

Mr. Sang Ha Baek



Ph. D. Candidate

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Education

- **2020.03. ~ Present:** Combined M.S./Ph.D. in Chemical Engineering, Sungkyunkwan University, Korea (Advisor: Prof. Ho Seok Park)
- **2016.03. ~ 2020.02.:** B.S. in Chemical Engineering (1st major) and B.S. in Energy Science (2nd major), Sungkyunkwan University, Korea

Research Experience

- **2023.08. ~ 2024.07.:** Visiting Graduate Researcher (VGR), University of California, Los Angeles (UCLA), USA (PI: Prof. Bruce Dunn). Studied the electrochemical deposition/dissolution mechanism of MnO_2 for rechargeable aqueous batteries, using EQCM as the primary technique.
- **2020.03. ~ Present:** Graduate Researcher, Energy Science and Engineering Materials Laboratory (ESEM), Sungkyunkwan University, Korea (PI: Prof. Ho Seok Park).

Research Expertise

- **Zn Metal Anode Chemistry:** Plating/stripping chemistry of Zn metal anodes, with a focus on surface modification, substrate design, and electrolyte optimization to suppress electrolyte decomposition and dendrite growth.
- **MnO_2 Deposition/Dissolution Mechanism:** Mechanistic study of the deposition and dissolution process for rechargeable aqueous battery cathodes.
- **Li-S Battery:** Synthesis of carbon/metal composites and functional composite separators to enhance cathode stability.
- **2D Materials:** Application of black phosphorus and phosphorene oxide as a functional substitute for graphene, exploiting the direct coupling between surface modification and bulk properties.
- **Computational Chemistry:** DFT-based modelling of binding/adsorption energetics, electronic structure, and simulated spectra to physically interpret experimental observations.

Technical Skills

- **Electrochemical Analysis:** GC, CV, EIS (incl. DRT analysis), GITT, CA, CP, EQCM, in-situ XRD/Raman, and in-situ optical microscopy.
- **Materials Synthesis:** Hydrothermal synthesis, chemical vapor transport (CVT), electrospinning, tube-furnace processing, and sintering.
- **Materials Characterization:** XRD, XPS (incl. depth profiling), SEM, TEM, cryo-EM, FIB, cross-sectional polisher (CP), Raman, FT-IR, UV-Vis, BET, XAS, confocal microscopy, and SIMS.
- **Battery Testing:** Full workflow from powder processing and electrode fabrication to coin-cell assembly in a glove box; protocol design on Wonatech, Maccor, Neware, Gamry, and EC-Lab systems.
- **Computation & IT:** DFT with VASP, phonopy, pDOS/COHP analysis; Python; Linux server administration and Slurm job scheduling.

Publications

1. First Author:

1. **S. H. Baek**, Y. J. Cho, J. M. Park, P. Xiong, J. S. Yeon, H. H. Rana, J. H. Park, G. Jang, S. J. Lee, and H. S. Park, "Electrospun conductive carbon nanofiber hosts for stable zinc metal anode," *International Journal of Energy Research* 46, 7201–7214 (2022). doi:10.1002/er.7609
2. **S. H. Baek**, J. S. Byun, H. J. Kim, S. J. Lee, J. M. Park, P. Xiong, Y. G. Chung, and H. S. Park, "Polyoxometalate–

polymer hybrid artificial layers for ultrastable and reversible Zn metal anodes,” *Chemical Engineering Journal* 468, 143644 (2023). doi:10.1016/j.cej.2023.143644

3. J. M. Park, **S. H. Baek**, W. I. Kim, S. J. Lee, G. S. Gund, and H. S. Park, “Hierarchical hybrid architecture of carbon nanotube branches grown onto steam activated-reduced graphene oxide/Ni nanoparticle for lithium-sulfur battery cathode,” *Electrochimica Acta* 462, 142750 (2023). doi:10.1016/j.electacta.2023.142750 [Co-first author]

2. Co-Author:

1. M. Choi, A. Reed, C. Mirsafian, **S. H. Baek**, R. Chen, and B. Dunn, “Characterizing the MnO₂ dissolution process via EQCM for rechargeable aqueous batteries,” *Journal of Materials Chemistry A* (2026). doi:10.1039/D5TA10427K
2. J. S. Kim, Y. Kim, **S. H. Baek**, Y. Jeon, S. Kim, W. I. Kim, D. W. Kim, H. Lee, S. Huang, H. C. Kim, et al., “Two-dimensional polymeric metal phthalocyanines with anion fluxing and Li-ion-conducting properties for lithium metal full batteries,” *eScience*, 100480 (2025). doi:10.1016/j.esci.2025.100480
3. J. S. Byun, W. I. Kim, **S. H. Baek**, F. Hao, H. Kim, Y. G. Chung, L.-X. Li, R. Zhang, and H. S. Park, “Polyoxometalate initiated in situ conformal coating of multifunctional hybrid artificial layers for high performance zinc metal anodes,” *Advanced Functional Materials* 35, 2412577 (2025). doi:10.1002/adfm.202412577
4. G. Jang, H. R. Park, J. S. Byun, D. W. Kim, **S. H. Baek**, S. J. Lee, J. S. Yeon, P. Xiong, and H. S. Park, “Evolutionary Zn ion storage mechanism of hierarchical nanotubular spinel FeV₂O₄ for Zinc–Metal full cells,” *Energy Storage Materials* 71, 103637 (2024). doi:10.1016/j.ensm.2024.103637
5. J. W. Hong, H. H. Rana, J. H. Park, J. S. Kim, S. J. Lee, G. Jang, T. H. Kang, K. H. Shin, **S. H. Baek**, W. Yang, et al., “High Na-ion conductivity and mechanical integrity of anion-exchanged polymeric hydrogel electrolytes for flexible sodium ion hybrid energy storage,” *SusMat* 4, 140–153 (2024). doi:10.1002/sus2.182
6. G. Jang, Y. S. Joe, S. J. Lee, H. G. Cho, **S. H. Baek**, P. Xiong, K. H. Shin, J. S. Yeon, M. S. Kang, S. H. Oh, et al., “Crystal reconstruction of V₂O₃/carbon heterointerfaces via anodic hydration for ultrafast and reversible Mg-ion battery cathodes,” *InfoMat* 6, e12517 (2024). doi:10.1002/inf2.12517
7. J. S. Kim, J. H. Park, J. W. Hong, H. H. Rana, **S. H. Baek**, T. H. Kang, S. J. Lee, and H. S. Park, “Polyacrylic acid tethered onto the surface of vinyl functionalized silica nanoparticles for flexible hydrogel electrolytes of sodium ion hybrid supercapacitors,” *Next Energy* 1, 100066 (2023). doi:10.1016/j.nxener.2023.100066
8. Y. S. Joe, M. S. Kang, G. Jang, S. J. Lee, P. Nakhnivej, **S. H. Baek**, Y. K. Kim, G. Jeong, H. Kim, and H. S. Park, “Intercalation of bilayered V₂O₅ by electronically coupled PEDOT for greatly improved kinetic performance of magnesium ion battery cathodes,” *Chemical Engineering Journal* 460, 141706 (2023). doi:10.1016/j.cej.2023.141706
9. J. M. Park, M. Jana, **S. H. Baek**, T. Kang, P. Xiong, J. H. Park, J. S. Kim, A. S. Zeraati, M. Shekhirev, P. V. Braun, et al., “MXene ink hosting zinc anode for high performance aqueous zinc metal batteries,” *Journal of Energy Chemistry* 76, 187–194 (2023). doi:10.1016/j.jechem.2022.09.018
10. S. J. Lee, Y. S. Joe, J. S. Yeon, D. H. Min, K. H. Shin, **S. H. Baek**, P. Xiong, P. Nakhnivej, and H. S. Park, “Hierarchically structured silicon/graphene composites wrapped by interconnected carbon nanotube branches for lithium-ion battery anodes,” *International Journal of Energy Research* 46, 15627–15638 (2022). doi:10.1002/er.8258
11. P. Xiong, Y. Zhang, J. Zhang, **S. H. Baek**, L. Zeng, Y. Yao, and H. S. Park, “Recent progress of artificial interfacial layers in aqueous Zn metal batteries,” *EnergyChem* 4, 100076 (2022). doi:10.1016/j.enchem.2022.100076
12. P. Xiong, Y. Kang, H. Yuan, Q. Liu, **S. H. Baek**, J. M. Park, Q. Dou, X. Han, W.-S. Jang, S. J. Kwon, et al., “Galvanically replaced artificial interfacial layer for highly reversible zinc metal anodes,” *Applied Physics Reviews* 9(1) (2022). doi:10.1063/5.0074327

Patents

1. Registered:

1. “Anode electrode, manufacturing method thereof and secondary battery using the same.” **KR 10-2914170**, registered 13 Jan 2026 (appl. 10-2023-0069223, filed 30 May 2023). Also filed in the US as **US appl. 18/678,394** (published as US 2024/0405222 A1, 5 Dec 2024). Inventors: H. S. Park, **S. H. Baek**, J. S. Byun.
2. “Aqueous–non-aqueous hybrid electrolyte for zinc ion batteries and method for preparing the same.” **KR 10-2892563**, registered 25 Nov 2025 (appl. 10-2022-0144097, filed 1 Nov 2022). Inventors: H. S. Park, P. Xiong, **S.**

H. Baek, J. M. Park.

3. “Aluminum ion secondary battery, and electrolyte, anode, and manufacturing methods therefor.” **KR 10-2803957**, registered 30 Apr 2025 (appl. 10-2022-0148345, filed 9 Nov 2022). Inventors: H. S. Park, Q. Dou, **S. H. Baek**, J. M. Park.
4. “Phosphorene oxide-coated zinc ion electrode, zinc ion battery including the same, and method for manufacturing the electrode.” **KR 10-2607004**, registered 23 Nov 2023 (appl. 10-2021-0040206, filed 29 Mar 2021). Inventors: H. S. Park, **S. H. Baek**, J. M. Park, T. H. Kang.
5. “Zinc metal electrode having an artificial interfacial layer and method for manufacturing the same.” **KR 10-2598835** registered 1 Nov 2023 (appl. 10-2021-0052099, filed 22 Apr 2021). Inventors: H. S. Park, P. Xiong, J. M. Park, **S. H. Baek**.

2. Under Examination:

1. “Composite separator for lithium–sulfur secondary batteries comprising transition metal-incorporated black phosphorus oxide, and method for preparing the same.” **KR appl. 10-2025-0087835** (filed 1 Jul 2025, under examination). Inventors: H. S. Park, J. M. Park, **S. H. Baek**.

Conference Presentations

1. **S. H. Baek**, J. M. Park, T. H. Kang, and H. S. Park, “Enhancing Aqueous Zinc Metal Anode Reversibility with the Nucleation Sites Given by Oxidized Black Phosphorus,” *242nd ECS Meeting*, Atlanta, GA, USA, 9–13 October 2022. **Oral presentation.**

Awards

1. **Excellent Paper Presentation Award (우수논문상)**, Korean Society of Industrial and Engineering Chemistry (KSIEC), 2025 Spring Meeting, 3 June 2025. Selected as an outstanding poster presentation for “*Organic-inorganic coating for stabilizing zinc metal anode*” (**S. H. Baek**, H. S. Park). Certificate no. KSIEC 2025-084.

Languages

- **Korean** – native; **English** – fluent in professional settings.