

## Biographical Sketch: N. A. W. Holzwarth (updated 8/14/2024)

### Address

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### Professional Preparation

**Undergraduate:** M. I. T. 1964-1967; BS degree in Chemical Physics, June 1967.

**Graduate:** U. Chicago 1967-1974; PhD degree in Physics, June 1975.

### Appointments

**1983-Present:** Professor of Physics, Wake Forest University (joined faculty in 9/83 as  
Assistant Professor of Physics)

**1982–1983:** Postdoctoral research under Professor Melvin Lax, Department of Physics,  
City College of New York

**1980-1982:** Research Physicist, Theoretical Sciences Group, Exxon Research and  
Engineering Company

**1975-1980:** Postdoctoral research under Professors L. A. Girifalco, S. Rabii, P. Soven, and  
S. G. Louie in the Departments of Metallurgy and Materials Science,  
Physics, and Electrical Engineering at the University of Pennsylvania

**1974-1975:** Postdoctoral research under Professor M. J. G. Lee, Department of Physics,  
University of Toronto

### Publications (since 2003)

1. D. Cory Lynch, Yan Li, Pieremanuele Canepa, and N.A.W. Holzwarth, “Computational investigation of the structural and electrolyte properties of the extended family of lithium (thio)boracite materials:  $\text{Li}_4\text{B}_7\text{O}_{12}\text{Cl}$  and beyond” *Physical Review Materials* **8**, 065401 (2024) <https://link.aps.org/doi/10.1103/PhysRevMaterials.8.065401>
2. Yan Li and N.A.W. Holzwarth, “First-principles simulations to understand the structural and electrolyte properties of idealized  $\text{Li}_{7.5}\text{B}_{10}\text{S}_{18}\text{X}_{1.5}$  ( $\text{X} = \text{Cl}, \text{Br}, \text{I}$ )” *Physical Review Materials* **6**, 045403 (2022) <https://doi.org/10.1103/PhysRevMaterials.6.045403>
3. N. A. W. Holzwarth, Marc Torrent, Jean-Baptiste Charraud, and Michel Côté, “Cubic spline solver for generalized density functional treatments of atoms and generation of atomic datasets for use with exchange-correlation functionals including meta-GGA ” *Physical Review B* **105**, 125144 (2022) <https://doi.org/10.1103/PhysRevB.105.125144>
4. Yan Li and N. A. W. Holzwarth, “First-principles simulations of Li boracites  $\text{Li}_4\text{B}_7\text{O}_{12}\text{Cl}$  and  $\text{Li}_5\text{B}_7\text{O}_{12.5}\text{Cl}$ ”, *Physical Review Materials* **6**, 025401 (2022) <https://link.aps.org/doi/10.1103/PhysRevMaterials.6.025401>
5. Yan Li, Zachary D. Hood, and N. A. W. Holzwarth, “Computational study of  $\text{Li}_3\text{BO}_3$  and  $\text{Li}_3\text{BN}_2$  II: Stability analysis of pure phases and of model interfaces with Li

- anodes" *Phys. Rev. Materials*, **5** 085403 (2021)  
<https://doi.org/10.1103/PhysRevMaterials.5.085403>
6. Yan Li, Zachary D. Hood, and N. A. W. Holzwarth, "Computational study of  $\text{Li}_3\text{BO}_3$  and  $\text{Li}_3\text{BN}_2$  I: Electrolyte properties of pure and doped crystals" *Phys. Rev. Materials*, **5** 085402 (2021) <https://doi.org/10.1103/PhysRevMaterials.5.085402>
  7. Yan Li, Zachary D. Hood, and N.A.W. Holzwarth, "Computational and experimental (re)investigation of the structural and electrolyte properties of  $\text{Li}_4\text{P}_2\text{S}_6$ , and  $\text{Na}_4\text{P}_2\text{S}_6$ , and  $\text{Li}_2\text{Na}_2\text{P}_2\text{S}_6$ ", *Physical Review Materials* **4**, 045406 (2020)  
<https://link.aps.org/doi/10.1103/PhysRevMaterials.4.045406>
  8. Yan Li, W. C. Kerr, and N. A. W. Holzwarth, "Continuity of phonon dispersion curves in layered ionic materials", *Journal of Physics: Condensed Matter* **32** 055402 (2019)  
<https://iopscience.iop.org/article/10.1088/1361-648X/ab4cc1/>
  9. N. A. W. Holzwarth, "Updated comments on projector augmented wave (PAW) implementations within various electronic structure code packages", *Computer Physics Communications* **234** 25-29 (2019) <https://doi.org/10.1016/j.cpc.2019.05.009>
  10. Jason David Howard and N. A. W. Holzwarth, "First-principles estimation of partition functions representing disordered lattices such as the cubic phases of  $\text{Li}_2\text{OHCl}$  and  $\text{Li}_2\text{OHBr}$ ", *Physical Review B* **99** 014109 (2019)  
<https://doi.org/10.1103/PhysRevB.99.014109>
  11. Jason David Howard and N. A. W. Holzwarth, "Analysis of the statistical and convergence properties of ionic transport coefficients with application to the solid electrolyte  $\text{Li}_2\text{OHCl}$ ", *Solid State Ionics* **325** 80-89 (2018);  
<https://doi.org/10.1016/j.ssi.2018.07.025>
  12. Jason Howard, Zachary D. Hood, and N. A. W. Holzwarth, "Fundamental aspects of the structural and electrolyte properties of  $\text{Li}_2\text{OHCl}$  from simulations and experiment", *Physical Review Materials* **1** 075406 (2017);  
<https://link.aps.org/doi/10.1103/PhysRevMaterials.1.075406>
  13. Larry E. Rush, Jr., Zachary D. Hood, and N. A. W. Holzwarth, "Unraveling the electrolyte properties of  $\text{Na}_3\text{SbS}_4$  through computation and experiment", *Physical Review Materials* **1** 075405 (2017);  
<https://link.aps.org/doi/10.1103/PhysRevMaterials.1.075405>
  14. Ahmad Al-Qawasmeh and N.A.W. Holzwarth, " $\text{Li}_{14}\text{P}_2\text{O}_3\text{N}_6$  and  $\text{Li}_7\text{PN}_4$ : Computational study of two nitrogen rich crystalline LiPON electrolyte materials" *Journal of Power Sources* **364** 410-419 (2017);  
<https://doi.org/10.1016/j.jpowsour.2017.08.025>
  15. Ahmad Al-Qawasmeh, Jason Howard, and N.A.W. Holzwarth, " $\text{Li}_4\text{SnS}_4$  and  $\text{Li}_4\text{SnSe}_4$ : Simulations of Their Structure and Electrolyte Properties", *J. Electrochem. Soc.* **164** A6386-A6394 (2017); <http://dx.doi.org/10.1149/2.0581701jes>
  16. N.A.W. Holzwarth, " $\text{Li}_4\text{SnS}_4$ : Simulations of Its Structure and Electrolyte Properties" *Electrochemical Society Transactions* **73** 231-240 (2016);  
<dx.doi.org/10.1149/07301.0231ecst>
  17. Jason Howard and N.A.W. Holzwarth, "First principles simulations of the porous

- layered calcogenides  $\text{Li}_{2+x}\text{SnO}_3$  and  $\text{Li}_{2+x}\text{SnS}_3$ ", *Phys. Rev. B* **94**, 064198 (2016);  
<http://dx.doi.org/10.1103/PhysRevB.94.064108>
18. Ahmad Al-Qawasmeh and N.A.W. Holzwarth, " Computational Study of Li Ion Electrolytes Composed of  $\text{Li}_3\text{AsS}_4$  Alloyed with  $\text{Li}_4\text{GeS}_4$ ", *Journal of the Electrochemical Society* **163**, A2079-A2088 (2016);  
<http://dx.doi.org/10.1149/2.1131609jes>
  19. Larry E. Rush Jr. and N. A.W. Holzwarth, "First principles investigation of the Structural and electrolyte properties of  $\text{Na}_4\text{P}_2\text{S}_6$  and  $\text{Li}_4\text{P}_2\text{S}_6$ ", *Solid State Ionics* **286**, 45-50 (2016)
  20. N. D. Lepley and N. A. W. Holzwarth, "Modeling interfaces between solids: Application to Li battery materials", *Phys. Rev. B* **92** 214201 (2015)
  21. Zachary D. Hood, Cameron Kates, Melanie Kirkham, Shiba Adhikari, Chengdu Liang, and N. A. W. Holzwarth, "Structural and electrolyte properties of  $\text{Li}_4\text{P}_2\text{S}_6$ " *Solid State Ionics* **284**, 61-70 (2015)
  22. M. D. Johannes and N. A. W. Holzwarth, "Crystalline Inorganic-Solid Electrolytes: Computer Simulations and comparisons with experiment" in Chapter 6, pp. 191 - 232 of **Handbook of Solid State Batteries**, 2nd Edition, Nancy J. Dudney, William C. West, and Jagjit Nanda Editors, World Scientific (2016); ISBN 978-981-4651-89-9
  23. Jacilynn A. Brant, Danielle M. Massi, N. A. W. Holzwarth, Joseph H. MacNeil, Alexios P. Douvalis, Thomas Bakas, Steve W. Martin, Michael D. Gross, and Jennifer A. Aitken, -- "Fast Lithium Ion Conduction in  $\text{Li}_2\text{SnS}_3$ : Synthesis, Physicochemical Characterization, and Electronic Structure" *Chemistry of Materials* **27**, 189-196 (2015)  
<http://pubs.acs.org/doi/10.1021/cm5037524>
  24. N. A. W. Holzwarth, -- "First Principles Modeling of Electrolyte Materials in All-Solid-State Batteries" *Physics Procedia* **57** 29-37 (2014)  
<http://dx.doi.org/10.1016/j.phpro.2014.08.127>
  25. Chaochao Dun, N. A. W. Holzwarth, Yuan Li, Wenxiao Huang, and David L. Carroll, -- " $\text{Cu}_2\text{ZnSnS}_x\text{O}_{4-x}$  and  $\text{Cu}_2\text{ZnSnS}_x\text{Se}_{4-x}$ : First principles simulations of optimal alloy configurations and their energies" -- *Journal of Applied Physics* **115**, 193513 (2014)  
<http://scitation.aip.org/content/aip/journal/jap/115/19/10.1063/1.4876447>
  26. François Jollet and Marc Torrent (CEA, France) and Natalie Holzwarth, -- "Generation of Projector Augmented-Wave atomic data: A 71 element validated table in the XML format" -- *Computer Physics Communications* **185**, 1246-1254 (2014)  
<http://www.sciencedirect.com/science/article/pii/S0010465513004359>
  27. Nicholas Lepley, Yaojun A. Du, and N. A. W. Holzwarth, "Structures,  $\text{Li}^+$  mobilities, and interfacial properties of solid electrolytes  $\text{Li}_3\text{PS}_4$  and  $\text{Li}_3\text{PO}_4$  from first principles" -- *Phys. Rev. B* **88**, 104103 (2013)  
<http://link.aps.org/doi/10.1103/PhysRevB.88.104103>
  28. Keerthi Senevirathne, Cynthia S. Day, Michael D. Gross, Abdessadek Lachgar, and N. A. W. Holzwarth, "A new crystalline LiPON electrolyte: Synthesis, properties, and electronic structure" -- *Solid State Ionics* **233**, 95-101 (2013)  
<http://dx.doi.org/10.1016/j.ssi.2012.12.013>
  29. N. D. Lepley and N. A. W. Holzwarth, "Computer Modeling of Crystalline

- Electrolytes -- Lithium Thiophosphates and Phosphates” -- *J. Electrochem. Soc.* **159**, A538-A547 (2012) <http://dx.doi.org/10.1149/2.jes113225>
30. Xiao Xu and N. A. W. Holzwarth, “Adaptation of the Projector Augmented Wave (PAW) formalism to the treatment of orbital-dependent exchange-correlation functionals” - *Phys. Rev. B* **84** 155113 (16 pages) (2011) <http://link.aps.org/doi/10.1103/PhysRevB.84.155113>
  31. N. A. W. Holzwarth and Xiao Xu, “Analysis of numerical methods for evaluating the Fock exchange integral in a plane wave basis” -- *Phys. Rev. B* **84** 113102 (4 pgs; brief report) (2011) <http://link.aps.org/doi/10.1103/PhysRevB.84.113102>
  32. N. D. Lepley and N. A. W. Holzwarth, “Computer Modeling of Crystalline Electrolytes -- Lithium Thiophosphates and Phosphates” -- *ECS Transactions* **35** (14) 39-51 (2011) <http://dx.doi.org/10.1149/1.3644902>
  33. N. A. W. Holzwarth, N. D. Lepley, and Yaojun A. Du, “Computer Modeling of Lithium Phosphate and Thiophosphate Electrolyte Materials “ -- *Journal of Power Sources* **196** 6870-6876 (2011) <http://dx.doi.org/10.1016/j.jpowsour.2010.08.042>
  34. Marc Torrent, N. A. W. Holzwarth, Francois Jollet, David Harris, Nicholas Lepley, and Xiao Xu, “Electronic structure packages: Two implementations of the projector augmented wave (PAW) formalism” -- *Computer Physics Communications* **181** 1862-1867 (2010) <http://dx.doi.org/10.1016/j.cpc.2010.07.036>
  35. Yaojun A. Du and N. A. W. Holzwarth, “First-principles study of LiPON and related solid electrolytes” -- *Phys. Rev. B*, **81** 184106 (15pp) (2010) <http://prb.aps.org/abstract/PRB/v81/i18/e184106>
  36. Xiao Xu and N. A. W. Holzwarth, “A projector augmented wave (PAW) formulation of Hartree-Fock calculations of electronic structure” -- *Phys. Rev. B* **81** 245105 (14pp) (2010) <http://link.aps.org/doi/10.1103/PhysRevB.81.245105>
  37. Yaojun A. Du and N. A. W. Holzwarth, “First principles simulations of Li ion migration in materials related to LiPON electrolytes” -- *ECS Transactions* **25** (36) 27-36 (2010) <http://dx.doi.org/10.1149/1.3393837>
  38. Yaojun A. Du and N. A. W. Holzwarth, “Effects of O vacancies and N or Effects of O vacancies and N or Si substitutions on Li<sup>+</sup> migration in Li<sub>3</sub>PO<sub>4</sub> electrolytes from first principles” -- *Phys. Rev. B* **76**, 174301 (2008) <http://link.aps.org/abstract/PRB/v78/e174301>
  39. Yaojun A. Du and N. A. W. Holzwarth, “Li ion migration in Li<sub>3</sub>PO<sub>4</sub> electrolytes: Effects of O vacancies and N substitutions” -- *ECS Transactions* **13** (26) 75-82 (2008) <http://dx.doi.org/10.1149/1.3050379>
  40. Yaojun A. Du and N. A. W. Holzwarth, “Mechanisms of Li<sup>+</sup> diffusion in crystalline  $\gamma$ - and  $\beta$ -Li<sub>3</sub>PO<sub>4</sub> electrolytes from first principles” -- *Phys. Rev. B* **76**, 174302 (2007) <http://link.aps.org/abstract/PRB/v76/e174302>
  41. Yaojun A. Du and N. A. W. Holzwarth, “Li ion diffusion mechanisms in the crystalline electrolyte  $\gamma$ -Li<sub>3</sub>PO<sub>4</sub>” -- *Journal of the Electrochemical Society* **155**, A999 (2007) <http://dx.doi.org/10.1149/1.3050379>
  42. Ping Tang, N. A. W. Holzwarth, and Yaojun A. Du, “Comparison of the electronic structures of four crystalline phases of FePO<sub>4</sub>” -- *Phys. Rev. B.* **76**, 174118 (2007)

- <http://link.aps.org/abstract/PRB/v76/e174118>
43. Yonas Abraham and N. A. W. Holzwarth, "A method for calculating electronic structures near surfaces of semi-infinite crystals" -- *Phys. Rev. B* **73**, 035412 (2006)  
<http://prb.aps.org/abstract/PRB/v73/i3/e035412>
44. Ping Tang and N. A. W. Holzwarth, "Electronic structure of FePO<sub>4</sub>, LiFePO<sub>4</sub>, and related materials" -- *Phys. Rev. B* **68**, 165107 (2003)  
<http://prb.aps.org/abstract/PRB/v68/i16/e165107>

### Invited presentations (since 2003)

1. Presentation by N. A. W. Holzwarth at the [11th International ABINIT Developer Workshop](#) -- July 1-4, 2024 in Quebec, Canada. "[PAW datasets for meta-GGA calculations](#)"
2. Presentation by N. A. W. Holzwarth at the [North Carolina Battery Technology Workshop 2024](#) -- June 6-7, 2024 in Charlotte, NC -- "[Exploration of Solid-State Electrolytes Based on Lithium \(Thio\) Boracites through Computer Simulation](#)"
3. Guest presentation to CHM 364 Materials Chemistry class at the invitation of Professor A. Lachgar at WFU – March 29, 2022 – “Ionic Conductivity from an Idealized Atomic Level Prospective”
4. Virtual presentation by N. A. W. Holzwarth at the Electronic Structure Discussion Group at Cambridge University invited by WFU alum Angela Harper -- June 9, 2021 – “First principles simulations of electrolyte materials with a view toward all solid-state battery technology -- Li<sub>4</sub>P<sub>2</sub>S<sub>6</sub>, Na<sub>4</sub>P<sub>2</sub>S<sub>6</sub>, and possible alloys”
5. Virtual presentation by N. A. W. Holzwarth at the 10<sup>th</sup> ABINIT International Developer Workshop May 31-June 4, 2021 – “Progress on self-consistent meta-gga PAW datasets from ATOMPAAW”
6. Presentation by N. A. W. Holzwarth at the Workshop on Precision Quantification in DFT May 23-24, 2019 in Louvain la Neuve, Belgium -- “Assessment of Accuracy and Efficiency of PAW Datasets in Materials Simulations”
7. Presentation by N. A. W. Holzwarth at the HybriD<sup>3</sup> Theory Training Workshop at Duke University, organized by Volker Blum (Duke) and Yosuke Kanai (UNC) Sept. 28-29, 2018 -- "Practical Density Functional Theory with Plane Waves"
8. Invited talk present by N. A. W. Holzwarth at the 2018 Electronic Structure Workshop, at the University of Pennsylvania, Philadelphia PA. June 10-14, 2018 -- "Perspectives on the Projector Augmented Wave Method (PAW)"
9. Invited talk presented by N. A. W. Holzwarth at the SSI: 21st International Conference on Solid State Ionics, Padua, Italy, June 18-23, 2017 -- "Simulations of Idealized Solid Electrolytes"
10. Invited talk presented by N. A. W. Holzwarth at the EMCMRE-4: 4th Euro-Mediterranean Conference on Materials and Renewable Energies, Marrakech, Morocco May 8-11, 2017. "Simulations of Idealized Solid Electrolytes"
11. Talk presented by N. A. W. Holzwarth at [the International Material Research Congress](#), August 15-19, 2016 Cancun, Mexico. "[Simulations of Idealized Solid Electrolytes](#)"

12. Talk presented by N. A. W. Holzwarth at Sandia National Laboratory in Albuquerque, NM at the invitation of Kevin Leung -- June 3, 2015 "Simulations of Idealized Solid Electrolytes for Solid State Battery Designs"
13. Talk presented by N. A. W. Holzwarth at the Joint School of Nanoscience and Nanoengineering in Greensboro at the invitation of professor Sung-Jin Cho -- January 16, 2015 "Overview of Computer Simulation Methods Used to Study and Design New Materials: Examples from the Study of Solid Electrolytes"
14. Invited talk by N. A. W. Holzwarth at the 27th Annual CSP Workshop February 24-28, 2014 in Athens, GA, USA – “First principles modeling of electrolyte materials in all-solid-state batteries”
15. Presentation by N. A. W. Holzwarth at the CFCAM meeting "Pseudopotentials and PAW atomic data: beyond a "black art"?" January 28-29, 2014 at the Ecole National Supérieure de Chimie de Paris, Paris, France; organized by F. Jollet, J. J. Mortensen, and G. Rignanes. -- Introduction to generating PAW Atomic Datasets
16. Invited talk presented by N. A. W. Holzwarth at the 6th International ABINIT Developer Workshop in Dinard, France April 15-18, 2013 -- Comments on Generating and Testing PAW Datasets
17. Talk presented by N. A. W. Holzwarth at Oak Ridge National Laboratory at the invitation of Dr. Paul Kent -- March 11, 2013 "Design and Synthesis of a Crystalline LiPON Electrolyte"
18. Talk presented by N. A. W. Holzwarth at the Duquesne University at the invitation of Professor Jennifer Aitken, Department of Chemistry and Biochemistry -- October 19, 2012 "Solid electrolytes for battery applications -- a theoretical perspective"
19. Talk presented by N. A. W. Holzwarth at the University of Louisville at the invitation of Professor Yongsheng Lian, Mechanical Engineering Department and the Conn Center for Renewable Energy Research -- April 6, 2012 -- "Solid electrolytes for battery applications - a theoretical perspective"
20. Talk presented by N. A. W. Holzwarth for WFU's Center for Energy, Environment, and Sustainability -- Renewable Energy Research (CEES-RER) Sept. 30, 2011 -- Solid electrolytes for battery applications -- a theoretical perspective
21. Invited talk presented by N. A. W. Holzwarth at the 5th International Abinit Developer Workshop in Han-sur-Lesse, Belgium April 11-15, 2011 -- The ATOMPAAW Generator
22. Invited talk presented by N. A. W. Holzwarth at 7th Canadian Computational Chemistry Conference July 20-24, 2009 , Dalhousie University in Halifax, Nova Scotia -- A Projector Augmented Wave Formulation of the Optimized Effective Potential Formalism
23. Invited talk presented by N. A. W. Holzwarth at "Workshop on Pseudopotentials and the Quantum Theory of Materials" in Austin, TX Apr. 9-11 2008 in honor of J. R. Chelikowsky -- Simulations of Li ion diffusion in the electrolyte material --  $\text{Li}_3\text{PO}_4$
24. Invited talk presented by N. A. W. Holzwarth at 74th Annual Meeting of the Southeastern Section of the APS in Nashville, November 2007 -- Simulations of Li ion diffusion in the electrolyte  $\text{Li}_3\text{PO}_4$
25. Invited talk presented by N. A. W. Holzwarth at the CEACAM workshop -- Lyon, France -- June 12-14, 2006: State of the art, developments and perspectives of electronic structure calculations in the frame of the Projector Augmented-Wave (PAW) method

**Seminar or colloquium presentations and contributed presentations at meetings and workshops by N. A. W. Holzwarth and collaborators (from last 10 years)**

1. Presentation by N. A. W. Holzwarth at the [March 2023 APS meeting](#) -- Mar. 5-10, 2023 in

- Las Vegas, Nevada -- ["Simulations and Analyses of Li<sub>4</sub> and Li<sub>6</sub> \(Thio\)Boracites As Promising Li Ion Conducting Electrolytes for All-Solid-State Batteries"](#)
2. Presentation by Cory Lynch at the [242th ECS Meeting](#) Oct 9-13, 2022 in Atlanta, GA -- ["Simulations and Analyses of Li<sub>4</sub> and Li<sub>6</sub> Boracites and Thioboracites as Promising Li Ion Conducting Electrolytes"](#)
  3. Presentation by N. A. W. Holzwarth at the [March 2022 APS meeting](#) -- Mar. 14-18, 2022 in Chicago Illinois. ["Development of self-consistent pseudopotentials and PAW datasets for meta-GGA exchange-correlation functionals"](#)
  4. Presentation (virtual) by Yan Li at the [240th ECS Meeting](#) Oct 10-14, 2021 -- ["Computational Investigation of Li Boracite Li<sub>4</sub>B<sub>7</sub>O<sub>12</sub>Cl and Related Materials as Solid Electrolytes "](#)
  5. Presentation (virtual) by N. A. W. Holzwarth at the [240th ECS Meeting](#) Oct 10-14, 2021 -- ["First Principles Simulations to Understand the Structural and Electrolyte Properties of Idealized Li<sub>7.5</sub>B<sub>10</sub>S<sub>18</sub>X<sub>1.5</sub> \(X = Cl, Br, I\) -- Li Superionic Conductors Recently Identified in the Experimental Literature "](#)
  6. Presentation (virtual) by Yan Li at the [March 2021 APS meeting](#) -- ["Li<sub>3</sub>BO<sub>3</sub> and Li<sub>3</sub>BN<sub>2</sub>: Computational study of structural and electrolyte properties of pure and doped crystals"](#)
  7. Annotated slides that would have been presented by Yan Li at the cancelled March 2020 APS meeting -- ["Prediction and analysis of a sodium ion electrolyte: Li<sub>2</sub>Na<sub>2</sub>P<sub>2</sub>S<sub>6</sub>"](#)
  8. Annotated slides that would have been presented by N. A. W. Holzwarth at the cancelled March 2020 APS meeting -- ["Continuity of Phonon Dispersion Curves of Anisotropic Ionic Materials"](#)
  9. Presentation by N. A. W. Holzwarth at Wake's CFM (Center for Functional Materials) Seminar Series -- ["First principles simulations of idealized known And unknown crystalline materials"](#) Dec. 4, 2019.
  10. Presentation by Yan Li at the [236th Meeting of the Electrochemical Society](#) in Atlanta, Ga Oct. 13-17, 2019. [Computational \(Re\)investigation of the Structural and Electrolyte Properties of Li<sub>4</sub>P<sub>2</sub>S<sub>6</sub>, Na<sub>4</sub>P<sub>2</sub>S<sub>6</sub>, and Li<sub>2</sub>Na<sub>2</sub>P<sub>2</sub>S<sub>6</sub>](#)
  11. Poster by Yan Li at the [2019 Workshop on Recent Developments in Electronic Structure](#) at the University of Illinois in Champaign-Urbana, Illinois May 20-22, 2019 [Computational Reinvestigation of the Structural and Electrolyte Properties of Li<sub>4</sub>P<sub>2</sub>S<sub>6</sub> and Na<sub>4</sub>P<sub>2</sub>S<sub>6</sub>](#)
  12. Contributed talk presented by Yan Li at the [March 2019 Meeting of the American Physical Society](#), March 4-8, 2019 in Boston, MA [Computational and experimental investigation of Na<sub>4</sub>P<sub>2</sub>S<sub>6</sub> as a promising solid electrolyte material for sodium metal batteries](#)
  13. Contributed talk presented by Jason Howard at the [March 2018 Meeting of the American Physical Society](#), March 6-9, 2018 in Los Angeles, CA [Understanding the phase properties of Li<sub>2</sub>OHCl, Li<sub>2</sub>\(OH\)<sub>1-x</sub>F<sub>x</sub>Cl, and Li<sub>2</sub>OHBr with first principles simulations.](#)
  1. Contributed talk presented by N. A. W. Holzwarth on behalf of Ahmad Al-Qawasmeh at the [March 2018 Meeting of the American Physical Society](#), March 6-9, 2018 in Los Angeles, CA [Computational Study of the Solid Electrolyte Li<sub>4</sub>PS<sub>4</sub>I and Related Materials](#)
  2. Eight minute talk presented by Natalie Holzwarth at the [New Ideas Series](#) from the Dean of the College of Wake Forest University, February 22, 2018 in the WFU Library Auditorium

- ["Simulations of materials -- focusing on electrolytes for all solid state batteries"](#)
3. Poster contributed by Jason Howard and Zachary Hood at the [232nd Meeting of the Electrochemical Society](#) Oct. 1-5, 2017 in National Harbor, MD -- [Structural and Electrolyte Properties of  \$\text{Li}\_2\text{OHCl}\$](#)
  4. Poster contributed by Jason Howard at the [29th Annual Workshop on Recent Developments in Electronic Structure Methods](#) June 25-28, 2017 at Princeton University -- [First Principles Simulations of  \$\text{Li}\_2\(\text{OH}\)\text{Cl}\$](#)
  5. Poster contributed by Ahmad Al-Qawasmeh at the [29th Annual Workshop on Recent Developments in Electronic Structure Methods](#) June 25-28, 2017 at Princeton University --  [\$\text{Li}\_{14}\text{P}\_2\text{O}\_3\text{N}\_6\$ : Computational study of a possible new electrolyte for Li ion batteries](#)
  6. Talk presented by Jason Howard at the [March 2017 Meeting of the American Physical Society](#), March 13-17, 2017 in New Orleans, LA [DFT simulations of Li-ion conductor  \$\text{Li}\_2\(\text{OH}\)\text{Cl}\$](#)
  7. Talk presented by Ahmad N. Al-Qawasmeh at the [March 2017 Meeting of the American Physical Society](#), March 13-17, 2017 in New Orleans, LA  [\$\text{Li}\_{14}\(\text{PON}\_3\)\_2\$ : Computational study of a possible new electrolyte for Li ion batteries.](#)
  8. Talk presented by Larry Rush, Jr. at the [March 2017 Meeting of the American Physical Society](#), March 13-17, 2017 in New Orleans, LA [Computational Study of Ideal Electrolyte/Anode Interface for  \$\text{Na}\_3\text{Sb}\_4/\text{Na}\$ .](#)
  9. Poster presented by N. A. W. Holzwarth at the [18th International Meeting on Lithium Batteries](#), June 19-24, 2016 in Chicago, IL.  [\$\text{Li}\_4\text{SnS}\_4\$ : Simulations of Its Structure and Electrolyte Properties](#)
  10. Talk presented by Larry Rush, Jr. at the [March 2016 Meeting of the American Physical Society](#), March 14-18, 2016 in Baltimore, MD. [First principles investigation of the structural and electrochemical properties of  \$\text{Na}\_4\text{P}\_2\text{S}\_6\$  and  \$\text{Li}\_4\text{P}\_2\text{S}\_6\$](#)
  11. Talk presented by Jason Howard at the [March 2016 Meeting of the American Physical Society](#), March 14-18, 2016 in Baltimore, MD. [Computational study of  \$\text{Li}\_{2+x}\text{SnO}\_3\$  and  \$\text{Li}\_{2+x}\text{SnS}\_3\$](#)
  12. Talk presented by Ahmad Al-Qawasmeh at the [March 2016 Meeting of the American Physical Society](#), March 14-18, 2016 in Baltimore, MD. [Computational study of Li ion electrolytes composed of  \$\text{Li}\_3\text{AsS}\_4\$  alloyed with  \$\text{Li}\_4\text{GeS}\_4\$](#)
  13. Talk presented by N. A. W. Holzwarth (based on work of Nicholas Lepley) at the [March 2016 Meeting of the American Physical Society](#), March 14-18, 2016 in Baltimore, MD. [A formalism for modeling solid electrolyte/electrode interfaces using first principles methods](#)
  14. Talk presented by Jason Howard at the 228th ECS Meeting, October 11-15, 2015 in Phoenix, AZ. "Computational Study of  $\text{Li}_2\text{SnO}_3$  and  $\text{Li}_2\text{SnS}_3$ ".
  15. Talk presented by N. A. W. Holzwarth at the 228th ECS Meeting, October 11-15, 2015 in Phoenix, AZ. "Electrolyte properties of  $\text{Li}_4\text{P}_2\text{S}_6$  -- Simulations and comparison with experiment; Contrast with simulations of Na analog", in collaboration with Z. D. Hood, M. J. Kirkham, and L. E. Rush, Jr..
  16. Undergraduate honors thesis by Hannah Zhang, in partial fulfillment of the Wake Forest University requirements for graduation with Honors in Physics (May 2015) --



- "Computational Modeling of Li Diffusion Using Molecular Dynamics" .
17. Contributed talk presented by Nicholas Lepley at the March Meeting 2015 of the American Physical Society March 2-6, 2015 in San Antonio, Texas. Modeling Electrolyte-Electrode interfaces with co-author N. A. W. Holzwarth
  18. Contributed talk presented by N. A. W. Holzwarth at the March Meeting 2015 of the American Physical Society March 2-6, 2015 in San Antonio, Texas. Structure and interface properties of the electrolyte material  $\text{Li}_4\text{P}_2\text{S}_6$  with co-authors Zachary D. Hood (Oak Ridge National Laboratory) and Cameron M. Kates (currently at Duke U.).
  19. Contributed poster presented by Nicholas Lepley at 2014 summer school on Transformational Technologies in Molecular Simulations held at University of Wisconsin-Madison, Madison, WI May 19-22, 2014 -- Modeling the Interface of Lithium Metal and Lithium Solid Electrolytes with First Principles calculations.
  20. Contributed poster presented by Chaochao Dun at the 26th Annual Workshop on Recent Developments in Electronic Structure Methods held at the University of North Texas, May 18-21, 2014 -- First principles simulations of  $\text{Cu}_2\text{ZnSnS}_x\text{O}_{4-x}$  alloys.
  21. Undergraduate honors thesis by James Drewery, in partial fulfillment of the Wake Forest University requirements for graduation with Honors in Physics -- Modeling Materials: Comparison of Two Projector-Augmented Wave (PAW) Datasets.
  22. Undergraduate honors thesis by Cameron Kates, in partial fulfillment of the Wake Forest University requirements for graduation with Honors in Physics -- Computational Modeling of Surface Energy and Structural Behavior of  $\text{Li}_4\text{P}_2\text{S}_6$  Electrolytic Solid Interfacing with Lithium Anodes.
  23. Contributed talk presented by Chaochao Dun (in collaboration with N. A. W. Holzwarth, Y. Li, W. Huang, and D. Carroll) APS March Meeting 2014, Denver, Colorado Mar. 3 - 7, 2014 --  $\text{Cu}_2\text{ZnSnS}_x\text{O}_{4-x}$  and  $\text{Cu}_2\text{ZnSnS}_x\text{Se}_{4-x}$ : First principles simulations of optimal alloy configurations and their energies
  24. Contributed talk presented by N. A. W. Holzwarth (with content from N. D. Lepley, A. Al-Qawasmeh, and C. Kates) at the APS March Meeting 2014, Denver, Colorado Mar. 3 - 7, 2014 -- First principles modeling of lithium (thio) phosphate solid electrolytes and lithium metal anodes
  25. Contributed talk presented by N. A. W. Holzwarth (with content from N. D. Lepley and A. Al-Qawasmeh) at the 224<sup>th</sup> ECS Meeting, in San Francisco, CA, Oct. 27-Nov. 1, 2013 -- First principles modeling of electrolyte/anode interfaces in an all-solid state battery --  $\gamma$ - $\text{Li}_3\text{PS}_4/\text{Li}$
  26. Contributed poster presented by N. A. W. Holzwarth (with content from N. D. Lepley) at the The 25th Annual Workshop on Recent Developments in Electronic Structure Methods held at the College of William and Mary, June 11-14, 2013 -- First principles modeling of the interface between a solid state lithium thiophosphate electrolyte and a lithium metal anode
  27. Contributed talk presented by N. A. W. Holzwarth (in collaboration with K. Senevirathne, C. Day, A. Lachgar, and M. Gross) at the APS March Meeting 2013 in Baltimore, MD, Mar. 18 - Mar. 22, 2013 -- Design and synthesis of a crystalline LiPON electrolyte
  28. Contributed talk presented by Nicholas Lepley (in collaboration with N. A. W. Holzwarth)

- at the APS March Meeting 2013 in Baltimore, MD, Mar. 18 - Mar. 22, 2013 -- Surface Structure and Stability in  $\text{Li}_3\text{PS}_4$  and  $\text{Li}_3\text{PO}_4$  Electrolytes from First Principles
29. Poster presented by N. Lepley at the ES12: 24th Annual Meeting of the Electronic Structure Workshop -- June 5-8, 2012 -- Computer Modeling of Crystalline Electrolytes - Lithium Thiophosphates and Phosphates.
  30. Poster presented by N. Holzwarth at the ES12: 24th Annual Meeting of the Electronic Structure Workshop -- June 5-8, 2012 -- First Principles Computer Simulations of  $\text{Li}_{10}\text{GeP}_2\text{S}_{12}$  and Related Lithium Superionic Conductors.
  31. Contributed talk presented by N. A. W. Holzwarth at the APS March Meeting 2012 in Boston, MA, Feb. 27 - Mar. 2, 2012 -- First principles computer simulations of  $\text{Li}_{10}\text{GeP}_2\text{S}_{12}$  and related lithium superionic conductors
  32. Contributed talk presented by Nicholas Lepley at the APS March Meeting 2012 in Boston, MA, Feb. 27 - Mar. 2, 2012 -- First principles investigation of the superionic electrolyte  $\text{Li}_7\text{P}_3\text{S}_{11}$
  33. Contributed talk presented by Xiao Xu at the APS March Meeting 2012 in Boston, MA, Feb. 27 - Mar. 2, 2012 -- Projector Augmented Wave formulation of orbital-dependent exchange-correlation functionals
  34. Poster presented by N. A. W. Holzwarth and N. Lepley at The 15th International Meeting on Lithium Batteries in Montreal, Canada June 27 - July 2, 2010 -- Computer Modeling of Lithium Phosphate and Thiophosphate Electrolyte Materials
  35. Poster presented by Xiao Xu at 22nd Annual Workshop on Electronic Structure Methods at the University of Texas - Austin, June 7-10, 2010 -- Projector augmented wave (PAW) formulation of Hartree-Fock calculations of electronic structure -- HF-PAW
  36. Poster presented by N. A. W. Holzwarth at 22nd Annual Workshop on Electronic Structure Methods at the University of Texas - Austin, June 7-10, 2010 -- Two implementations of the Projector Augmented Wave (PAW) formalism
  37. Talk presented by N. A. W. Holzwarth at 2010 APS March Meeting in Portland, OR March 2010 -- "Prediction of a New Material -- Lithium Phosphorus Oxynitride  $\text{Li}_2\text{PO}_2\text{N}$ "
  38. Talk presented by N. A. W. Holzwarth at 216<sup>th</sup> Biannual Meeting of the Electrochemical Society Meeting October 4-9, 2009 in Vienna, Austria -- First principles simulations of Li ion migration in materials related to LiPON electrolytes
  39. Poster presented by N. A. W. Holzwarth at 21th Annual Workshop on Recent Developments in Electronic Structure Methods at the University of California Davis campus, June 22-25, 2009 -- Simulations of Li-ion migration in LiPON electrolytes
  40. Talk presented by Yaojun Du at 2009 APS March Meeting in Pittsburgh, PA, March 2009 - - First-principles simulations of extended structures in the lithium phosphorous oxynitride electrolytes
  41. Talk presented by Xiao Xu at 2009 APS March Meeting in Pittsburgh, PA, March 2009 -- Implementation of the Optimized Effective Potential Method within the Projector Augmented Wave Scheme
  42. Poster presented by Xiao Xu at 20th Annual Workshop on Recent Developments in Electronic Structure Methods in the University of Illinois at Urbana-Champaign, June 17-20, 2008 -- "Projector Augmented Wave Formulation of Optimized Effect Potential Density Functional Theory -- PAW-OEP"
  43. Talk presented by Yaojun Du at 213th Biannual Meeting of the Electrochemical Society in Phoenix, AZ May 18-22, 2008 -- "Li ion migration in  $\text{Li}_3\text{PO}_4$  electrolytes: Effects of O vacancies and N substitutions"
  44. Talk presented by N. A. W. Holzwarth at 2008 APS March Meeting in New Orleans, LA, March 2008 -- Simulation of Li ion diffusion near electrolyte-metal interface --  $\text{Li}_3\text{PO}_4$  and Li
  45. Poster presented by William Hodge at 2008 APS March Meeting in New Orleans, LA,

- March 2008 -- The One-Hole, One-Dimensional Hubbard Model at  $U = \infty$
46. Poster presented by Xiao Xu at 19th Annual Workshop on Recent Developments in Electronic Structure Methods in Raleigh, NC June 2007 -- Projector Augmented Wave Formulation of Exact Exchange Density Functional Theory -- PAW-EXX
  47. Poster presented by Yaojun Du at 19th Annual Workshop on Recent Developments in Electronic Structure Methods in Raleigh, NC June 2007 -- Li ion diffusion mechanisms in  $\text{Li}_3\text{PO}_4$  electrolytes
  48. Talk presented by Xiao Xu at March 2007 APS meeting in Denver -- Simulated electrolyte-metal interfaces --  $\text{Li}_3\text{PO}_4$  and Li
  49. Talk presented by Dr. Yaojun Du at March 2007 APS meeting in Denver -- Li-ion diffusion mechanisms in crystalline  $\text{Li}_3\text{PO}_4$  electrolytes
  50. Poster presented by William Hodge at March 2007 APS meeting in Denver -- Pair State Analysis of the Hubbard Hamiltonian in One-Dimension

### Thesis Students (from last 15 years)

1. Dominique S. Itanze – thesis defense on June 26, 2024 – jointly mentored with Scott Geyer and Patricia Dos Santos (Chemistry) -- “First-Principles Simulations for Catalysis for Sustainable Production of Fuels and Chemicals”
2. Yan Li, Ph. D. -- December 2021 – “First Principles Investigations of Electrolyte Materials in All-Solid-State Batteries”
3. Ahmad Al-Qawasmeh -- Ph. D. August 2018 – “Ab Initio Simulations of Idealized Solid Electrolytes in Lithium Ion Batteries”
4. Jason Howard -- Ph. D. May 2018 – “First-Principles Simulations of Solid State Battery Materials”
5. Larry E. Rush Jr – M. S. May 2017 – “First-Principles Investigation of Electronic Properties in Sodium-ion Electrolytes for Solid-state Battery Materials”
6. Nicholas D. Lepley – Ph. D. December 2015 – “First Principles Investigations of Solid-Solid Interfaces in Lithium Battery Materials”
7. Nicholas D. Lepley – M. S. December 2013 – “An investigation of lithium solid electrolyte materials with first principles calculations”
8. Xiao Xu – Ph. D. August 2011 – “Orbital Dependent Functionals: An Atom Projector Augmented Wave Method Implementation”
9. William Hodge – Ph. D. August 2008 (also mentored by W. C. Kerr) – “Exact and variational investigations of Hubbard rings”
10. Kevin Conley – Ph. D. May 2008 – “A Dirac all-electron basis and spin-orbit coupled project implementation of the projector augmented wave method for atomic systems”
11. Ping Tang – Ph. D. August 2006 – “Computational research on lithium ion battery materials”
12. Yonas Abraham – Ph. D. December 2004 (also mentored by R. T. Williams) – “Electronic states near surfaces – a) Analysis of calculation methods using semi-infinite boundary conditions; b) Sensitive detection using laser photoelectron spectroscopy

### Other professional activities

1. Reviewer for Physical Review journals and others; served on NSF and APS review panels.
2. For two years (2018 and 2017), together with Richard Hennig (University of Florida) and Francois Gygi (University of California at Davis) and a few others, have served on the advisory board for the Center for Predictive Simulation of Functional Materials, directed by Paul Kent (Oak Ridge National Laboratory), participating in a yearly review and preparing

- a short report.
3. Together with colleagues Timo Thonhauser and Akbar Salam formed the local organizing committee for ES12: The *24th Annual Workshop on Recent Developments in Electronic Structure Theory*, held June 5-8, 2012 at Wake Forest University in Winston-Salem, NC 27109.

### **Grant funding (from last 10 years)**

1. NSF DMR-2242959: Computational studies of solid electrolytes – 04/01/2023-3/31/2025 -- \$186,395
2. NSF DMR-1940324: Computational studies of solid electrolytes – 03/20/2020-03/31/2023 -- \$200,000
3. NSF DMR-1507942: Computational studies of solid electrolytes – 09/01/2015-08/31/2019 -- \$300,000
4. NSF DMR-1105485: First principles simulations of battery materials -- 09/01/2011-08/31/2015 -- \$300,000
5. NSF DMR-0705239: First Principles Simulations of Battery Materials -- 12/15/2007-11/30/2011 -- \$225,000
6. NSF DMR-0427055: ITR - Computational Tools for Detailed Simulations of Materials -- 09/01/2004-08/31/2010 -- \$336,000
7. NSF DMR-0405456: Computational Study of Transition Metal Phosphate Materials -- 08/01/2004- 07/31/2008 -- \$143,000