Curriculum Vitae

Prof. Han-Hee Cho

Assistant Professor

Department of Materials Science and Engineering
Graduate School of Carbon Neutrality
Ulsan National Institute of Science and Technology (UNIST)
UNIST-gil 50, Ulsan, 44919, Republic of Korea
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Date of birth: 1989.01.31

Education

2011–2017 **Ph.D. in Chemical & Biomolecular Engineering,** Korea Advanced Institute of Science and Technology (KAIST)
Dissertation title: Planarity Control of Conjugated Polymers for Enhancement in Their Electrical Properties. Directed by *Prof. Bumjoon J. Kim*. Joined as a set-up member.

2007–2011 **B.S. in Chemical & Biomolecular Engineering,** Korea Advanced Institute of Science and Technology (KAIST)
With High Honors, *Summa Cum Laude*.

Professional Experience

2022– **Adjunct Professor in Graduate School of Caron Neutrality**, Ulsan National Institute of Science and Technology (UNIST)

2022– **Assistant professor of Materials Science and Engineering (Tenure Track)**, Ulsan National Institute of Science and Technology (UNIST)
Director of the Optoelectronic Nanomaterials Engineering Laboratory (ONEL).

2018–2022 **Research Scientist,** Ecole polytechnique fédérale de Lausanne (EPFL)
The Laboratory for Molecular Engineering of Optoelectronic Nanomaterials (LIMNO),
PI: *Prof. Kevin Sivula*.

2017 **Subgroup leader**, Korea Advanced Institute of Science and Technology (KAIST)
The Polymer Nano Electronics Laboratory. PI: *Prof. Bumjoon J. Kim*.

Awards & Honors

- Young Investigator Award, the Korean Electrochemical Society (한국전기화학회 신진연구자상, 2023)
- Best Poster Award, KPVS Fall Meeting (*International Conference*, 2017)
- Graduated with High Honor, *Summa Cum Laude* (Feb. 2011)
- Honors Program Member, Korea Advanced Institute of Science and Technology (KAIST) (2009–2011)

- Department Scholarship (2008–2009)
- Korea National Foundation Full Scholarship for Undergraduate (2007–2011)

Languages

- Korean: Native language
- English: Fluent in both oral and written communication

Teaching Experience

- **Lecture: Materials for Photoelectrochemical Devices**, *Ulsan National Institute of Science and Technology (UNIST), Spring semester* (2022–)
- **Lecture: Polymer Structures and Properties**, *Ulsan National Institute of Science and Technology (UNIST), Fall semester* (2022–)
- Teaching Assistant, *KAIST-Korea Science Academy (KSA) Joint Research & Education Program* (Mar. 2015–Dec. 2015)
- Teaching Assistant, *KAIST-High school Research Program (HRP)* (Jun. 2014–Aug. 2014)
- Teaching Assistant, *KAIST Undergraduate Research Program (URP)* (Mar. 2013–Aug. 2013)
- Teaching Assistant, *KAIST Undergraduate Research Program (URP)* (Sep. 2012–Feb. 2013)

Supervision of Graduate Students

- Current supervision of 1 Master thesis, *Ulsan National Institute of Science and Technology (UNIST)*, the Optoelectronic Nanomaterials Engineering Laboratory (ONEL).
- 1 Ph.D. and 3 Master candidates, *Ecole polytechnique fédérale de Lausanne (EPFL)*, The Laboratory for Molecular Engineering of Optoelectronic Nanomaterials (LIMNO)
- 2 Ph.D. and 2 Master candidates, *Korea Advanced Institute of Science and Technology (KAIST)*, The Polymer Nano Electronics Laboratory

Research Activities Summary

- Co-author of 33 peer-reviewed publications
- *h*-index of 23 (Google Scholar, as of May 2023)
- 3 Registered patents (Korea)

Editor and Review Activities

- Selected as Lead Organizers for the following symposium topic at the PRiME 2024
  Photocatalysts for solar fuel productions
  Advances in photoelectrochemical cells
- Technical Journal Editor, Korea Polymer Society (2023)
- Co-organization of conference symposium for Korea Electrochemical Society (2023–2024)
- Academic Committee Member of Korea Electrochemical Society (2023–2024)
- Individual scientific reviewing activities
  - Reviewing papers submitted to *Advanced Materials, Advanced Functional Materials, Advanced Energy Materials, ACS Energy Letters, Small Structures, Dyes and Pigments, Nano Energy, and Materials Chemistry Frontiers*.

Publications

33 D. Zhang[†], **Han-Hee Cho**[†], J.-H. Yum, M. Mensi, and K. Sivula*, "An Organic Semiconductor Photoelectrochemical Tandem Cell for Solar Water Splitting", *Adv. Energy Mater.* **2022**, 2202363, [†]***Equal contribution***, https://doi.org/10.1002/aenm.202202363

32 Arvindh Sekar, Juan Manuel Moreno-Naranjo, Yongpeng Liu, Jun-Ho Yum, Barbara Primera Darwich, **Han-Hee Cho**, Nestor Guijarro, Liang Yao, and Kevin Sivula*, "Bulk heterojunction organic semiconductor photoanodes: Tuning energy levels to optimize electron injection", *ACS Appl. Mater. Interfaces* **2022**, 14, 6, 8191–8198, https://doi.org/10.1021/acs ami.1c21440

31 **Han-Hee Cho** and K. Sivula*, "Advancing operational stability and performance of organic photoanodes for solar water oxidation", *Trends Chem.* **2022**, 4, 93–95, https://doi.org/10.1016 /j.trechm.2021.11.004

30 **Han-Hee Cho**, L. Yao, J.-H. Yum, Y. Liu, F. Boudoire, R. A. Wells, N. Guijarro, A. Sekar, and K. Sivula*, "A Semiconducting Polymer Bulk Heterojunction Photoanode for Solar Water Oxidation", *Nat. Catal.* **2021**, 4, 431–438, https://doi.org/10.1038/s41929-021-00617-x

29 B. P. Darwich, N. Guijarro, **Han-Hee Cho**, L. Yao, L. Monnier, P. Schouwink, M. Mensi, J.-H. Yum, K. Sivula*, "Benzodithiophene-based Spacers for Layered and Quasi-layered Lead Halide Perovskite Solar Cells", *ChemSusChem* **2021**, 14, 3001, https://doi.org/10.1002/cssc. 202100992

28 L. Yao†, Y. Liu†, **Han-Hee Cho**, M. Xia, A. Sekar, B. P. Darwich, R. A. Wells, J.-H. Yum, D. Ren, M. Grätzel, N. Guijarro, K. Sivula*, "A hybrid bulk-heterojunction photoanode for direct solar-to-chemical conversion", *Energy Environ. Sci.* **2021**, 14, 3141–3151 *†Equal contribution*, https://doi.org /10.1039/D1EE00152C

27 L. Yao, N. Guijarro, F. Boudoire, Y. Liu, A. Rahmanudin, R. A. Wells, A. Sekar, **Han-Hee Cho**, J.-H. Yum, F. L. Formal, and K. Sivula*, "Establishing Stability in Organic Semiconductor Photocathodes for Solar Hydrogen Production", *J. Am. Chem. Soc*. **2020**, 142, 7795–7802, https:// doi.org/ 10.1021/jacs.0c00126

26 N. Guijarro, L. Yao, F. L. Formal, R. A. Wells, Y. Liu, B. P. Darwich, L. Navratilova, **Han-Hee Cho**, J.-H. Yum, and K. Sivula*, "Lead Halide Perovskite Quantum Dots to Enhance the Power Conversion Efficiency of Organic Solar Cells", *Angew. Chem. Int. Ed.* **2019**, 58, 12696 –12704, https://doi.org/ 10.1002/ange.201906803

25 K.-H. Lin, A. Prlj, L. Yao, N. Drigo, **Han-Hee Cho**, M. K. Nazeeruddin, K. Sivula, and C. Corminboeuf*, "Multiarm and Substituent Effects on Charge Transport of Organic Hole Transport Materials", *Chem. Mater.* **2019**, 31, 6605–6614, https://doi.org/10.1021/ acs.chem mater.9b00438

24 A. Rahmanudin, L. Yao, A. Sekar, **Han-Hee Cho**, Y. Liu, C. R. Lhermitte, and K. Sivula*, "Fully Conjugated Donor–Acceptor Block Copolymers for Organic Photovoltaics via Heck–Mizoroki Coupling", *ACS Macro Lett.* **2019**, 8, 134–139, https://doi.org/10.1021/ acsmacrolett.8b00932

23 **Han-Hee Cho**, S. Kim, T. Kim, V. G. Sree, S.-H. Jin, F. S. Kim, and Bumjoon J. Kim*, "Design of Cyanovinylene-Containing Polymer Acceptors with Large Dipole Moment Change for Efficient Charge Generation in High-Performance All-Polymer Solar Cells", *Adv. Energy Mater.* **2018**, 8, 1701436 ***Cover picture**, https://doi.org/10.1002/aenm.201701436

22 H. You, D. Kim, **Han-Hee Cho**, C. Lee, S. Chong, N. Y. Ahn, M. Seo, J. Kim, F. S. Kim, and B. J. Kim*, "Shift of the Branching Point of the Side-Chain in Naphthalenediimide (NDI)-Based Polymer for Enhanced Electron Mobility and All-Polymer Solar Cell Performance", *Adv. Funct. Mater.* **2018**, 28, 1803613, https://doi.org/10.1002/adfm.201803613

21 **Han-Hee Cho**, G. Han, R. Younts, W. Lee, B. R. Gautam, S. Lee, C. Lee, T. Kim, F. S. Kim, K. Gundogdu, and B. J. Kim*, "Impact of Highly-Crystalline, Isoindigo-Based Small Molecule Additives for Improving Performance of All-Polymer Solar Cells Based on Naphthalenediimide-Based Polymer Acceptor", *J. Mater. Chem. A* **2017**, 5, 21291–21299, https://doi.org/10.1039/C7TA06939A

20 **Han-Hee Cho**, T. Kim, K. Kim, C. Lee, F. S. Kim*, and B. J. Kim*, "Synthesis and Side Chain Engineering of Phenylnaphthalenediimide (PNDI)-Based n-Type Polymers for Producing Efficient All-Polymer Solar Cells", *J. Mater. Chem. A.* **2017**, 5, 5449–5459, https://doi.org/ 10.1039/C6TA 10978K

19 C. Lee, T. Giridhar, J. Choi, S. Kim, Y. Kim, T. Kim, W. Lee, **Han-Hee Cho**, C. Wang, H. Ade, and B. J. Kim*, "Importance of 2D Conjugated Side Chains of Benzodithiophene-Based Polymers in Controlling Polymer Packing, Interfacial Ordering, and Composition Variations of All-Polymer Solar Cells", *Chem.*

Mater. **2017**, 29, 9407–9415, https://doi.org/10.1021/ acs.chemmater. 7b03495

18 M.-H. Jang, H. Yang, Y. H. Chang, H.-C. Park, H. A. Park, **Han-Hee Cho**, B. J. Kim, Y.-H. Kim, and Y.-H. Cho*, "Selective Engineering of Oxygen-Containing Functional Groups using Alkyl Ligand of Oleylamine for Revealing Luminescence Mechanism of Graphene Oxide Quantum Dots", *Nanoscale* **2017**, 9, 18635–18643, https://doi.org/10.1039/C7NR04150K

17 Y. Kim, **Han-Hee Cho**, T. Kim, K. Liao, and B. J. Kim*, "Terpolymer Approach for Controlling the Crystalline Behavior of Naphthalene Diimide-based Polymer Acceptors and Enhancing the Performance of All-Polymer Solar Cells", *Polymer Journal* **2016**, 48, 517–524, https://doi.org/ 10.1038 /pj.2016.22

16 T. E. Kang, J. Choi, **Han-Hee Cho,** and B. J. Kim*, "Donor-Acceptor Random versus Alternating Copolymers for Efficient Polymer Solar Cells: Importance of Optimal Composition in Random Copolymers", *Macromolecules* **2016**, 49, 2096–2105, https://doi.org/10.1021/acs.macromol.5b 02772

15 J. Lee, H. Yang, C. H. Park, **Han-Hee Cho**, H. Yun, and B. J. Kim*, "Colorimetric Thermometer from Graphene Oxide Platform Integrated with Red, Green, and Blue Emitting, Responsive Block Copolymers", *Chem. Mater.* **2016**, 28, 3446–3453, https://doi.org/10.1021/acs. chemmater.6b00 913

14 H. Yang, K. H. Ku, J. M. Shin, J. Lee, C. H. Park, **Han-Hee Cho**, S. G. Jang, and B. J. Kim*, "Engineering the Shape of Block Copolymer Particles by Surface-Modulated Graphene Quantum Dots", *Chem. Mater*. **2016**, 28, 830–837, https://doi.org/10.1021/acs. chemmater.5b04222

13 **Han-Hee Cho**, H. Yang, D. J. Kang, and B. J. Kim*, "Surface Engineering of Graphene Quantum Dots and Their Applications as Efficient Surfactants", *ACS Appl. Mater. Interfaces* **2015**, 7, 8615–8621, https://doi.org/10.1021/acsami.5b00729

12 **Han-Hee Cho**, C.-H. Cho, H. Kang, H. Yu, J. H. Oh, and B. J. Kim*, "Molecular Structure-Device Performance Relationship in Polymer Solar Cells Based on Indene-C60 Bis-Adduct Derivatives", *Korean J. Chem. Eng.* **2015**, 32, 261–267, https://doi.org/10.1007/s11814-014-0220-2

11 D. J. Kang, **Han-Hee Cho**, I. Lee, K.-H. Kim, H. J. Kim, K. Liao, T.-S. Kim, and B. J. Kim*, "Enhancing Mechanical Properties of Highly Efficient Polymer Solar Cells Using Size-Tuned Polymer Nanoparticles", *ACS Appl. Mater. Interfaces* **2015**, 7, 2668–2676, https://doi.org/10.1021/am507710p

10 C. H. Park, H. Yang, J. Lee, **Han-Hee Cho**, D. Kim, D. C. Lee, and B. J. Kim*, "Multicolor Emitting Block Copolymer-Integrated Graphene Quantum Dots for Colorimetric, Simultaneous Sensing of Temperature, pH, and Metal Ions", *Chem. Mater.* **2015**, 27, 5288–5294, https://doi.org/10.1021/ acs.chemmater.5b01545

9 H. Yang, D. J. Kang, K. H. Ku, **Han-Hee Cho**, C. H. Park, J. Lee, D. C. Lee, P. M. Ajayan, and B. J. Kim*, "Highly Luminescent Polymer Particles Driven by Thermally Reduced Graphene Quantum Dot Surfactants", *ACS Macro Lett.* **2014**, 3, 985–990, https://doi.org/ 10.1021/mz5003855

8 H. Yu†, **Han-Hee Cho**†, C.-H. Cho, K.-H. Kim, D.-Y. Kim, B. J. Kim*, and J. H. Oh*, "Polarity and Air-Stability Transitions in Field-Effect Transistors Based on Fullerenes with Different Solubilizing Groups", *ACS Appl. Mater. Interfaces* **2013**, 5, 4865–4871 ***†Equal contribution***, https://doi.org/10. 1021/am400618r

7 T. E. Kang, **Han-Hee Cho**, H. J. Kim, W. Lee, H. Kang, and B. J. Kim*, "Importance of Optimal Composition in Random Terpolymer Based Polymer Solar Cells", *Macromolecules* **2013**, 46, 6806–6813, https://doi.org/10.1021/ma401274r

6 T. E. Kang, **Han-Hee Cho**, C.-H. Cho, K.-H. Kim, H. Kang, M. Lee, S. Lee, B. S. Kim, C. Im, and B. J. Kim*, "Photo-induced Charge Transfer in a Donor-Acceptor (D-A) Copolymer: Fullerene Bis-adduct Polymer Solar Cells", *ACS Appl. Mater. Interfaces* **2013**, 5, 861–868, https://doi.org /10.1021 /am302479u

5 K.-H. Kim, H. Yu, H. Kang, D. J. Kang, C.-H. Cho, **Han-Hee Cho**, J. H. Oh, and B. J. Kim*, "Influence of

the Intermolecular Interactions of Electron Donating Small Molecules on the Molecular Packing and the Performance of Organic Electronic Devices", *J. Mater. Chem. A* **2013**, 1, 14538–14547, https://doi.org/10.1039/C3TA13266H

4 **Han-Hee Cho**, T. E. Kang, K.-H. Kim, H. Kang, H. J. Kim, and B. J. Kim*, "Effect of Incorporated Nitrogens on the Planarity and Photovoltaic Performance of Donor-Acceptor Copolymers", *Macromolecules* **2012**, 45, 6415−6423, https://doi.org/10.1021/ma301362t

3 H. J. Kim, A.-R. Han, C.-H. Cho, H. Kang, **Han-Hee Cho**, M. Y. Lee, J. M. J. Fréche, J. H. Oh, and B. J. Kim*, "Solvent-Resistant Organic Transistors and Thermally Stable Organic Photovoltaics Based on Cross-linkable Conjugated Polymers", *Chem. Mater.* **2012**, 24, 215–221, https://doi.org/10.1021/cm203058p

2 H. Kang, C.-H. Cho, T. E. Kang, H. J. Kim, K.-H. Kim, **Han-Hee Cho**, S. C. Yoon, and B. J. Kim*, "Controlling Number of Indene Solubilizing Groups in Multiadduct Fullerenes for Tuning Opto-Electronic Properties and Open-Circuit Voltage in Organic Solar Cells", *ACS Appl. Mater. Interfaces* **2012**, 4, 110−116, https://doi.org/10.1021/am201075y

1 C.-H. Cho, H. Kang, T. E. Kang, **Han-Hee Cho**, S. C. Yoon, M.-K. Jeon, B. J. Kim*,"Controlling side-chain density of electron donating polymers for improving their packing structure and photovoltaic performance", *Chem. Commun*. **2011**, 47, 3577−3579, https://doi.org/10.1039/ C1CC10184F

Selected Presentations

13 "Organic semiconductor-based photoelectrodes for Green H_2 Production", 2023 Korea Ceramic Society Conference, *Invited speaker*. Republic of Korea (Oct. 2023)

12 "Organic Photoelectrochemical Cells for Overall Solar Water Splitting", Hybrid Workshop on Organic PEC Devices. *Invited speaker*. Originally in Sweden (Jun. 2023)

11 "A Photoelectrochemical Tandem Cell Based on Organic Semiconductors for Overall Water Splitting", CSW2023, *Invited speaker*. Republic of Korea (Jun. 2023)

10 "Semiconducting Polymers as Promising Materials for Photoelectrochemical Water Splitting", MRS 2021 Fall Meeting. *Oral Presentation*. USA (Dec. 2021)

9 "Incorporation of Electron-Withdrawing Acrylonitrile Group into Naphthalenediimide (NDI)-Based Polymer Acceptor for High-Performance All-Polymer Solar Cells", KPVS (Korea Photovoltaic Society) 2017 Fall Meeting. *Poster Presentation*. Republic of Korea (Oct. 2017)

8 "Incorporation of Acrylonitrile Group into Naphthalenediimide (NDI)-Based Polymer Acceptor for Efficient Charge Generation in High-Performance All-Polymer Solar Cells", 9th Asian Conference on Organic Electronics (A-COE) 2017. *Poster presentation*. Republic of Korea (Oct. 2017)

7 "Controlling Packing Structure of Naphthalenediimide-Based Polymer Acceptors for High-Performance All-Polymer Solar Cells", MRS 2017 Spring Meeting. *Oral Presentation*. USA (Apr. 2017)

6 "Introduction of Cyano Groups to Naphthalenediimide-Based Polymer Acceptors for Achieving High Fill Factor in All-Polymer Solar Cells", GPVC (Global Photovoltaic Conference) 2017 Spring. *Oral Presentation*. Republic of Korea (Mar. 2017)

5 "Design and Optimization of Conjugated Side Chain on Naphthalenediimide-based Polymer Acceptor", MRS 2016 Fall Meeting, *Poster Presentation.* USA (Nov. 2016)

4 "Conjugated Side Chain Engineering of Naphthalenediimide(NDI)-Based *n*-Type Polymer Acceptors for Efficient All-Polymer Solar Cell", IUPAC-PSK40*, Poster Presentation.* Korea (Oct. 2016)

3 "Conjugated Side Chain Engineering of Naphthalenediimide(NDI)-Based *n*-Type Polymers", International Conference of Synthetic Metal 2016 (ICSM 2016), *Poster Presentation.* China (Jun. 2016)

2 "Systematical Preparation of Modified Grapheme Quantum Dot (GQD) with Tunable Surface Property", IUPAC World Polymer Congress – MACRO 2014*, Poster Presentation.* Thailand (Jul. 2014)

1 "Effect of Incorporated Nitrogens on the Planarity and Photovoltaic Performance of Donor-Acceptor

Copolymers", MRS 2012 Fall Meeting, *Poster Presentation*. USA (Nov. 2012)

Patents (Registered)

3 **Han-Hee Cho** and B. J. Kim, "Novel naphthalene diimide based polymers and organic electronic device" (KR101978556)

2 Y. Kim, **Han-Hee Cho**, T. Kim, and B. J. Kim, "Electron accepting polymer of formed random terpolymer, producing method of the same and inverted type polymer solar cells comprising the same" (KR101821971)

1 **Han-Hee Cho** and B. J. Kim, "Conjugated polymer having electron donor and acceptor alternately, organic photoelectric device and organic solar cell comprising the same" (KR101387065)