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Engineering & Scientific Consulting

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Professional Profile

Dr. Han has a background in both electrochemistry and materials science. His primary consulting area is electrochemical energy conversion and storage, including batteries, fuel cells, electrolyzers, etc. He has worked in academia and a governmental laboratory, with rich experience in evaluating and investigating the performance, lifetime, failure modes, and degradation processes of batteries, fuel cells, electrolyzers, and the related electrode/catalyst materials for a variety of applications, including electric vehicles, consumer electronics, medical devices, grid storage, and water splitting. He has mastered a broad spectrum of characterization techniques, including both electrochemical characterizations, such as standard battery cycling and testing, cyclic voltametry (CV), rotating (ring) disk electrode measurements (RDE/RRDE), electrochemical impedance spectroscopy (EIS), as well as material characterizations, including scanning and transmission electron microscopy (SEM/TEM), atomic force microscopy (AFM), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), nuclear magnetic resonance (NMR), X-ray computed tomography (CT).

Dr. Han earned his Ph.D. in Materials Science and Engineering from the Massachusetts Institute of Technology, with research focused in the stability and activity study of metal and metal-oxides for oxygen catalysis in fuel cells, water splitting, and metal-air batteries. He and his team developed the first stable Pt-Ni alloy catalyst that meets the DOE 2017 target for oxygen reduction catalysis in fuel cells and discovered the influence of oxygen energy band on the oxygen evolution kinetics and catalytic mechanisms of oxide catalysts. His related first-author papers have been published in top academic journals such as Nature Chemistry and Nature Materials. After receiving his Ph.D., he joined Argonne National Laboratory as a postdoctoral associate in the Chemical Sciences and Engineering division, where he conducted fundamental investigations on surface-coated cathode materials and electrolytes optimized for silicon anode materials for next-generation Li-ion batteries with higher voltages, higher energy densities, and higher stabilities. His work at Argonne provided several new commercially-friendly and industrially-compatible approaches to greatly improve the performance of Li-ion batteries with little change to the current industrial processes. From years of experience, he has accumulated a range of skills in oxides synthesis, surface coating application, material characterization, material/system testing, programmatic data processing, and deep-dive data analysis.

Academic Credentials & Professional Honors

Ph.D., Materials Science and Engineering, Massachusetts Institute of Technology (MIT), 2016

B.S., Physics, Peking University, 2011

Prior Experience

Postdoctoral Appointee, Argonne National Laboratory, 2016-2019

Graduate Research Assistant, Massachusetts Institute of Technology, 2011-2016

Graduate Teaching Assistant, Massachusetts Institute of Technology, 2015

Undergraduate Research Assistant, Peking University, 2009-2011

Professional Affiliations

American Chemical Society—ACS

The Electrochemical Society—ECS

Languages

Chinese

Japanese

Publications

Han B, Liao C, Dogan F, Trask SE, Lapidus SH, Vaughey JT, Key B. Using Mixed Salt Electrolytes to Stabilize Silicon Anodes for Lithium-Ion Batteries via In situ Formation of Li-M-Si Ternaries (M= Mg, Zn, Al, Ca). *ACS Applied Materials & Interfaces*. 2019; 11(33):29780-90

Han B, Piernas-Muñoz MJ, Dogan F, Kubal J, Trask SE, Bloom ID, Vaughey JT, Key B. Probing the Reaction between PVDF and LiPAA vs Li₇Si₃: Investigation of Binder Stability for Si Anodes. *Journal of The Electrochemical Society*. 2019;166(12):A2396-A2402.

Sa N, Mukherjee A, Han B, Ren Y, Klie RF, Key B, Vaughey JT. Direct observation of MgO formation at cathode electrolyte interface of a spinel MgCo₂O₄ cathode upon electrochemical Mg removal and insertion. *Journal of Power Sources*. 2019;424:68-75.

Shkrob IA, Han B, Sahore R, Tornheim AP, Zhang L, Abraham DP, Dogan F, Zhang Z, Liao C. Facile in Situ Syntheses of Cathode Protective Electrolyte Additives for High Energy Density Li-Ion Cells. *Chemistry of Materials*. 2019;31(7):2459-68.

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Han B, Grimaud A, Giordano L, Hong WT, Diaz-Morales O, Yueh-Lin L, Hwang J, Charles N, Stoerzinger KA, Yang W, Koper MT. Iron-based perovskites for catalyzing oxygen evolution reaction. *The Journal of Physical Chemistry C*. 2018;122(15):8445-8454.

Kuznetsov DA, Han B, Yu Y, Rao RR, Hwang J, Román-Leshkov Y, Shao-Horn Y. Tuning redox transitions via inductive effect in metal oxides and complexes, and implications in oxygen electrocatalysis. *Joule*. 2018;2(2):225-244.

Han B, Risch M, Belden S, Lee S, Bayer D, Mutoro E, Shao-Horn Y. Screening Oxide Support Materials for OER Catalysts in Acid. *Journal of The Electrochemical Society*. 2018;165(10):F813-F820.

Han B, Dunlop AR, Trask SE, Key B, Vaughey JT, Dogan F. Tailoring Alumina Based Interphases on Lithium Ion Cathodes. *Journal of The Electrochemical Society*. 2018;165(14):A3275-83.

Han B, Key B, Lapidus SH, Garcia JC, Iddir H, Vaughey JT, Dogan F. From coating to dopant: how the transition metal composition affects alumina coatings on Ni-rich cathodes. *ACS Applied Materials & Interfaces*. 2017;9(47):41291-41302.

Han B, Paulauskas T, Key B, Peebles C, Park JS, Klie RF, Vaughey JT, Dogan F. Understanding the role of temperature and cathode composition on interface and bulk: Optimizing aluminum oxide coatings for Li-ion cathodes. *ACS Applied Materials & Interfaces*. 2017;9(17):14769-14778.

Du L, Luo L, Feng Z, Engelhard M, Xie X, Han B, Sun J, Zhang J, Yin G, Wang C, Wang Y. Nitrogen-doped graphitized carbon shell encapsulated NiFe nanoparticles: A highly durable oxygen evolution catalyst. *Nano Energy*. 2017;39:245-52.

Risch M, Stoerzinger KA, Han B, Regier TZ, Peak D, Sayed SY, Wei C, Xu Z, Shao-Horn Y. Redox processes of manganese oxide in catalyzing oxygen evolution and reduction: An in situ soft X-ray absorption spectroscopy study. *The Journal of Physical Chemistry C*. 2017;121(33):17682-92.

Han B, Stoerzinger KA, Tileli V, Gamalski AD, Stach EA, Shao-Horn Y. Nanoscale structural oscillations in perovskite oxides induced by oxygen evolution. *Nature Materials*. 2017;16(1):121.

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Stoerzinger KA, Risch M, Han B, Shao-Horn Y. Recent insights into manganese oxides in catalyzing oxygen reduction kinetics. *ACS Catalysis*. 2015;5(10):6021-31.

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Han B, Carlton CE, Suntivich J, Xu Z, Shao-Horn Y. Oxygen reduction activity and stability trends of bimetallic Pt_{0.5}M_{0.5} nanoparticle in acid. *The Journal of Physical Chemistry C*. 2015;119(8):3971-3978.

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Xie J, Yang X, Han B, Shao-Horn Y, Wang D. Site-selective deposition of twinned platinum nanoparticles on TiSi₂ nanonets by atomic layer deposition and their oxygen reduction activities. *ACS Nano*. 2013;7(7):6337-45.

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Presentations

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Alumina Coated Cathode Materials for Lithium-ion Batteries". Oral Presentation, 256th ACS Meeting, Boston, MA, 2018.

Han B, Shao-Horn Y. "In-situ Study of the Activated Lattice Oxygen Redox Reactions in Metal Oxides during Oxygen Evolution Catalysis". Oral Presentation, 233th ECS Meeting, Seattle, WA, 2018.

Han B, Key B, Lapidus S, Garcia J, Iddir H, Vaughey JT, Dogan F. "Investigation of Al₂O₃ Wet-Chemical Coatings on Cathode Materials of Lithium-ion Batteries". Oral Presentation, 233th ECS Meeting, Seattle, WA, 2018.

Han B, Key B, Lapidus S, Garcia J, Iddir H, Vaughey JT, Dogan F. "Study of Cathode Compositional Effects on Al₂O₃ Coatings in Lithium-ion Batteries". Oral Presentation, MRS Spring Meeting, Phoenix, AZ, 2018

Han B, Peebles C, Penkauskas T, Vaughey JT, Dogan F. "Compositional Effect on Al₂O₃ Coatings of Lithium-ion Cathodes". Poster Presentation, ABAA-10 Meeting, Chicago, IL, 2017

Han B, Peebles C, Penkauskas T, Vaughey JT, Dogan F. "Effects of Sintering Temperature and Cathode Composition on Al₂O₃ Coatings of Lithium-ion Cathodes". Oral Presentation, 231st ECS Meeting, New Orleans, LA, 2017

Han B, Peebles C, Penkauskas T, Vaughey JT, Dogan F. "Characterizations of Al₂O₃ Coatings on Lithium-ion Cathodes: Effects of Cathode Compositions and Annealing Temperatures". Poster Presentation, MRS Spring Meeting, Phoenix, AZ, 2017

Han B, Risch M, Lee YL, Ling C, Jia H, Shao-Horn Y. "Activity and Stability of Perovskite Oxides at Neutral pH for Oxygen Evolution Catalysis". Oral Presentation, 228th ECS Meeting, Phoenix, AZ, 2015

Han B, Stoerzinger KA, Tileli V, Gamalski A, Stach EA, Shao-Horn Y. "In-Situ TEM Study of Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O₃ for Oxygen Evolution Electrocatalysis". Oral Presentation, 228th ECS Meeting, Phoenix, AZ, 2015

Han B, Stoerzinger KA, Tileli V, Gamalski A, Stach EA, Shao-Horn Y. "In-situ TEM Study of Perovskites for Oxygen Electrocatalysis". Poster Presentation, 65th ISE Annual Meeting, Lausanne, Switzerland, 2014

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ChemComm, ACS Applied Materials & Interfaces

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