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Senior Research Scientist

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References: Website, LinkedIn, Google scholar, Researchgate, ORCID

RESEARCH INTERESTS

All-solid-state Li metal batteries having both a long cycle life and a high energy density:

- Design/Development of buffer layers to stabilize the interfaces: CAM/SSE and SSE/Li metal.
- Investigation on the buried interface by using correlative techniques with minimized sample damage.
- Surface manipulation of Li ceramic/thio-phosphate solid-state electrolytes for materials protection.

Correlative analyses on the degradation behaviors of $LiNi_xCo_yMn_zO_2$ (NCM) cathode material:

- Irreversible phase transition behavior induced by cation mixing and lattice strain in NCM materials.
- Characterization of the solid-electrolyte interphase (SEI/CEI) at the surface of cathode active material.
- Correlation study between performance degradation of battery material and process parameters (particle size, coating material, thickness, binder distribution, composite cathode, etc.)

Advanced analyses based on bleeding-edge electron microscopy techniques:

- *In situ* / *operando* studies on the diffusion of charge-carrier (H^+/Li^+/Na^+/K^+, etc.) ions during reactions.
- 4D-STEM analysis and spectrum processing for statistical analysis in a large area at materials interfaces.
- Low e-beam dose / Cryo-EM techniques to minimize the sample damage during the observation.
- STEM / FIB tomography of the environment sensitive materials and their data processing.
- ML / Automation on the EM analysis process (Sample prep–Transfer–Acquisition–Processing–Report).

Understanding of synthesis reaction mechanism on the energy storage materials

- Exploration of the preferrable reaction pathway to reduce the production costs.
- Unraveling the synthesis reaction mechanisms how the conditions control the formation of products.

EDUCATION

09/2013 – 02/2020 **Korea University** Seoul, Korea
Ph.D. in Materials Science and Engineering.

Thesis title: Studies of sodiation behaviors in Sn anodes using *in situ* electron microscopy
(Advisor: Prof. Jae-Chul Lee)

03/2007 – 08/2013 **Korea University** Seoul, Korea
B.S. in Materials Science and Engineering.

WORK EXPERIENCES

11/2023 – present ***Senior Research Scientist*** Seoul, Korea

Head of the TEM group, Advanced Analysis and Data Center,
Korea Institute of Science and Technology (KIST)

- Developing advanced EM techniques for energy storage materials applications.
- Investigations on the materials/interfacial degradation behaviors (e.g.: solid-state electrolytes and composite electrodes)

03/2020 – 10/2023 ***Postdoctoral Research Scholar*** Berkeley, CA, USA
(Principal Investigators: Dr. Haegyeom Kim and Dr. Peter Ercius)

Materials Sciences Division, Lawrence Berkeley National Laboratory (LBNL)

- Investigated the buried interphases between a solid-state electrolyte and a metal anode, based on the one of the most advanced TEM in the world: TEAM I in NCEM LBNL.
- Developed an airtight sample transfer system to characterize air-sensitive materials.
- 3-dimensional STEM/FIB tomography on the bio-nanomaterials using diatom frustules.
- Systematically synthesized and characterized on the high-performance oxide catalyst support materials for PEMFC applications.

05/2013 – 02/2020 ***Research Assistant*** Seoul, Korea
(Principal Investigator: Dr. Jae-Pyoung Ahn)

Electron Microscopy Team, Advanced Analysis Center, KIST

- Developed an airtight sample transfer system to characterize air-sensitive materials.
- Pioneered the correlative analysis of battery electrode materials by using various analytical instruments (XRD, XPS, SEM, TEM, EDS, EELS, and APT).
- Observed the formation and growth behavior of SEI layer during fast charging/discharging.

03/2014 – 12/2017 ***Teaching Assistant*** Seoul, Korea
Department of Materials Science and Engineering, Korea University

- *Course Offering*: Engineering Mathematics II (2017); Mechanical Properties of Materials (2015); Metallic Material Processing (2014); Engineering Mathematics I (2014)

03/2009 – 04/2011 ***Sergeant*** *(honorable discharged)* Jinju, Korea
Education & Training Command, Republic of Korea Air Force

- Produced e-learning contents for aircraft maintenance and air-traffic control

SERVICE and OUTREACH EXPERIENCES

- **Editorial Director**, Korean Society of Microscopy 2024 – Present
- **Member**, Electrochemical Society 2022 – Present
- **Member**, Materials Research Society 2018 – Present
- **Member**, Korean Society of Metals and Materials 2014 – Present
- **Member**, Korean Society of Microscopy 2014 – Present
- **Member**, Korean American Scientists and Engineers Association (KSEA) 2020 – 2023
- **President**, KSEA Berkeley Local Chapter 2021 – 2023
- **Journal Reviewer**, *Materials Today Energy, Electrochimica Acta, ACS Applied Materials & Interfaces, Applied Sciences, Materials, IJMS, Molecules, Batteries, Energies*

PATENTS

[1] Shape-controlled multi-pod nanowire structure for direct methanol fuel cell application and preparation method thereof, *KR Patent: 1014211040000* (2014)

AWARDS AND HONORS

2019.10.29 **Best Poster Award**, 2019 Fall conf. of Korean Institute of Metals and Materials (KIM), Daegu, Korea
2019.01.31 **Best Student Researcher Award**, Korea Institute of Science and Technology (KIST)
2018.11.29 **Best Poster Award**, 2018 MRS Fall Meeting, Boston, MA, USA
2018.06.22 **Best Poster Award**, 2018 Spring conf. of Korean Society of Microscopy, Jeju, Korea
2017.10.27 **Best Poster Award**, 2017 Fall conf. of KIM, Daegu, Korea
2016.05.13 **Excellence Paper Award**, 2016 Spring conf. of Korean Battery Society, Seoul, Korea
2016.04.29 **Best Poster Award**, 2016 Spring conf. of KIM, Gyungju, Korea
2015.10.30 **Best Poster Award**, 2015 Fall conf. of KIM, Daejeon, Korea
2015.04.24 **Best Poster Award**, 2015 Spring conf. of KIM, Changwon, Korea
2014.10.24 **Best Poster Award**, 2014 Fall conf. of KIM, Jeongseon, Korea
2012.02.02 **Best Paper Award**, 4th Internship papers competition for undergraduates, Korea University

2022.04.14 **Networking of Next-generation Leaders in Science and Technology (2022)**, KOFST
2017.12.20 **Industrial Scholarship (2018-2019)**, LG Chem
2014.05.07 **Korea Technocomplex Scholarship (2014)**, Korea University
2012.02.24 **Undergraduate Scholarship (2012-2013)**, Haedong Foundation for Science and Culture

SELECTED RESEARCH PROJECTS

- *"Solid state batteries with long cycle life and high energy density through materials design and integration"* DOE/EERE/VTO Lab call, USA **(FY2022-23)**
- *"Understanding performance degradation of Li-cathode materials"* Rivian Automotive, Inc., USA **(FY2023)**
- *"High-Conductivity Ceramic Catalyst Supports for PEMFC"* Robert Bosch Corporation, USA **(FY2020-22)**
- *"Designer bio-nanomaterials using diatom frustules"* Laboratory Directed Research and Development Program of LBNL under U.S. DOE Contract (**FY2021-23**)
- *"Investigation of buried interphases between a solid-state electrolyte and a metal anode"* Laboratory Directed Research and Development Program of LBNL under U.S. DOE Contract **(FY2020-21)**
- *"Advanced characterization and mechanism clarification for designing the fast chargeable and high-power batteries"* Samsung Research Funding & Incubation Center for Future Technology, Korea **(2016-19)**
- *"Development of characterization techniques of cell and material of Li-ion all solid-state batteries"* Hyundai Motor Company, Korea **(2017-19)**
- "*Development of all solid-state battery technology based on NCM cathode / solid electrolyte design*" Ministry of Science and ICT, National Research Foundation of Korea **(2017-19)**

JOURNAL PUBLICATIONS

*You can also see the list at Google scholar, Researchgate, and ORCID († equal contribution, * corresponding author)*

◦ *In preparation (papers participated as the first author only)*

[-] **Young-Woon Byeon**, Hong-Kyu Kim, Hyun-Jeong Lee, Ji Yeong Lee, Hyung Cheoul Shim*, and Jae-Pyoung Ahn* "Understanding the Degradation Mechanism of $LiNi_{1/3}Co_{1/3}Mn_{1/3}O_2$ Cathode Material in Lithium-ion Batteries", *In preparation*, (Expected in 2024).

[-] **Young-Woon Byeon**, Hyun-Jeong Lee, Hong-Kyu Kim, So-Hee Kim, Hae-Ryung Kim, and Jae-Pyoung Ahn* "Understanding the Degradation Mechanism of NMC Cathode Material in All-solid-state Li metal Batteries", *In preparation*, (Expected in 2024).

◦ *In progress (submitted / under review / under revision / in press)*

[-] Young-Woon Byeon et al., "Manuscript A", under embargo, (2024)

◦ *Published* (First author on 13 papers out of 28 total publications)

[28] **Young-Woon Byeon**†, Shirin Mehrazi†, Björn M. Stühmeier, Venkata Sai Avvaru, Dong-min Kim, Lei Cheng*, and Haegyeom Kim*, "Inverse Consequences of the SnO_2 Protection Layers on Pt/C catalysts in Proton Exchange Membrane Fuel Cells", ***Energy & Fuels***, Article ASAP, (2024). Link

[27] Nathan J. Szymanski, **Young-Woon Byeon**, Yingzhi Sun, Yan Zeng, Jianming Bai, Martin Kunz, Dong-Min Kim, Brett A. Helms, Christopher J. Bartel, Haegyeom Kim*, and Gerbrand Ceder* "Quantifying the regime of thermodynamic control for solid-state reactions during ternary metal oxide synthesis", ***Science Advances***, vol.10, pp.1-11 (2024). Link

[26] Youngmin Ko, Michael A. Baird, Xinxing Peng, Tofunmi Ogunfunmi, **Young-Woon Byeon**, Liana M. Klivansky, Haegyeom Kim, Mary Scott, Brett A. Helms* "Omics-enabled understanding of electric aircraft battery electrolytes", ***Joule***, vol.8, pp.1-19 (2024). Link

[25] **Young-Woon Byeon**†, Sizhuo Yang†, Guang Yang, Dong-Min Kim, Venkata Sai Avvaru, Tofunmi Ogunfunmi, Mary Scott, Brett Helms, Jeffrey J. Urban*, Haegyeom Kim* "Conductive carbon embedded beneath cathode active material for longevity of solid-state batteries", ***Journal of Materials Chemistry A***, vol.12, pp.8359-8369 (2024). Link

[24] Zheren Wang, Yingzhi Sun, Kevin Cruse, Yan Zeng, Yuxing Fei, Zexuan Liu, Junyi Shangguan, **Young-Woon Byeon**, KyuJung Jun, Tanjin He, Wenhao Sun, Gerbrand Ceder*, "Optimal Thermodynamic Conditions to Minimize Kinetic Byproducts in Aqueous Materials Synthesis", ***Nature Synthesis,*** pp.1-10 (2024). Link

[23] Sung-Yeob Kim, Hee-Jae Ahn, Hyun-Min Lee, Son-Jae Sim, Young-Hoon Kim, Hong-Kyu Kim, **Young-Woon Byeon**, Jae-Chul Lee*, "Self-Healing CuS Anodes with Conversion Reaction for Ultrafast Na-ion Storage", ***Journal of Materials Chemistry A***, vol.11, pp.21972-21982 (2023). Link

[22] Haeseong Jang, Ivana Hasa, Hyunchul Kim, Yoon Hwa, **Young-Woon Byeon**, Robert Kostecki*, Haegyeom Kim*, "Exploring the storage mechanism of alkali ions in non-graphitic hard carbon anodes", ***Journal of the Electrochemical Society***, vol.170, no.9, pp,090538 (2023). Link

[21] Piyachai Khomein†, **Young-Woon Byeon**†, Dongye Liu, Jin Yu, Andrew M. Minor, Haegyeom Kim*, Gao Liu*, "Lithium Phosphorus Sulfide Chloride-Polymer Composite via Solution-Precipitation Process for Improving Stability Toward Dendrite Formation of Li-Ion Solid Electrolyte", ***ACS Applied Materials & Interfaces***, vol.15, no.9, pp.11723-11730, (2023). Link

[20] **Young-Woon Byeon**, Min-Jeong Gong, Zijian Cai, Yingzhi Sun, Nathan J. Szymanski, Jianming Bai, Dong-Hwa Seo, Haegyeom Kim*, "Effects of Cation and Anion Substitution in $KVPO_4F$ for K-ion Batteries", ***Energy Storage Materials***, vol.57, pp.81-91 (2023). Link

[19] Kyu-Joon Lee†, **Young-Woon Byeon**†, Hyun-Jeong Lee†, Ye-Bin Lee, Soohyung Park, Hye-Ryung Kim, Hong-Kyu Kim, Soong Ju Oh, and Jae-Pyoung Ahn*, "Crack-healing Mechanism of NCM Composite Cathode for Sustainable Cyclability of Sulfide-based Solid Batteries", ***Energy Storage Materials***, vol.57, pp.326-333 (2023). Link

[18] Yan Zeng, Bin Ouyang, Jue Liu, **Young-Woon Byeon**, Lincoln Miara, Yan Wang, Gerbrand Ceder*, "High-entropy mechanism to boost ionic conductivity", ***Science***, vol.378, no.6626, pp.1273-1274 (2022). Link

[FEATURED IN THE NEWS ARTICLE : LBNL]

[17] Liliang Huang, Peichen Zhong, Yang Ha, Zijian Cai, Fengyu Xie, **Young-Woon Byeon**, Tzu-Yang Huang, Yingzhi Sun, Han-Ming Hau, Haegyeom Kim, Mahalingam Balasubramanian, Bryan D. McCloskey, Wanli Yang, and Gerbrand Ceder*, "Optimizing Li-Excess Cation-Disordered Rocksalt Cathode Design through Partial Li Deficiency", ***Advanced Energy Materials***, 2202345 (2022). Link

[16] **Young-Woon Byeon**, Jonathan P. Mailoa, Mordechai Kornbluth, Gihyeok Lee, Zijian Cai, Yingzhi Sun, Wanli Yang, Christina Johnston, Jake Christensen, Soo Kim*, Lei Cheng* and Haegyeom Kim* "Electronic Structure Manipulation by Composition Tuning for the Development of High Conductive and Acidic-stable Oxides", ***Journal of Materials Chemistry A***, vol.10, pp.23155-23164 (2022). Link

[FEATURED AS A HOT PAPERS COLLECTION IN THE JOURNAL]

[15] Hyun-Jeong Lee, Jong-Seok Moon, **Young-Woon Byeon**, Woo Young Yoon, Hong-Kyu Kim*, and Jae-Pyoung Ahn* "Lithiation Pathway Mechanism of Si-C Composite Anode Revealed by the Role of Nanopore using in-situ Lithiation", ***ACS Energy Letters***, vol.7, pp.2469-2476, (2022). Link

[FEATURED IN THE NEWS ARTICLES: #1_EurekAlert! / #2_Newswise]

[14] Haegyeom Kim*, **Young-Woon Byeon**, Jingyang Wang, Yaqian Zhang, Mary C. Scott, "Understanding of Electrochemical K^+/Na^+ Exchange Mechanisms in Layered Oxides", ***Energy Storage Materials***, vol.47, pp.105-112 (2022). Link

[13] Jae-Hwan Kim, Young-Hwan Lee, Jun-Hyoung Park, Byeong-Joo Lee, **Young-Woon Byeon**, Jae-Chul Lee*, "Ultrafast Na Transport into Crystalline Sn via Dislocation-Pipe Diffusion for Rapid Battery Charging", ***Small***, 2104944 (2021). Link

[12] Jun-Hyoung Park, Yong-Seok Choi, ChangHyeon Kim, **Young-Woon Byeon**, Yongmin Lee, Byeong-Joo Lee, Jae-Pyoung Ahn, Hyojun Ahn, Jae-Chul Lee*, "Self-Assembly of Pulverized Nanoparticles: An Approach to Realize Large-Capacity, Long-Lasting, and Ultra-Fast-Chargeable Na-Ion Batteries", ***Nano Letters***, vol.21, no.3, pp.9044-9051 (2021). Link

[11] **Young-Woon Byeon**, Haegyeom Kim*, "Review on Interface and Interphase Issues in Sulfide Solid-State Electrolytes for All-Solid-State Li-Metal Batteries", ***Electrochem***, vol.2, no.3, pp.452-471 (2021). Link
[FEATURED AS A COVER STORY OF THE JOURNAL]

[10] **Young-Woon Byeon**, Jae-Pyoung Ahn, and Jae-Chul Lee*, "Diffusion along Dislocations Mitigates Self-limiting Na Diffusion in Crystalline Sn", ***Small***, 2004868 (2020). Link

[9] Jun-Hyoung Park, Yong-Seok Choi, **Young-Woon Byeon**, Jae-Pyoung Ahn, and Jae-Chul Lee*, "Diffusion Kinetics Governing the Diffusivity and Diffusional Anisotropy of Alloying Anodes in Na-ion Batteries", ***Nano Energy***, vol.65, 104041 (2019). Link

[8] **Young-Woon Byeon**†, Yong-Seok Choi†, Jae-Pyoung Ahn, and Jae-Chul Lee*, "Isotropic Sodiation Behavior of Ultrafast-chargeable Sn Crystals", ***ACS Applied Materials & Interfaces***, vol.10, no.48, pp.41389-41397 (2018). Link

[7] Yong-Seok Choi, **Young-Woon Byeon**, Jae-Pyoung Ahn, and Jae-Chul Lee*, "Evaluation of Energy Loss at Sn Anodes based on Phase Transition Behaviors and Formation of Electrically Resistive Phases of Na-Sn Batteries", ***Journal of Materials Chemistry A***, vol.6, no.20, pp.9428-9436 (2018). Link

[6] Yong-Seok Choi†, **Young-Woon Byeon**†, Jun-Hyoung Park, Jong-Hyun Seo, Jae-Pyoung Ahn, and Jae-Chul Lee*, "Ultrafast Sodiation of Single-Crystalline Sn Anodes", ***ACS Applied Materials & Interfaces***, vol.10, no.1, pp.560-568 (2017). Link

[5] **Young-Woon Byeon**†, Yong-Seok Choi†, Jae-Pyoung Ahn, and Jae-Chul Lee*, "Origin of High Coulombic Loss During Sodiation in Na-Sn Battery", ***Journal of Power Sources***, vol.343, pp.513–519 (2017). Link

[4] Yong-Seok Choi†, **Young-Woon Byeon**†, Jae-Pyoung Ahn, and Jae-Chul Lee*, "Formation of Zintl Ions and Their Configurational Change during Sodiation in Na–Sn Battery", ***Nano Letters***, vol.17, no.2, pp.679–686 (2017). Link

[3] Jung Sub Kim, A-Young Kim, **Young-Woon Byeon**, Jae-Pyoung Ahn, Dongjin Byun, and Joong Kee Lee*, "Porous Zn_2GeO_4 Nanowires with Uniform Carbon-Buffer Layer for Lithium-Ion Battery Anodes with Long Cycle Life", ***Electrochimica Acta***, vol.195, pp.43–50 (2016). Link

[2] **Young-Woon Byeon**, Yong-Seok Choi, Jong-Hyun Seo, Ka-Hyun Hur, Jae-Pyoung Ahn, and Jae-Chul Lee*, "A Simple Method of Analyzing the Phase Transition Behavior of a Na-Sn Battery Using Energy-Dispersive X-Ray Spectroscopy", ***Korean Journal of Metals and Materials***, vol.53, no.12, pp.926–930 (2015). Link

[1] Jin-Woo Cho, Sung-Hoon Kim, **Young-Woon Byeon**, Ji Yeong Lee, Jae-Pyoung Ahn*, "Next-Generation Analysis Technologies of Nano materials: Based on Electron Microscopy", ***Trends in Metals and Materials Engineering***, vol.28, pp.26-43 (2015). Link