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Education

2012 **M. S. & Ph. D.** Sungkyunkwan University, South Korea. Department of Energy and Science

Thesis title: Two-dimension property based advanced functionality in material electronics

2005 **B. S.** Pohang University of Science and Technology, South Korea Department of Chemistry

Professional Position

Present	**Associate professor**	Department of Chemistry, Myongji University, South Korea
2021 ~ 2025	**Assistant professor**	Department of Chemistry, Myongji University, South Korea
2020 ~ 2021	**Post-doctor**	Advanced Photonics Research Institute, Gwangju Institute of Science and Technology
2018 ~ 2020	**Research Associate**	Department of Engineering, University of Cambridge, UK
2017 ~ 2018	**Visiting Researcher**	Department of Engineering, University of Cambridge, UK

Research Interest

Development of a New Platform of Synthesis for Nano-dimensional Materials through Artificial Intelligence

- Extensive knowledge and hands-on experience in nanomaterial synthesis

: Perovskite quantum dot, Carbon based nano-materials & Functionalization of carbon based materials, Transition metal dichalcogenides (TMD) & Functionalization of TMD, Surface chemistry, perovskite, high entropy materials, hetero-structure, multidimensional nanomateirals.

- Study on stability and phase transition of nanomaterials

: XPS, XRD investigation on hetero-structured nanomaterials

: Photocatalytic, electrochemical catalytic, photo-electrochemical catalytic behavior of nanomaterials

- Inkjet printing

: Ink formulation for inkjet printer (polymer, graphene, 2D material, ZnO, Ag, etc)

: Study on the printing parameter (drop spacing, purging time, plate temp. waveform, Z value)

: Designing the device configuration for field effect transistor (FET), sensor, capacitor, photodetector, LEDs.

- Electronic devices

: The transparent conductive film for display

: Printed electronics *via* inkjet printer

: Device fabrication of FET, sensor, and the photodetector for wearable devices.

Recent Publication https://orcid.org/0000-0003-0958-6514

1. H. S. Oh, B. J. Yoo, G. Cho, J. Yang, H. Kim, M. Kim, S. Park, B. Chae, W-G. Jung, W-J. Moon, Y. Han, J. B. Son, H. S. Kim,* J. Y. Lee,* **Hanleem Lee***, "Spatially Controlled Doping via High Diffusion Dynamics in Perovskite Nanocrystals for Efficient and Stable CO_2 Reduction Photocatalysis", **ACS Applied Materials and Interfaces** under revision
2. W. T. Hong et al., "Perovskite Quantum Dot-Incorporated Heterostructural Metal Oxide Photoanode for Boosting Solar Water Splitting" submitted.
3. **Hanleem Lee**, C. K. Trinh, M. G. So, C-L Lee *, "In-situ Investigation on the High stability nature of High-crystalline Core-Shell Perovskite Quantum Dots", submitted.
4. H. Kim, Y. Jeong, W-G Jung, M. Kim, J. Yang, M. Kim, Y. Han, H. Ko, S. W. Hwang, W-J Moon, **H. Lee**, "Designing multiple charge carrier separation pathways in core-type near infrared colloidal nanocrystal for broadband photodetector", **RSC Advances**, 2025, 15, 6531.
5. S. W. Hwang et al., "Strong enhancement of light emission in core-shell InGaN/GaN multi-quantum-well nanowire light-emitting diodes by incorporating graphene quantum dots" **ACS Applied Materials and Interfaces,** 2025, 17, 6597−6603.
6. G. Hwan Park‡ Meeree Kim‡, Hyunjung Kim, **Hanleem Lee,*** Hyoyoung Lee*, "Enlarged interlayer channels of graphene oxide frameworks for activating large-size chemical warfare agents detection", **ACS materials Letters**, 2024, 6, 260−266
7. Hyegyeong Min,‡ Wan-Gil Jung,‡ Jiyoon Yang,‡ Ha Som Oh, Byung Jun Yoo, Won-Jin Moon, Hyunjung Kim, and **Hanleem Lee***, "Systematic Approach to Study of Optical Stability According to the Crystal Structure of Perovskite Quantum Dot", **Journal of Physical Chemistry C**, 2023, 127(46), 22713
8. Cuc Kim Trinh*, Ha Som Oh, **Hanleem Lee***, "The solvent effect on the morphology and molecular ordering of Benzothiadiazole-based small molecule for inkjet-printed thin-film transistors", **RSC Advances**, 2023, 13, 14210-14216.
9. Hyunjung Kim, **Hanleem Lee***, "Improvement of Chemical Stability of Perovskite Nanocrystals as a Photoelectrochemical Catalyst for Hydrogen Evolution Reaction", **Catalysts**, 2023, 13(4), 752.
10. S. Lee, et al., "Truly form-factor-free industrially scalable system integration for electronic textile architectures with multifunctional fiber devices", **Science Advances**, 2023, 9, eadf4049.
11. **Hanleem Lee**, et al., "Air stable eco-friendly quantum dots with a light-mediated photoinitiator for an inkjet printed flexible light emitting diode" **Journal of Materials Chemistry C** 2022, 10, 10708-10718.
12. Yuankai Li et al., "Rational Nanopositioning of Homogeneous Amorphous Phase on Crystalline Metal Oxide for Boosting Solar Water Oxidation", **Chemical Engineering Journal** 2022, 438, 135532.
13. H. W. Choi et al., "Smart textile lighting/display system with multifunctional fibre devices for large scale smart home and IoT applications", **Nature Communications** 2022, 13, 814.
14. **Hanleem Lee**, C. K. Trinh, M. G. So, C-L Lee *, "Sequential Structural Degradation in Red Perovskite Quantum Dot Light Emitting Diodes and its Prevention by Introducing Stable Gradient Iodine Concentration in Core-shell Architecture", **Nanoscale**, 2022, 14, 3425-3440.
15. **Hanleem Lee**, Y. T. Chun*, "Ferroelectric Induced UV Light-responsive Memory Devices with Low Dark Current", **Electronics**, 10, 16, 1897, 2021.
16. C. K. Trinh‡, **Hanleem Lee**‡, M. G. So, C-L Lee *, "Synthesis of Chemically Stable Ultrathin SiO_2-Coated Core–Shell Perovskite QDs via Modulation of Ligand Binding Energy for All-Solution-Processed Light Emitting Diodes", **ACS Applied Materials and Interfaces**, 13, 25, 2021.
17. **Hanleem Lee**‡, S. Lee‡, H. Lee*, "Energy/Charge Transfer Modulation with Spacer Ligands for High Emissive Quantum Dot – Polymer Blend", **ACS Applied Materials and Interfaces,** 13, 18, 21534, 2021.

18. **Hanleem Lee,** J. W. Jeong, M. G. So, G. Y. Jung, C-L Lee*, "Design of Chemically Stable Organic Perovskite Quantum Dots for Micropatterned Light-Emitting Diodes through Kinetic Control of Cross-linkable Ligand System", **Advanced Materials**, 2007855, 2021, doi.org/10.1002/adma.202007855.

19. **Hanleem Lee**‡***,** M. Kim‡, H. Lee, "Reducing the Photodegradation of Perovskite Quantum Dots to Enhance Photocatalysis in CO_2 Reduction", **Catalyst**, 11, 1, 61, 2021 (invited paper)

20. **Hanleem Lee**‡**,** S. Bak‡, J. Kim, H. Lee*, "The effect of the dopant's reactivity for high-performance 2D MoS2 thin-film transistor", **Nano Research**, 14, 198, 2020

21. **Hanleem Lee**, et al., "Nano-to-Microporous Networks via Inkjet Printing of ZnO Nanoparticles/ Graphene Hybrid for Ultraviolet Photodetectors", **ACS applied Nano Materials**, 3, 5, 4454-4464, 2020

22. D-W Shin, et al., "Waterproof Flexible InP@ZnSeS Quantum dot Light-Emitting Diode", **Advanced Optical Materials**, 8, 1901362, 2020.

23. S. Jung, H. et al., "Modeling Electrical Percolation to optimize the Electromechanical Properties of CNT/Polymer Composites in Highly Stretchable Fiber Strain Sensors", **Scientific Reports**, 9, 20376, 2019.

24. **Hanleem Lee,** S. Bak, Y. Cho, M. Kim, S. H. Kang, V. Q. Bui, H. M. Le, S. W. Kim, H. Lee*, "Hydrogen adsorption engineering by intramolecular proton transfer on 2D nanosheets", **NPG Asia Materials**, 10, 441–454, 2018.

25. J.M. Kim et al., "Si-quantum-dot heterojunction solar cells with 16.2% efficiency achieved by employing doped-graphene transparent conductive electrodes" **Nano Energy**, 43, 124-129, 2018

26. **Hanleem Lee,** S. Bak, S-J An, J. H. Kim, E. Yun, M. Kim, S. Seo, Y. Lee, M. Jeong, H. Lee*, "Highly Efficient Thin-Film Transistor via Cross-Linking of 1T Edge Functional 2H Molybdenum Disulfides"**, ACS nano**, 11, 12832–12839, 2017.

27. **Hanleem Lee,** M. Kim, I. Kim, H. Lee*, "Flexible and Stretchable Optoelectronic Devices using Silver Nanowire and Graphene", **Advanced Materials**, 28(22), 4541-4548, 2016.

28. **Hanleem Lee,** I. Kim, M. Kim, H. Lee*, "Moving beyond flexible to stretchable conductive electrodes using metal nanowires and graphenes", **Nanoscale**, 8, 1789-1822, 2016.

29. K. Lee, **Hanleem Lee**, Y. Shin, Y. Yoon, D. Kim, H. Lee*, Highly Transparent and Flexible Supercapacitors Using Graphene-Graphene Quantum Dots Chelate, **Nano Energy**, 26, 746-754, 2016.

30. E. Hwang, H. Hwang, Y. Shin, Y. Yoon, **Hanleem Lee**, J. Yang, S. Bak, H. Lee*, "Chemically modulated graphene quantum dot for tuning the photoluminescence as novel sensory probe", **Scientific Reports,** 6, 39448, 2016.

31. K. Lee, Y. Yoon, Y. Cho, S. M. Lee, Y. Shin, **Hanleem Lee**, H. Lee*, "Tunable Sub-nanopores of Graphene Flake Interlayers with Conductive Molecular Linkers for Supercapacitors", **ACS Nano,** 10, 6799−6807, 2016.

32. **Hanleem Lee**‡**,** G. Han‡, M. Kim, H. Ahn*, H. Lee*, "High Mechanical and Tribological Stability of an Elastic Ultrathin Overcoating Layer for Flexible Silver Nanowire Films", **Advanced Materials**, 27(13), 2252-9, 2015.

33. Y. Yoon, K. Samanta, **Hanleem Lee**, K. Lee, A. P. Tiwari, J-H. Lee, J. Yang, H. Lee*, "Highly Stretchable and Conductive Silver Nanoparticle Embedded Graphene Flake Electrode Prepared by In situ Dual Reduction Reaction", **Scientific Reports** 5, 14177, 2015.

34. **Hanleem Lee**, K. Lee, J. T. Park, W. C. Kim*, H. Lee*, "Well-ordered and High Density Coordination-type Bonding to Strengthen Contact of Silver nanowires on Highly Stretchable Polydimethylsiloxane", **Advanced Functional Materials**, 24 (21), 3276-3283, 2014.

35. E. Hwang, S. Seo, S. Bak, **Hanleem Lee**, M. Min, H. Lee*, "An Electrolyte-Free Flexible Electrochromic Device Using Electrostatically Strong Graphene Quantum Dot-Viologen Nanocomposites", **Advanced Materials**, 26, 5129–5136, 2014.

36. L. Wang, Y.Park, P. Cui, S. Bak, **Hanleem Lee**, S. Mi Lee, H. Lee*, "Facile preparation of an n-type reduced graphene oxide field effect transistor at room temperature", **Chemical Communications**, 50, 1224-1226, 2014. IF 6.222

37. I. K Moon‡, J. I. Kim‡, **Hanleem Lee**‡**,** W. C. Kim*, H. Lee*, "2D Graphene Oxide Nanosheets as an Adhesive Over-Coating Layer for Flexible Transparent Conductive Electrodes", **Scientific Reports**, 3, 1112, 2013. IF 4.379

38. Y. Li, P. Cui, L. Wang, **Hanleem Lee**, K. Lee, H. Lee*, "Highly Bendable, Conductive and Transparent Film by an Enhanced Adhesion of Silver Nanowires", **ACS Applied Materials and Interfaces**, 5(18), 9155-60, 2013.

Recent Patent

1. **Hanleem Lee,** Hyoyoung Lee, TMD Manufacturing method, Korean patent 10-1766768 (Aug, 03, 2017)
2. **Hanleem Lee,** Hyoyoung Lee, Transparent electrode and manufacturing method, Korean patent 10-1600395 (Feb, 26, 2016)
3. **Hanleem Lee,** Do Yoen Hwang, Hyoyoung Lee, Nanosheet-inorganic layered porous nanostructure, and preparing method of the SAM, Korean Patent 10-1563231 (Oct, 26, 2015)
4. **Hanleem Lee, Machine learning based analytic method for phase separation of nanocrystal,** Korean patent 10-2024-0153358 (Dec, 2024)

Conference presentation

1. **Hanleem Lee,** Design of Robust Perovskite Quantum Dot to Promote Photocarrier Generation, Korean Physical Society April 2024
2. **Hanleem Lee,** Research on Degradation and Phase transition of Semiconducting Nanomaterials, Korean Chemical Society April 2024
3. **Hanleem Lee**, Development of Semiconducting Nanomaterials for Printed Optoelectronic Devicess, Korean Chemical Society April 2022
4. **Hanleem Lee,** Development of Stable Perovskite Quantum Dot for Optoelectronic Application, Young Scientist Workshop in Seoul national university 17. Aug 2021
5. **Hanleem Lee,** C.-Y. Lee, Realizing Inkjet-printed Quantum Dot Light Emitting Diode, The 8th ICMAP & The 9th ISFM 18. Jan 2021
6. **Hanleem Lee,** Material Engineering of 2D materials for Realizing the Electronics from TFT to Electrochemical devices, Innovations in Large-Area Electronics Conference 2019, 23. Jan 2019
7. **Hanleem Lee,** F. Torrisi, Molecular Engineering for Developing MoS2 Thin Film Field Effect Transistor, Innovations in Large-Area Electronics Conference 2018, 23. Jan 2018
8. **Hanleem Lee,** H. Lee, Edge Functional Exfoliated MoS_2 for field effect transistor, 7th A3 Symposium on Emerging Materials: Nanomaterials for Electronics, Energy and Environment, 29. Oct 2016
9. **Hanleem Lee,** H. Lee, Novel Functionality of MoS_2 for improved electrical and electrochemical properties, 2016 Material Research Society, 26. Nov 2016
10. **Hanleem Lee**, H. Lee, Exfoliation by selective phase transition for TMDs, 2016 Muju international winter school, 26. Jan 2016
11. **Hanleem Lee,** H. Lee, Flexible transparent conductive film with silver nanowires, 2015 International conference on Molecular electronic and Device, 21. May 2015
12. **Hanleem Lee,** H. Lee, Mechanical stability of Transparent Conductive Film with Silver nanowires on various Substrates, 2015 Muju international winter school, 25. Jan 2015
13. **Hanleem Lee,** H. Lee, High performance flexible transparent conductive film with silver nanowires on various substrate, 2014 Material Research Society, 20. April 2014
14. **Hanleem Lee,** H. Lee, Adhesive Over-Coating Layer using 2D Graphene Oxide for Flexible Transparent Conductive Ag NW film, 2013 International conference on Molecular electronic and Device, 16. May, 2013