

양자 물질 계면 및 나노 소자 연구실

Quantum Materials
Interfaces and Nano
Devices Laboratory



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Education

- 2020** Ph.D. in Physics, Ulsan National Institute of Science and Technology (Dissertation: Ballistic Carrier Transport Through Graphene: Out-of-Plane and In-Plane Aspects)
- 2013** B.S. in Device Physics & Mechanical System Design and Manufacturing (Dual Major), Ulsan National Institute of Science and Technology (Valedictorian at Commencement Ceremony)

Experience

- 2023~** Assistant Professor, Department of Semiconductor Engineering, Gwangju Institute of Science and Technology
- 2022~2023** Staff Engineer, Process Architecture Team, Foundry Business Department, Device Solutions Division, Samsung Electronics
- 2022** Academy Postdoctoral Fellow, Department of Electronics and Nanoengineering, Aalto University, Finland
- 2020~2022** Postdoctoral Fellow, Department of Electronics and Nanoengineering, Aalto University, Finland
- 2020** Postdoctoral Fellow, Department of Physics, Ulsan National Institute of Science and Technology
- 2012** Intern Researcher, Single-Electron Quantum Device Team, Quantum Technology Institute, Korea Research Institute of Standards and Science

Fact Sheet

- 2022~2025** Academy Research Fellowship, Academy of Finland
- 2019** Oral Presentation Award, Korean Physical Society
- 2018** Poster Presentation Award, Korean Physical Society
- 2015~2020** Global Ph.D. Fellowship, National Research Foundation of Korea
- 2015** Poster Presentation Award, Korean Physical Society
- 2012** Excellence Award, Undergraduate Research Program, Korea Foundation for the Advancement of Science and Creativity
- 2011~2013** Science & Technology Club Support, Korean Federation of Science and Technology Societies

연구실 소개

양자 물질 계면 및 나노 소자 연구실에서는 인공지능 반도체와 양자 컴퓨팅 하드웨어를 위한 반도체 소자 연구에 주력합니다. 다양한 양자 물질들의 물성과 물질 간 접합 계면에서 발견되는 독특한 현상을 탐구합니다. 그리고 이를 기반으로 한 소자의 제작 및 특성화 그리고 실제 응용을 목표로 합니다. 세부 연구 주제: (1) 인공지능 내장 센서 (초소형 전산 분광기, 광자 증폭 광 검출기, 비냉각 복사열 및 적외선 감지기), (2) 모어 댄 무어 소자 (위상 절연 유전체, 다진법 논리 게이트, 광전자 시냅스 소자), (3) 전자 양자 광학 (양자점 접촉, 탄도 전자 수송 및 게이트 제어, 베셀라코 렌즈, 초격자 시준기, 전자 간섭계), (4) 양자 상전이 (2차원 반데르발스 조셉슨 접합, 손대칭 전하 밀도 파동 및 표면 근접 효과, 마요라나 페르미온), 온 디바이스 AI (인공지능 알고리즘 기반 데이터 처리 및 분석 기능 내장 센서), 자율주행 (광시야각 위치 추적 센서), 빅데이터 (빛의 속도로 인코딩되는 다진법 논리 게이트), 초연결 (칩 내 및 칩 간 네트워크), 하이브리드 큐비트 플랫폼 (전자 간섭계와 혼합된 초전도 접합) 분야에 핵심 기술을 제공할 수 있습니다.

Artificial Intelligent Sensors
Electrically-tunable vdW junction, Monochromatic light, Wavelength meter, Broadband light, Spectrometer, Gate tuning, Wavelength, Digital imager, Electrically-tunable spectral response matrix

More than Moore Devices
Optically configurable anti-ambipolar and bi-ambipolar photoresponses, Bi-anti-ambipolar, Input A: wavelength, Anti-ambipolar, Input B: gate voltage

Electron Quantum Optics
Quantum Phase Transitions, Functionalized, Binding energy (eV)

연구 성과

수행중인 주요 연구과제 (주요과제경력)

- Artificial Intelligence Built-in Sensors: Miniaturized and All-in-One Spectrometers Without the Need for Separate Light Source and Diffraction Grating, GIST, 2024
- More Than Moore: Quantum Material Interfaces and Nano Devices, GIST, 2023~2025
- Single-Junction Broadband Spectrometers, Academy Research Fellowship, Academy of Finland, 2022~2025
- Conductance Switching of Supercollimated Dirac Electrons by All-Electrically-Controlled Quantum Interference, Global Ph.D. Fellowship, National Research Foundation of Korea, 2015~2020

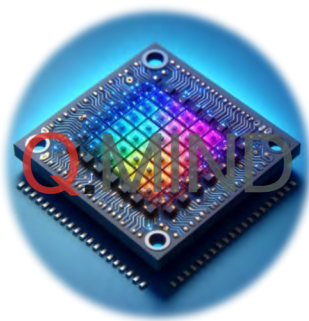
주요논문 (대표실적)

- Broadband Miniaturized Spectrometers with a van der Waals Tunnel Diode, Nature Communications (2024).
- Hybrid Integration of 2D Materials for On-Chip Nonlinear Photonics, Light: Advanced Manufacturing (2023).
- Deterministic Polymorphic Engineering of MoTe2 for Photonics and Optoelectronics, Advanced Functional Materials (2023).
- Miniaturized Spectrometers with a Tunable van der Waals Junction, Science (2022).
- Switchable Photoresponse Mechanisms Implemented in Single van der Waals Semiconductor/Metal Heterostructure, ACS Nano (2022).
- Tunable Quantum Tunneling through a Graphene/Bi2Se3 Heterointerface for the Hybrid Photodetection Mechanism, ACS Applied Materials & Interfaces, (2021).
- Negative Fermi-level Pinning Effect of Metal/n-GaAs (001) Junction Induced by Graphene Interlayer, ACS Applied Materials & Interfaces (2019).
- Strong Fermi-level Pinning at metal/n-Si(001) Interface Ensured by Forming an Intact Schottky Contact with a Graphene Insertion Layer, Nano Letters (2017).

주요특허

- CMOS-Compatible On-Chip Miniaturized Spectrometers with Graphene Barristor, 핀란드, FI20237026, 출원일 2023.02.08.
- Ultra-Miniaturized Spectrometers with Tunable Heterojunctions, 핀란드, FI20227114, 출원일 2022.08.25.

융합연구 및 비전



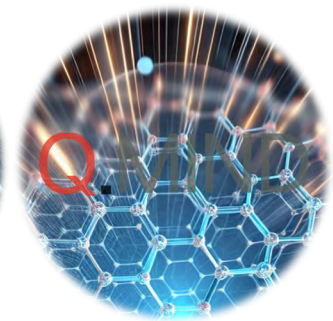
인공지능 센서



모어 댄 무어 소자



전자 양자 광학



양자 상전이