Wessel van den Bergh, Ph.D.

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Summary

Expert materials scientist of energy storage materials with an emphasis on studying structure-behavior relationships using modern analysis methods.

Education

Ph.D.	Chemistry	U. of South Carolina (U of SC)	Columbia, SC	2022, May
B.S.	ACS Certified Chemistry	Hope College	Holland, MI	2017, May

Research Experience (6 of 6)

Research Scientist, A123 Systems Inc., Waltham, MA (January 2024 —Ongoing)

- Research into new formulations and slurry processing techniques to improve the performance of solid-state Li-ion cathode.
- Creation of metrics for electrode microstructure using hand-made Python scripts for automated SEM and EDS analysis.
- Development and root cause analysis of solid-state cell designs.

Chemiker, BELLA Labs, KIT, Leopoldshafen, DE (August 2022—December 2023)

- Lead on synthesizing Hi-Ni singe-crystal NCMs for a joint project between BASF, U of Darmstadt, U of Manchester which acted as computational counterparts.
- Acted as in-lab manager of day-to-day operations, troubleshooting and delegating logistics.
- Used a combination of cell cycling, automated SEM image analysis, and Rietveld refinement to characterize materials.
- Acted as synthetic support for other projects studying single-crystal NCMs.

Ph.D. Candidate, M. Stefik Lab, U of SC, Columbia, SC (August 2017—May 2022)

- Unambiguously quantified nanostructure-behavior relationships in Li-ion materials yielding 3 first author publications.
- Designed and performed *in-situ* X-ray scattering measurements of H^+/Zn^{2+} dual insertion materials to study crystallographic changes and insertion mechanisms resulting in 3 co-author publications.
- Development of novel sol-gel recipes for micelle templated nanomaterials as powder and thin-films yielding a first author publication and 2 on-going collaborations.
- 5 research mentorships, lab safety officer, TA of 3 classes with a teaching award, 2 outreach programs demonstrating X-ray and electrochemical concepts, officer of 3 school clubs, preparation of 2 lessons and demonstrations for high school.

Process Chemistry Intern, Vertellus R&D, Zeeland, MI (May 2016—August 2016)

- Experimental design (DOE) of synthetic menthol crystallization, advanced lab-scale fractional distillation for memory foam compounds, long-term monitoring of decomposition in proprietary reducing agents.

Undergrad. Researcher, T. Guarr Lab, MSU Bioecon. Institute, Holland, MI (May 2015—May 2016)

- Organic synthesis of monomers for flow-cell membranes. Work involved organic synthesis and analysis using NMR and mass spectrometry. (2017 Sigma Xi Senior Research Award, Hope College)

Undergrad. Researcher, Stukey Lab, Hope College, Holland, MI (January 2014—May 2015)

- Studied cytotoxicity of specific genes mycobacterophages.

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Publications and Patents (17 of 17)

[1] **v. d. Bergh, W.**; Yao, R.; Zhang, R.; Janek, J.; Kondrakov, A.; Brezesinski, T.; Effect of salt selection and molar ratio in molten salt synthesis of single-crystalline $LiNiO_2$. *Journal of Materials Chemistry A*. **2024**, 12, 8683-8688.

[2] **v. d. Bergh, W.**; Karger, L.; Murugan, S.; Janek, J.; Kondrakov, A.; Brezesinski, T.; Single Crystal Layered Oxide Cathodes: The Relationship between Particle Size, Rate Capability, and Stability. *ChemElectroChem,* **2023**, e202300165 . *(*Journal Cover)

[3] **v. d. Bergh, W.**; Stefik, M., Understanding Rapid Intercalation Materials One Parameter at a Time, *Advanced Functional Materials,* **2022**, 32, 2204126, 1-19. (Invited)

[4] **v. d. Bergh, W.**; Wechsler, S.; Lokupitiya, H. N.; Jarocha, L.; Kim, K.; Chapman, J.; Kweon, K. E.; Wood, B. C.; Heald, S.; Stefik, M. Amorphization of T-Nb_2O_5 Accelerates Intercalation Pseudocapacitance via Faster Lithium Diffusivity Revealed using Tunable Isomorphic Architectures. *Batteries & Supercaps*, **2022**, 5(7), e202200122, 1-13. (Journal Cover, Editor's Choice Spotlights)

[5] **v. d. Bergh, W.**; Larison, T.; Fornerod, M. J.; Guldin, S.; Stefik, M. Faster Intercalation Pseudocapacitance Enabled by Adjustable Amorphous Titania where Tunable Isomorphic Architectures Reveal Accelerated Lithium Diffusivity. *Batteries & Supercaps,* **2022,** 5(6), e202200056**.** (Journal Cover)

[6] **v. d. Bergh, W.**; Williams, E. R.; Vest, N. A.; Chiang, P.-H.; Stefik, M. Mesoporous TiO_2 Microparticles with Tailored Surface, Pore, Wall, and Particle Dimensions using Persistent Micelle Templates. *Langmuir,* **2021**, 37(44), 12874-12886**.** (Journal Cover)

[7] **v. d. Bergh, W.**; Lokupitiya, H.; Vest, N. A.; Reid, B.; Guldin, S.; Stefik, M. Tunable Isomorphic Architectures of T-Nb_2O_5 Quantify Nanostructure Dependence of Intercalation Pseudocapacitance upon Diffusive Processes. *Advanced Functional Materials,* **2021**, 31, 2007826, 1-11. (Frontsipiece)

[8] Karger, L.; Korneychuk, S.; **v. d. Bergh, W.;** Dreyer, S. L.; Zhang, R.; Goonetilleke, D.; Kondrakov, A.; Janek, J.; Brezesinski, T. See-Saw Effect of $Ni_{Li}^{\bullet}$ Defects on Electrochemical Performance Studied in Size Tailored $LiNiO_2$. *Chemistry of Materials*, **2024**, 36, 3, 1497-1512.

[9] Nunes, B. N.; **v. d. Bergh, W.**; Strauss, F.; Kondrakov, A.; Brezesinski, T.; Janek, J.; The role of niobium in layered oxide cathodes for conventional lithium-ion and solid-state batteries. *Inorganic Chemistry Frontiers*, **2023**, 10, 7126-7145.

[10] Zhao, W.; Wang, K.; Fan, X.; Ren, F.; Xu, X.; Liu, Y.; Xiong, S.; Liu, X.; Zhang, Z.; Si, M.; Zhang, R.; **v. d. Bergh, W.**; Yan, P.; Battaglia, C.; Brezesinski, T.; Yang, Y. Quantifying Degradation Parameters of Single-Crystalline Ni-Rich Cathodes in Lithium-Ion Batteries. *Angewandte Chemie International Edition,* **2023**, e202305281.

[11] Karger, L.; **v. d. Bergh, W.**; An, S.; Kondrakov, A.; Brezesinski, T.; Cathode active material and its use in rechargeable electrochemical cells. *Pending* (Patent, BASF) **2023**.

[12] Karger, L.; **v. d. Bergh, W.**; Kondrakov A,; Brezesinski, T.; Process for making a cathode active material, and cathode active material. *Pending* (Patent, BASF) **2023**.

[13] Williams, E. R.; **v. d. Bergh, W.**; Stefik, M. High-χ, low-N Micelles from Partially Pefluorinated Block Polymers. *Soft Matter*, **2022**, 18, 7917-7930.

[14] Zhu, K.; Wu, T.; **v. d. Bergh, W.**; Stefik, M.; Huang, K. Reversible Molecular and Ionic Storage Mechanisms in High-Performance $Zn_{0.1}V_2O_5 \bullet nH_2O$ Xerogel Cathode for Aqueous Zn-ion Batteries. *ACS Nano*, **2021**, 15, 6, 10678-10688.

[15] Lu, Y.; Zhu, T.; **v. d. Bergh, W.**; Stefik, M.; Huang, K. A High Performing Zn-ion Battery Cathode Enabled by *in-situ* Transformation of V_2O_5 Atomic Layers. *Angewandte Chemie International Edition* **2020**, 132, 17152-17159.

[16] Zhu, K.; Wu, T.; Sun, S.; **v. d. Bergh, W**.; Stefik, M.; Huang, K. Synergistic H^+/Zn^{2+} dual ion insertion mechanism in high-capacity and ultra-stable hydrated VO_2 cathode for aqueous Zn-ion batteries. *Energy Storage Materials* **2020**, 29, 60-70.

[17] Lantz, K. A.; Clamp, N. B.; **v. d. Bergh, W.**; Sarkar, A; Stefik, M. Full Gamut Wall Tunability from Persistent Micelle Templates via Ex Situ Hydrolysis. *Small* **2019**, 15, 1900393. (Journal Cover)

Awards

The Hiram and Lawanda Allen Senior Graduate Student Achievement Award for Excellence in Chem. & Biochem.	University of South Carolina	2022
J. W. Bouknight Teaching Award	University of South Carolina	2018
Distinguished Scholar Award	Hope College	2017
Sigma Xi Research Award	Hope College	2017

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Research Skills

Solid state and molten salt chemistry

- Design and synthesis using of novel molten salt eutectics for NCM materials.

Coin cell preparation and testing — MACCOR

- Preparation and testing of cathode NCMs in half-cells to analyze capacity, rate capability, and cycle stability.

Solid-state cell testing — MACCOR

- Preparation and testing of cathode NCMs in In/InLi cells for solid-state battery performance.

Cyclic Voltammetry (CV) and Electrochemical Impedance Spectroscopy (EIS) — BIOLOGIC

- *in-situ* and kinetic data analysis of CV and EIS experiments for thin films and model sandwich cells for Li-ion and H^+/Zn^{2+}.

Rietveld Refinement (GSAS II)

- In-house (Mo) XRD analysis of NCM structures to determine degree of point defects and phases in NCM materials.

Python, MATLAB, and R Programming

- Author of a suite of scripts for the automation of data extraction, analysis, and plotting for both electrochemical and physical datasets. Examples include 3D EIS bode in MATLAB and intermittent current interrupt (ICI) analysis in Python for extraction of performance relevant parameters.

Sol-Gel Chemistry

- Designed +5 novel sol-gel recipes for thin-films and powders of alkoxide and salt precursors.

Persistent Micelle Templating (PMT)

- A technique unique to the Stefik lab, produced dozens of series of nanoscale architectures with single parameter features.

Small and Wide Angle X-ray Scattering/Diffraction (SAXS/WAXS)

- *in-situ* measurements of charge-discharge experiments, routine transmission, and grazing-incidence measurements for nanostructure and crystallinity.

Scanning Electron Microscopy (SEM)

- Top-down and cross-sectional SEM for quantitative image analysis of metal oxide nanostructured films, noble metal mesoporous nanoparticles, and NCM single-crystal materials.

Design of Experiment (DOE)

- Designed small factorial runs to identify critical variables of nanomaterial templating and synthetic menthol crystallization. Specialization certification from ASU.

Dynamic Light Scattering (DLS) + PSD

- Tracking of micelle formation and sol-gel particle growth over time for troubleshooting of templating experiments.

Nuclear Magnetic Resonance Spectroscopy (NMR)

- Routine measurements and analysis of polymerization reactions, polymers, and small molecules.

Atom-Transfer Radical Polymerization (ATRP)

- Prepared several block polymers for use as micelle templates.

Gel Permeation Chromatography (GPC)

- Routine measurements of polymers for determination of dispersity.

Leadership Positions

Secretary	POLY/PMSE (U of SC)	2021 — 2022
Secretary	SACS (U of SC)	2020 — 2021
Officer	ECS (U of SC)	2019 — 2020
President	Biochem. & Mol. Bio. Club (Hope College)	2015 — 2017

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Presentations (13 of 13)

[1] **2023**, May — BASF "New recipes for SC NCMs"
[2] **2023**, February — Texas A&M "Life as a Postdoc"
[3] **2022**, March — U of SC Senior Graduate Student Award
"Tailored nanomaterials for advancing fast-charge batteries"
[4] **2022,** February— U of SC Graduate Poster Session
"Precision nanomaterials reduce ambiguity in ultra-fast energy storage systems"
[5] **2021**, July – NGRPC2021 (Virtual)
"Persistent Micelle Templates for Tunable Isomorphic Architectures to Probe Nanostructure Dependence of Pseudo-capacitive T-Nb_2O_5"
[6] **2021**, April - ACS Spring National Conference (Virtual)
"Tunable Isomorphic Architectures Reveal the Nanostructure Dependence of Nb_2O_5 Intercalation Pseudocapacitance"
[7] **2019**, August – International School for Materials for Energy and Sustainability (Pasadena, CA)
"Systematic Series of Porous Nanomaterials Revealing Unexpected Confinement Trends for Electrochemical Lithiation"
[8] **2016**, April – Hope College Research Symposium (Holland, MI)
[9] **2015**, July – Hope College Summer Research Fair (Holland, MI)
[10] **2015**, May – American Society for Microbiology Conference (New Orleans, LA)
[11] **2015**, April – Hope College Research Symposium (Holland, MI)
[12] **2014**, July – Midwest Microbiology Conference (Chicago, IL)
[13] **2014**, April – Hope College Research Symposium (Holland, MI)

Research Mentorships

Rui Yao	(Now at KIT)	2023, Fall — Present
Mason Wright	(Undergraduate at U of SC)	2021, Fall – 2022, Fall
Christian Golden	(Undergraduate at U of SC)	2021, Summer
Kayleigh van Alstine (Project SEED)	(Undergraduate at U of SC)	2019, Summer
Natalie Vest	(Now PhD from Texas A&M)	2018, Fall – 2020, Spring
Pei-Hua Chiang	(Graduate Student at USC)	Fall 2017, Summer 2018

Teaching Positions at U of SC

Organic Chemistry Recitation I	2022, Spring
Organic Chemistry Recitation II	2020, Spring
Organic Chemistry II Lab (J. W. Bouknight Teaching Award)	2018, Spring
Organic Chemistry I Lab	2017, Fall

Extracurricular Activities

Canvasser (Door Knocking), Devine, T.	(Mayoral Candidate of Columbia, SC)	2021, October
Educational Lab Designer	(RET program, Fairfield Central High, Arava, L. S.)	2021, Summer
Invited Panelist, Graduate TA Orientation	(U of SC)	2021, August; 2020, August
Co-Chair, Oral Presentation Session	NGRPC2021 (Virginia Tech)	2021, July
Interactive Audience Member	Next Generation Electrochemistry (NGenE)	2021, June
Attendee, Student Program	ARPA-E (US Gov)	2021, May
Attendee, Presenter (Poster)	Int'l School for Mater. for Energy & Sustain. (ISMES)	2019, August
Assistant of Outreach Demonstrations	SC SAXS Collaborative (SCSC)	2019, May
Judge of Annual Meeting	South Carolina Academy of Science (SCAS)	2018, April