizing photonic devices and optical systems**. Strong background in **optical simulation, automated optical test platforms**, Python/MATLAB-based measurement, and **ML-driven data analysis**. Experienced in translating photonic device concepts into working hardware through nanofabrication (**Superuser**), optical characterization, and iterative test-driven optimization.

Key Projects and Achievement:

- AI-assisted real-time **optical sensing and characterization** system enabling detection and analysis of nanoparticle as small as **60 nm** (optical alignment, Python, ML, interferometric imaging)
- Built a **mode-locked fiber laser with an amplifier setup** achieving **~50% second-harmonic generation** conversion efficiency (fiber optics, optical coupling, modulation, laser optics, alignment, cavity, HI1060 coupling)
- Developed a metasurface-based thermal emitter for a **high-Q optical resonator**, demonstrating a thermally stable **infrared emitter with ~40% emission** (diffraction, near-field coupling, far-field measurement, Fourier plane, FDTD)
- Developed an **automated optical setup and characterization pipeline** and metric extraction (SDK, microcontroller integration, tracking algorithms, image contrast enhancement)

SKILLS

- **Optical & Photonic Systems:** Metasurfaces, nanophotonics, integrated photonics, **optical sensing and detection**, computational imaging, optical system modeling, real-time image processing
- **Simulation Tools:** Maxwell-solver (FDTD), COMSOL, Fourier optics, electromagnetic modeling, device optimization
- **Programming:** Python, MATLAB, automation scripting (SDK), experiment control, data logging, calibration workflows
- **AI / Signal & Image Processing:** ML-based image analysis, tracking, signal processing, real-time analysis pipelines, data-driven optimization, U-net, RAG-LLM pipeline, Fourier optics (Adjoint method)
- **Prototyping & Fabrication:** EBL, PECVD, RIE, FIB, nanofabrication workflow integration
- **Characterization:** OSA, oscilloscope, Spectrum Analyzer, interferometric imaging, free-space and fiber alignment

EDUCATION

Vanderbilt University	Nashville, Tennessee
Ph.D. candidate, Electrical and Computer Engineering (Doctor of Philosophy)	03/2021 – Present
University of Seoul	Seoul, South Korea
M.S. in Electrical and Computer Engineering; GPA: 4.19/4.5	03/2018 – 02/2021
University of Seoul	Seoul, South Korea
B.S. in Electrical and Computer Engineering; GPA: 3.78/4.5	03/2010 – 02/2016

WORK EXPERIENCE

Samsung Electronics , Visual Display Business	Suwon, South Korea
Software Engineer	01/2016 – 02/2018
<ul style="list-style-type: none">• Developed and optimized Smart TV application software for commercial product releases using C# on embedded Linux, contributing to deployment across high-volume consumer devices. Collaborated with cross-functional engineering teams in a fast-paced product development environment, balancing feature implementation, performance, and release schedules.• Debugged and improved S/W performance by optimizing runtime logic and internal pipelines, reducing latency by ~30%.• Earned Samsung Software Certification (Advanced Level) for technical proficiency and software optimization.	
Republic of Korea Army – 3rd Infantry Division	Cheorwon, South Korea
Headquarters Officer, Logistics Division	01/2011 – 11/2012
<ul style="list-style-type: none">• Coordinated vehicle dispatch and managed military supply logistics; honorably discharged as Sergeant (E-5).	

RESEARCH EXPERIENCE

Vanderbilt Institute of Nanoscale Science and Engineering (VINSE)	Nashville, Tennessee
Cleanroom Superuser	05/2025 – Present
<ul style="list-style-type: none">• Designated Cleanroom Superuser, providing hands-on training and troubleshooting support for 20+ users on EBL, PECVD, and E-beam deposition systems.• Authored 5+ SOPs and best-practice documents to standardize process steps, improve reproducibility, and strengthen internal knowledge sharing.	

- Supported rapid prototyping and failure analysis of nanophotonic devices by diagnosing fabrication/process issues and refining process windows.

Vanderbilt University

Nashville, Tennessee

Graduate Research Assistant

08/2021 – Present

- **Nanoscale Design & Fabrication:** Designed, simulated (FDTD/COMSOL/RCWA), fabricated, and experimentally validated metaphotonic devices, translating physics-based designs into working prototypes with sub-10 nm precision.
- **Near-Field Photonics:** Designed silicon nanoantenna structures delivering **41× electromagnetic field enhancement**, enabling low-power operation and scalable device integration for optical trapping experiments.
- **Optical Characterization:** Built and integrated optical test platforms for label-free imaging and sensing (interferometric imaging, Raman spectroscopy, scattering-based detection), including system alignment, calibration, debugging, repeatable data acquisition, and **sensor evaluation**.
- **Thermal Photonic Devices:** Developed and benchmarked large-area metasurface thermal emitters (3.5 mm × 3.5 mm), achieving near-unity absorption and $Q \approx 120$ through iterative design, fabrication, and test-driven performance evaluation.
- **Automation & Data Analysis:** Developed Python/MATLAB-based automation workflows for experiment control, data logging, **calibration**, and performance metric extraction, accelerating simulation-to-experiment iteration and improving reproducibility.
- **AI / Real-Time Processing:** Implemented **AI-assisted image** and optical **signal processing** pipelines for particle detection, tracking, and quantitative analysis, enabling near-real-time feedback for device and system optimization.
- Collaborated in cross-functional technical reviews to evaluate device designs, measurement results, and system-level trade-offs across simulation, fabrication, and characterization stages.

Oak Ridge National Laboratory (ORNL), Center for Nanophase Materials Sciences (CNMS).

Oak Ridge, TN

Visiting Scholar

07/2022; 08/2025

- Collaborated with ORNL researchers to fabricate large-area nanophotonic devices using EBL, supporting prototype scaling, process reproducibility, and transfer of fabrication workflows for optical device validation.

University of Seoul

Seoul, South Korea

Graduate Research Assistant

02/2018 – 07/2021

- **Nonlinear Optics Experiment:** Demonstrated second-harmonic generation (SHG) using a pulsed laser, achieving an enhanced conversion efficiency of 53% in a periodically poled lithium niobate (PPLN) crystal.
- **Fiber Laser System Design:** Designed and implemented a Q-switched, mode-locked **fiber laser system** generating 180-ps pulses by integrating an acousto-optic modulator, achieving **watts-level operation** with pulse energies up to 26 nJ. Built and optimized a two-stage fiber amplifier, analyzing gain saturation and stability to scale output power.

SELECTED PUBLICATIONS (FIRST AUTHOR)

- [1] **Ikjun Hong** et al. — AI-assisted nanotweezer platform for label-free single-particle analysis of milk-derived extracellular vesicles. **npj Biosensing**, under review (2026).
- [2] **Ikjun Hong** et al. — Real-time label-free detection and trapping of nanoscale particles and extracellular vesicles. **Light: Science & Applications** (2026).
- [3] **Ikjun Hong** et al. — Hybrid optical and diffusiophoretic nanomanipulation using all-dielectric anapole-enhanced thermonanophotonics. **ACS Photonics** (2023).
- [4] **Ikjun Hong** et al. — Anapole-assisted low-power optical trapping of nanoscale extracellular vesicles and particles. **Nano Letters** (2023).
- [5] **Ikjun Hong** et al. — 532-nm second-harmonic generation with enhanced efficiency using subharmonic cavity modulation-based quasi-Q-switched mode-locked pulses. **Optics Express** (2020).

SELECTED CONFERENCE PRESENTATIONS (FIRST AUTHOR)

- [1] **Ikjun Hong** et al. — Interferometric electrohydrodynamic tweezers for high-throughput, label-free single-nanoparticle analysis. SPIE – Active Photonic Platforms (2025).
- [2] **Ikjun Hong** et al. — Nano-optical trapping and detection of nanoscale biological particles using all-dielectric nanoantennas. SPIE – Optical Trapping and Optical Micromanipulation XXI (2024).
- [3] **Ikjun Hong** et al. — Diffusiophoresis-induced nanoscale particle transport, trapping, and manipulation using optical anapole antennas. SPIE – Optical Trapping and Optical Micromanipulation XX (2023).

PATENTS

- [1] System and method of nanoscale optical trapping and analysis using engineered dielectric optical nano-antenna, Justus C Ndukaife, **Ikjun Hong**, et al., US18989285

AWARDS, RECOGNITIONS, AND MENTORING

- **Mentor**, REHSS Program, Summer 2023 — Mentored high school student Moreen Habib in optics research.
- Vanderbilt Graduate Dean's Fellowship (Russell G. Hamilton Scholarship), 2021–Present.