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Engineering & Scientific Consulting

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Professional Profile

Dr. Lee specializes in engineering of energy storage materials through data-driven methods, supporting the development of software for advanced embedded prognostic and diagnostic solutions. By leveraging his understanding of the fundamental principles of material sciences and data sciences, Dr. Lee applies machine learning (ML) to generate estimates of key battery life parameters, including state of charge (SOC), state of health (SOH), and remaining useful life (RUL).

Dr. Lee has extensive experience implementing a wide range of ML methods, including artificial neural networks (ANN), recurrent neural networks (RNN), convolutional neural networks (CNN), and physics-informed neural networks (PINN). His expertise includes data modeling and estimation techniques such as particle filters, Monte Carlo methods, and Bayesian optimization. Dr. Lee frequently works with battery reduced-order models for simulation and estimation of battery states and parameters. Additionally, he is proficient at characterizing battery materials using techniques like scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDS), transmission electron microscopy (TEM), and X-ray diffraction (XRD). His skillset also includes a variety of electrochemical characterization techniques, including standard battery cycling and testing, cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), and Galvanostatic Intermittent Titration Technique (GITT).

Prior to joining Exponent, Dr. Lee was a battery engineer in the Mobile eXperience (MX) division of Samsung Electronics Co. Ltd.; his responsibilities covered the development and maintenance of on-device battery SOH estimation algorithm, on-device battery failure detection, and data-driven early assessment of long-term cycle lives of battery cells. Before working in industry, he made academic contributions in the field of third-generation photovoltaics and next-generation battery materials during his doctorate study in Seoul National University, South Korea.

Academic Credentials & Professional Honors

Ph.D., Materials Science and Engineering, Seoul National University, Korea, 2019

B.S., Materials Science and Engineering, Seoul National University, Korea, 2013

Prior Experience

Staff Engineer, Global Technology Research (GTR), Samsung Electronics Co. Ltd., May 2024 to October 2024

Staff Engineer, Mobile eXperience (MX) Business, Samsung Electronics Co. Ltd., Mar 2019 to October 2024

Professional Affiliations

Institute of Electrical and Electronics Engineers (IEEE), 2025-Current

The Electrochemical Society (ECS), 2025-Current

Patents

US Patent App. No. 18/327395, Method and Electronic Devices for Forecasting Remaining Useful Life (RUL) of Battery, Jan 2024 (Sahoo S, Hariharan KS, Agarwal S, Brahmadathan SS, Lee S)

US Patent App. No. 18/347880, Electronic Apparatus and Controlling Method Thereof, Dec 2023 (Yadu A, Brahmadathan SS, Agarwal S, Hariharan KS, Han S, Lee S)

US Patent App. No. 18/507825, Method and Electronic Device for Charging Battery, Nov 2023 (Lee S, Kim Y)

US Patent App. No. 18/296618, Systems and Methods for Intelligent Management of a Battery, Aug 2023 (Agarwal S, Lee S. Hariharan KS, Han S, Bharti R, Yadu A)

US Patent App. No. 18/094621, Method for Controlling Current Ratio Between Multiple Battery Cells Connected in Parallel, and Control System Therefor, Jan 2023 (Lee S)

US Patent 11533005, Electornic Devices with Structure for Harvesting Energy, Dec 2022 (Lee S, An S, Oh B, Lee J)

Publications

On-Device Personalized Charging Strategy With an Aging Model for Lithium-Ion Batteries Using Deep Reinforcement Learning Ankit Yadu, Subramanian B. Swernath, Samarth Agarwal, D. B. Sreevatsa, Sangheon Lee, and Youngju Kim IEEE Transactions on Automation Science and Engineering, 1-11 (2023) DOI: 10.1109/TASE.2023.3307168

Transfer Learning Based Generalized Framework for State of Health Estimation for Li-Ion Cells Subhasmita Sahoo,* Krishnan S. Hariharan, Samarth Agarwal, Subramanian B. Swernath, Roshan Bharti, Seongho Han, and Sangheon Lee Scientific Reports 12, 13173 (2022) DOI: 10.1038/s41598-022-16692-

Effects of Photochemical Oxidation of the Carbonaceous Additives on Li-S Cell Performance Jungjin Park, Joonhee Moon, Kookhan Kim, Vitalii Ri, Sangheon Lee, Byung Hee Hong, Yung-Eun Sung, Chunjoong Kim,* and Elton J. Cairns* ACS Applied Materials & Interfaces 13(35), 41517-41523 (2021) DOI: 10.1021/acsami.1c07452

Diagnosing Various Failures of Lithium-Ion Batteries using Artificial Neural Network Enhanced by Likelihood Mapping Sangheon Lee,* Seongho Han, Kyoung Hwan Han, Youngju Kim, Samarth Agarwal, Krishnan S. Hariharan, Bookeun Oh, and Jongmoon Yoon* Journal of Energy Storage 40, 102768 (2021) DOI: 10.1016/j.est.2021.102768

Nitrogen-Doped Graphene Quantum Dots: Sulfiphilic Additives for the High-Performance Li-S Cells Jungjin Park, Joonhee Moon, Vitalii Ri, Sangheon Lee, Chunjoong Kim,* and Elton J. Cairns* ACS Applied Energy Materials 4(4), 3518-3525 (2021) DOI: 10.1021/acsaem.0c03247

Efficient Type-II Heterojunction Nanorod Sensitized Solar Cells Realized by Controlled Synthesis of Core/Patchy Shell Structure and CdS Cosensitization Sangheon Lee,+ Joseph C. Flanagan,+ Jaewook Kim, Alan Jiwan Yun, Byungho Lee, Moonsub Shim,* and Byungwoo Park* ACS Applied Materials & Interfaces 11(21), 19104-19114 (2019) DOI: 10.1021/acsami.9b02873

Microstructural Evolution of Hybrid Perovskites Promoted by Chlorine and Its Impact on the Performance of Solar Cell Byungho Lee, Taehyun Hwang, Sangheon Lee, Byungha Shin,* and Byungwoo Park* Scientific Reports 9, 4803 (2019) DOI: 10.1038/s41598-019-41328-

An Aromatic Diamine Molecule as the A-Site Solute for Highly Durable and Efficient Perovskite Solar Cells Jinhyun Kim, Taehyun Hwang, Byungho Lee, Sangheon Lee, Kimin Park, Helen Hejin Park, and Byungwoo Park* Small Methods 3(1), 1800361 (2019) DOI: 10.1002/smtd.201800361

From Nanostructural Evolution to Dynamic Interplay of Constituents: Perspectives for Perovskite Solar Cells Taehyun Hwang,+ Byungho Lee,+ Jinhyun Kim,+ Sangheon Lee,+ Bumjin Gil, Alan Jiwan Yun, and Byungwoo Park* Advanced Materials 30(42), 1704208 (2018) DOI: 10.1002/adma.20174208

Selective Rear Contact for Ga0.5In0.5P- and GaAs-Based Solar Cells Sun-Tae Hwang, Taehyun Hwang, Sangheon Lee, Bumjin Gil, and Byungwoo Park* Solar Energy Materials and Solar Cells 182, 348-353 (2018) DOI: 10.1016/solmat.2018.03.037

Optimum Morphology of Mixed-Olivine Mesocrystals for a Li-Ion Battery Kimin Park, Jaewon Kim, Sungun Wi, Sangheon Lee, Taehyun Hwang, Jaewook Kim, Joonhyeon Kang, Joon-Phil Choi, Seunghoon Nam,* and Byungwoo Park* Inorganic Chemistry 57(10), 5999-6009 (2018) DOI: 10.1021/acs.inorgchem.8b00501

Complementary Surface Modification by Disordered Carbon and Reduced Graphene Oxide on SnO2 Hollow Spheres as an Anoe for Li-Ion Battery Hyungsub Woo, Sungun Wi, Jaewon Kim, Jinhyun Kim, Sangheon Lee, Taehyun Hwang, Joonhyeon Kang, Jaewook Kim, Kimin Park, Bumjin Gil, Seunghoon Nam,* and Byungwoo Park* Carbon 129, 342-348 (2018) DOI: 10.1016/j.carbon.2017.12.015

Tailoring the Mesoscopic TiO2 Layer: Concomitant Parameters for Enabling High-Performance Perovskite Solar Cells Taehyun Hwang,+ Sangheon Lee,+ Jinhyun Kim, Jaewon Kim, Chunjoong Kim, Byungha Shin, and Byungwoo Park* Nanoscale Research Letters 12, 57 (2017) DOI: 10.1186/s11671-016-1809-7

Synergetic Effect of Double-Step Blocking Layer for the Perovskite Solar Cell Jinhyun Kim, Taehyun Hwang, Sangheon Lee, Byungho Lee, Jaewon Kim, Jaewook Kim, Bumjin Gil, and Byungwoo Park* Journal of Applied Physics 122(14), 145106 (2017) DOI: 10.1063/1.4991633

Breathable Carbon-Free Electrode: Black TiO2 with Hierarchically Ordered Porous Structure for Stable Li-O2 Battery Joonhyeon Kang, Jinyoung Kim, Sangheon Lee, Sungun Wi, Chunjoong Kim, Seungmin Hyun, Seunghoon Nam,* Yongjoon Park,* and Byungwoo Park* Advanced Energy Materials 7(19), 1700814 (2017) DOI: 10.1002/aenm.201700814

Route to Improving Photovoltaics Based on CdSe/CdSexTe1-x Type-II Heterojunction Nanorods: The Effect of Morphology and Cosensitization on Carrier Recombination and Transport Sangheon Lee,+ Joseph C. Flanagan,+ Byungho Lee, Taehyun Hwang, Jaewook Kim, Bumjin Gil, Moonsub Shim,* and Byungwoo Park* ACS Applied Materials & Interfaces 9(37), 31931-31939 (2017) DOI: 10.1021/acsami.7b09745

Insights on the Delithiation/Lithiation Reactions of LixMn0.8Fe0.2PO4 Mesocrystals in Li+ Batteries by in situ Techniques Sungun Wi,+ Jungjin Park,+ Sangheon Lee,+ Jaewon Kim, Bumjin Gil, Alan Jiwan Yun, Yung-Eun Sung,* Byungwoo Park,* and Chunjoong Kim* Nano Energy 39, 371-379 (2017) DOI: 10.1016/j.nanoen.2017.07.016

Single-Layer Graphene-Wrapped Li4Ti5O12 Anode with Superior Lithium Storage Capability Jaewon Kim,+ Kyung Eun Lee,+ Kyung Hwan Kim, Sungun Wi, Sangheon Lee, Seunghoon Nam, Chunjoong Kim,* Sang Ouk Kim,* and Byungwoo Park* Carbon 114, 275-283 (2017) DOI: 10.1016/j.carbon.2016.12.022

Synchrotron-Based X-Ray Absorption Spectroscopy for the Electronic Structure of LixMn0.8Fe0.2PO4 Mesocrystal in Li+ Batteries Sungun Wi,+ Jungjin Park,+ Sangheon Lee, Joonhyeon Kang, Taehyun Hwang, Kug-Seung Lee, Han-Koo Lee, Seunghoon Nam, Chunjoong Kim,* Yung-Eun Sung,* and Byungwoo Park* Nano Energy 31, 495-503 (2017) DOI: 10.1016/j.nanoen.2016.11.044

Evaluating the Optoelectronic Quality of Hybrid Perovskites by Conductive Atomic Force Microscopy with Noise Spectroscopy Byungho Lee, Sangheon Lee, Duckhyung Cho, Jinhyun Kim, Taehyun Hwang, Kyung Hwan Kim, Seunghoon Hong,* Taeho Moon,* and Byungwoo Park* ACS Applied Materials & Interfaces 8(45), 30985-30991 (2016) DOI: 10.1021/acsami.6b11011

Synthesis of LixMn0.8Fe0.2PO4 Mesocrystals for High-Performance Li-Ion Chatode Materials Sungun Wi, Jaewon Kim, Sangheon Lee, Joonhyeon Kang, Kimin Park, Kunsu Kim, Seunghoon Nam,* Chunjoong Kim,* and Byungwoo Park* Electrochimica Acta 216, 203-210 (2016) DOI: 10.1016/j.electacta.2016.09.005

Bandgap Grading and Al0.3Ga0.7As Heterojunction Emitter for Highly Efficient GaAs-Based Solar Cells Sun-Tae Hwang, Soohyun Kim, Hyeunseok Cheun, Hyun Lee, Byungho Lee, Taehyun Hwang, Sangheon Lee, Wonki Yoon, Heon-Min Lee, and Byungwoo Park* Solar Energy Materials and Solar Cells 155, 264-272 (2016) DOI: 10.1016/j.solmat.2016.06.009

Investigation of Chlorine-Mediated Microstructural Evolution of CH3NH3PbI3(Cl) Grains for High Optoelectronic Responses Taehyun Hwang, Duckhyung Cho, Jinhyun Kim, Jaewon Kim, Sangheon Lee, Byungho Lee, Kyung Hwan Kim, Seunghoon Hong, Chunjoong Kim, and Byungwoo Park* Nano Energy 25, 91-99 (2016) DOI: 10.1016/j.nanoen.2016.04.044

Solvent and Intermediate Phase as Boosters for the Perovskite Transformation and Solar Cell Performance Jinhyun Kim, Taehyun Hwang, Sangheon Lee, Byungho Lee, Jaewon Kim, Gil Su Jang, Seunghoon Nam, and Byungwoo Park* Scientific Reports 6, 25648 (2016) DOI: 10.1038/srep2564

Evaluation of Graphene-Wrapped LiFePO4 as Novel Cathode Materials for Li-Ion Batteries Sungun Wi,+ Jaewon Kim,+ Kimin Park,+ Sangheon Lee, Joonhyeon Kang, Kyung Hwan Kim, Seunghoon Nam,* Chunjoong Kim,* and Byungwoo Park* RSC Advances 6, 105081-105086 (2016) DOI: 10.1039/C6RA24514E

Integration of CdSe/CdSexTe1-x Type-II Heterojunction Nanorods into Hierarchically Porous TiO2 Electrode for Efficient Solar Energy Conversion Sangheon Lee,+ Joseph C. Flanagan,+ Joonhyeon Kang, Jinhyun Kim, Moonsub Shim,* and Byungwoo Park* Scientific Reports 5, 17472 (2015) DOI: 10.1038/srep17472

Reduced Graphene Oxide/Carbon Double-Coated 3-D Porous ZnO Aggregates as High-Performance Li-Ion Anode Materials Sungun Wi,+ Hyungsub Woo,+ Sangheon Lee, Joonhyeon Kang, Jaewon Kim, Subin An, Chohui Kim, Seunghoon Nam, Chunjoong Kim, and Byungwoo Park* Nanoscale Research Letters 10, 204 (2015) DOI: 10.1186/s11671-015-0902-

Nanoroughness Control of Al-Doped ZnO for High Efficiency Si Thin-Film Solar Cells Seung-Yoon Lee, Taehyun Hwang, Sangheon Lee, Woojin Lee, Byungho Lee, Jinhyun Kim, Soohyun Kim, Hyun Lee, Heon-Min Lee, and Byungwoo Park* Current Applied Physics 15(11), 1353-1357 (2015) DOI: 10.1016/j.cap.2015.07.024

Organic-Acid Texturing of Transparent Electrodes toward Broadband Light Trapping in Thin-Film Solar Cells Woojin Lee, Taehyun Hwang, Sangheon Lee, Seung-Yoon Lee, Joonhyeon Kang, Byungho Lee, Jinhyun Kim, Taeho Moon,* and Byungwoo Park* Nano Energy 17, 180-186 (2015) DOI: 10.1016/j.nanoen.2015.08.015

Wrapping SnO2 with Porosity-Tuned Graphene as a Strategy for High-Rate Performance in Lithium

Battery Anodes Seunghoon Nam, Seung Jae Yang, Sangheon Lee, Jaewon Kim, Joonhyeon Kang, Jun Young Oh, Chong Rae Park, Taeho Moon,* Kyu Tae Lee,* and Byungwoo Park* Carbon 85, 289-298 (2015) DOI: 10.1016/j.carbon.2015.01.005

The Construction of Tandem Dye-Sensitized Solar Cells from Chemically-Derived Nanoporous Photoelectrodes Hongsik Choi, Taehyun Hwang, Sangheon Lee, Seunghoon Nam, Joonhyeon Kang, Byungho Lee, and Byungwoo Park* Journal of Power Sources 274, 937-942 (2015) DOI: 10.1016/j.jpowsour.2014.10.12

Oxygen-Controlled Seed Layer in DC Sputter-Deposited ZnO:Al Substrate for Si Thin-Film Solar Cells Seung-Yoon Lee, Taehyun Hwang, Woojin Lee, Sangheon Lee, Hongsik Choi, Seh-Won Ahn, Heon-Min Lee, and Byungwoo Park* IEEE Journal of Photovoltaics 5(2), 473-478 (2014) DOI: 10.1016/JPHOTOV.2014.2376052

Improving Scattering Layer through Mixture of Nanoporous Spheres and Nanoparticles in ZnO-Based Dye-Sensitized Solar Cells Chohui Kim, Hongsik Choi, Jae Ik Kim, Sangheon Lee, Jinhyun Kim, Woojin Lee, Taehyun Hwang, Suji Kang, Taeho Moon,* and Byungwoo Park* Nanoscale Research Letters 9, 295 (2014) DOI: 10.1186/1556-276X-9-295

Oriented Hierarchical Porous TiO2 Nanowires on Ti Substrate: Evolution of Nanostructures for Dye-Sensitized Solar Cells Byungho Lee,+ Jae Ik Kim,+ Sangheon Lee, Taehyun Hwang, Seunghoon Nam, Hongsik Choi, Kunsu Kim, Jaewon Kim, and Byungwoo Park* Electrochimica Acta 145, 231-236 (2014) DOI: 10.1016/j.electacta.2014.09.015

Enhanced Rate Capability of LiMn0.9Mg0.1PO4 Nanoplates by Reduced Graphene Oxide/Carbon Double Coating for Li-Ion Batteries Sungun Wi, Jaewon Kim, Seunghoon Nam, Joonhyeon Kang, Sangheon Lee, Hyungsub Woo, Moosang Lee, Chong Ho Sonu, Taeho Moon,* and Byungwoo Park* Current Applied Physics 14(5), 725-730 (2014) DOI: 10.1016/j.cap.2014.03.00

Effective Wrapping of Graphene on Individual Li4Ti5O12 Grains for High-Rate Li-Ion Batteries Yuhong Oh,+ Seunghoon Nam,+ Sungun Wi, Joonhyeon Kang, Taehyun Hwang, Sangheon Lee, Helen Hejin Park, Jordi Cabana, Chunjoong Kim,* and Byungwoo Park* Journal of Materials Chemistry A 2, 2023-2027 (2014) DOI: 10.1039/C3TA14347C

Presentations

S. Lee, J. C. Flanagan, J. Kang, J.Kim, M. Shim, and B. Park “Integration of II-VI Nanorods in Sensitized Photovoltaics via Open-Structured Photoanode and Co-Sensitization Strategy” Materials Research Society (MRS) Fall Meeting. Boston, MA, November 26-December 2, 2016. [Oral Presentation]

S. Lee, J. C. Flanagan, J. Kang, J. Kim, M. Shim, and B. Park “Integration of II-VI Nanorods in Sensitized Photovoltaics via Open-Structured Photoanode and Co-Sensitization Strategy” International Conference on Electronic Materials and Nanotechnology for Green Environment (ENGE2016). Jeju, Korea, November 6-9, 2016. [Oral Presentation]

S. Lee, J. C. Flanagan, J. Kang, J. Kim, M. Shim, and B. Park “Integration of CdSe/CdSexTe1-x Type-II Heterojunction Nanorods into Hierarchically Porous TiO2 Electrode for Efficient Solar Energy Conversion” Global Photovoltaic Conference 2015 (GPVC2015). Busan, Korea, November 15-20, 2015. [Poster Presentation]