

Department of Chemistry
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Research Vision

My research pertains to solid-state and materials chemistry; my interest lies in discovering and understanding emergent properties and reactivity of materials to achieve a paradigm of materials design. As materials are key enablers of technology, the goal of this research is to discover and design new functionality in materials, *i.e.*, control macroscopic electronic and magnetic properties through the competition of local interactions in materials. While we primarily perform experiments to make materials, characterize their structure and properties, we gain additional insight through numerical calculations and simulations.

Employment

2019–current Associate Professor.

2013–2019 Assistant Professor.

Department of Chemistry, Colorado State University, Fort Collins, CO USA.

2011–2013 Post-doctoral Associate.

Department of Chemistry, Department of Physics & Astronomy, and the Institute for Quantum Matter, Johns Hopkins University, Baltimore, MD USA.

Research: *Development of low-temperature routes to inorganic materials and structure/property relationships in strongly correlated electron materials and superconductors.*

Advisor: Professor Tyrel M. McQueen.

Education

2006–2011 Ph.D., Biomolecular Science & Engineering.

University of California Santa Barbara, Santa Barbara, CA USA.

Thesis title: *Kinetic Control of Aqueous Hydrolysis: Modulation of Structure/Property Relationships in Inorganic Crystals.*

Advisor: Professor Daniel E. Morse.

2005 Summer Undergraduate Research Fellowship.

University of Cambridge, Cambridge, U.K.

Research: *Vibrational properties of glasses.*

Advisor: Professor Stephen R. Elliot.

2002–2006 B.S., Materials Science & Engineering, June 2006. Minor in Spanish.

Lehigh University, Bethlehem, PA USA.

Research: *Chalcogenide glasses and Nanolithography.*

Advisor: Professor Himanshu Jain.

Graduate / Undergraduate Awards

National Science Foundation, Graduate Research Fellowship, 2007-2010

MRS Graduate Student Award, Silver Medalist, 2010

Barry M. Goldwater Scholar, 2005

Awards

- American Chemical Society *Chemistry of Materials* Lectureship and Best Paper Award, 2019.
- Research Corporation for Science Advancement, Scialog: Advanced Energy Storage Team Awards, 2018.
- College of Natural Sciences, Colorado State University, *Early Career (Pre-Tenure) Faculty Excellence in Teaching and/or Mentoring Award*, 2017.
- Research Corporation for Science Advancement, Scialog Fellow: Advanced Energy Storage, 2017.
- Alfred P. Sloan Foundation, Sloan Research Fellowship, 2017-2019.
- Research Corporation for Science Advancement, Cottrell Scholar Award, 2017-2020.
- National Science Foundation, Early CAREER Award, 2017-2022.
- Department of Energy Early Career Award, 2016-2021.

Group / Mentoring

Graduate Students: Total: 14, including alumni.

Current: Gia Thinh Tran (2018–current); Alexandra Koegel (2017–current); Chris Rom (2017–current); Jewels Fallon (2016–current); Ethan Emerson (2015–current); Eve Mozur (2015–current); Paul Todd (2015–current); Arnold Paecklar (2014–current).

Alumni: Victoria Combs (2016–2019); Dr. Annalise Maughan (2013–2018, PhD); Mary Marisa (2013–2017, MS); Dr. Andrew Martinolich (2013–2017, PhD); Michael Tarne (2014–2017, MS); Loryn Killpack (2014–2016, MS); Greg Terho (2013–2014, MS).

Postdoctoral Associates: Total: 2, including alumni.

Current: Dr. Allison Wustrow (2019–current).

Alumni: Dr. Iain Oswald (2017–2019); Dr. Josh Kurzman (2013–2015).

Visiting Scholars: Prof. Takafumi Yamamoto (Tokyo Institute of Technology, Fall 2018); Prof. Kate Ross (CSU, 2014–2015); Prof. Catherine Oertel (Oberlin College, summers 2016, 2017).

Undergraduate Interns: Total: 15, including alumni.

Current: Julia Trowbridge (2016–current); Ben Wasinger (2018–current); Callan Knebel (2019–current); Jose Rivera (2019–current).

Alumni: Erik Rognerud (2016–2018); Matt Gorman, (2016–2018); Andrew Candia (2016–2017); Alex Milder (Haverford REU 2017); Kyle Peterson (2016–2017); David Boyle (JMU REU 2016); Mohammed Almaker (2016); Juliette Granger (2015–2016); J. James Allen (2014–2016); Mitchel Bordelon (2013–2016); Geordan Brickey (2013–2014).

Publications (updated August 14, 2019)

With DOI links where available. Also listed at: <http://sites.chem.colostate.edu/neilsonlab/research.html>
Citation tracking at: [Google Scholar](#).

In Press or Review (manuscripts available upon request)

E. G. Rognerud, C. L. Rom, P. K. Todd, N.R. Singstock, C. J. Bartel, A. M. Holder, J. R. Neilson, Kinetically-controlled low-temperature solid-state metathesis of manganese nitride Mn_3N_2 . *Under revision*.

P. K. Todd, A. M. M. Smith, J. R. Neilson, Yttrium manganese oxide phase stability and selectivity using lithium carbonate assisted metathesis reactions. *Under revision*.

M. J. Fallon, A. J. Martinolich, A. E. Maughan, L. C. Gallington, J. R. Neilson, Low-Temperature Synthesis of Superconducting Iron Selenide Using a Triphenylphosphine Flux. *Under review*.

I. W. H. Oswald, H. Ahn, J. R. Neilson, Influence of organic cation rigidity on structural templating in hybrid metal-halides. *Under review*.

Awarded US Patents:

1. J. R. Neilson, T. M McQueen, *Magnetocaloric materials for cryogenic liquification*. United States Patent, 9,568,223 (Feb 14, 2017). [USPTO]

Appeared

59. E. M. Mozur, J. C. Trowbridge, A. E. Maughan, M. J. Gorman, C. M. Brown, T. R. Prisk, J. R. Neilson, Dynamical Phase Transitions and Cation Orientation Dependent Photoconductivity in $\text{CH}(\text{NH}_2)_2\text{PbBr}_3$. *ACS Materials Lett.*, (2019), 1, 2, 260-264. [doi]
58. G. Hester, H. S. Nair, T. Reeder, D. R. Yahne, T. N. DeLazzer, L. Berges, D. Ziat, J. A. Quilliam, J. R. Neilson, A. A. Aczel, G. Sala, K. A. Ross, A Novel Strongly Spin-Orbit Coupled Quantum Dimer Magnet: $\text{Yb}_2\text{Si}_2\text{O}_7$. *Phys. Rev. Lett.*, 123, 027201. [arXiv][doi]
57. J. Hu, I. W. H. Oswald, H. Hu, S. J. Stuard, M. M. Nahid, L. Yan, Z. Chen, H. Ade, J. R. Neilson, W. You, Aryl-Perfluoroaryl Interaction in Two-Dimensional Organic-Inorganic Hybrid Perovskites Boosts Stability and Photovoltaic Efficiency. *ACS Materials Lett.*, (2019) 1, 1,171-176. [doi]
56. V. E. Combs, I. W. H. Oswald, J. R. Neilson, Hydrothermal Crystal Growth of Mixed Valence Cs_2SbBr_6 . *Cryst. Growth & Des.*, (2019), 19, 7, 4090-4094. [doi]
55. I. W. H. Oswald, I. P. Moseley, H. Ahn, J. R. Neilson, Hybrid charge-transfer semiconductors: $(\text{C}_7\text{H}_7)\text{SbI}_4$, $(\text{C}_7\text{H}_7)\text{BiI}_4$, and their halide congeners, *Inorg. Chem.*, (2019), 58(9), 5818-5826. [doi] [ChemRxiv]
54. J. Hu, I. W. H. Oswald, S. Stuard, M. M. Nahid, N. Zhou, O. Williams, Z. Guo, L. Yan, H. Hu, Z. Chen, X. Xiao, Y. Lin, Z. Yang, J. Huang, A. Moran, H. Ade, J. R. Neilson, W. You, Synthetic Control over Orientational Degeneracy of Spacer Cations Enhances Solar Cell Efficiency in Two-Dimensional Perovskites. *Nat. Commun.*,(2019) 10, 1276. [doi]
53. A. E. Maughan, A. M. Ganose, D. O. Scanlon, J. R. Neilson, Perspectives and Design Principles of Vacancy-Ordered Double Perovskite Halide Semiconductors, *Chem. Mater.*, (2019), 31(4), 1184-1195. [doi]
52. P. K. Todd, J. R. Neilson, Selective Formation of Yttrium Manganese Oxides through Kinetically Competent Assisted Metathesis Reactions, *J. Am. Chem. Soc.* (2019), 141 (3), 1191-1195. [doi]
51. I. W. H. Oswald, A. A. Koegel, J. R. Neilson. General Synthesis Principles for Ruddlesden-Popper Hybrid Perovskite Halides from a Dynamic Equilibrium. *Chem. Mater.* (2018), 30(23), 8606-8614. [doi]
50. A. E. Maughan, A. A. Paecklar, J. R. Neilson, Bond valences and anharmonicity in vacancy-ordered double perovskite halides, *J. Mater. Chem. C.* (2018), 6, 12095-12104. [doi]
49. M. Mondal, D. Chaudhuri, M. Salehi, C. Wan, N. J. Laurita, B. Cheng, A. V. Stier, M. A. Quintero, J. Moon, D. Jain, P. P. Shibayev, J. R. Neilson, S. Oh, N. P. Armitage, Electric field modulated topological magnetoelectric effect in Bi_2Se_3 , *Phys. Rev. B.* (2018) 98, 121106(R) [doi]





48. I. Bakst, K. J. Dusoe, G. Drachuck, J. R. Neilson, P. C. Canfield, S.-W. Lee, C. R. Weinberger, The effects of point defects on the mechanical response of LaRu₂P₂. *Acta Mater.* (2018) 160, 224-234. [doi]
47. I. Bhowmick, A. J. Roehl, J. R. Neilson, A. K. Rappé, M. P. Shores, Slow magnetic relaxation in octahedral low-spin Ni(III) complexes, *Chem. Sci.* (2018) 9, 6564-6571. [doi]
46. A. E. Maughan, A. M. Ganose, M. A. Almaker, D. O. Scanlon, and J. R. Neilson, Tolerance Factor and Cooperative Tilting Effects in Vacancy-Ordered Double Perovskite Halides, *Chem. Mater.* (2018), 30(11), 3909-3919. [doi]
45. I. Bakst, J. T. Sypek, J. R. Neilson, S.-W. Lee, C. R. Weinberger, Modeling pseudo-elastic behavior in small-scale ThCr₂Si₂-type crystals. *Comp. Mat. Sci.* (2018), 150, 86-95. [doi]
44. A. E. Maughan, A. M. Ganose, A. M. Candia*, J. T. Granger*, D. O. Scanlon, and J. R. Neilson, Anharmonicity and Octahedral Tilting in Defect-Ordered Hybrid Perovskites. *Chem. Mater.* (2018), 30(2), 472-483. (*ACS Editors' Choice; Issue cover graphic*) [doi]
43. D. Olds, K. V. Lawler, A. A. Paecklar, J. Liu, K. L. Page, P. F. Peterson, P. M. Forster, and J. R. Neilson, Capturing the details of N₂ adsorption in zeolite X using stroboscopic isotope contrasted neutron total scattering. *Chem. Mater.* (2018), 30(1), 296-302. [doi]
42. M. J. Tarne, M. M. Bordelon, S. Calder, J. R. Neilson, K. A. Ross, Tuning the antiferromagnetic helical pitch length and nanoscale domain size in Fe₃PO₄O₃ by magnetic dilution. *Phys. Rev. B* (2017) 96, 214431. [arXiv],[doi]
41. E. M. Mozur, A. E. Maughan, Y. Cheng, A. Huq, N. Jalarvo, L. L. Daemen, and J. R. Neilson, Orientational Glass Formation in Substituted Hybrid Perovskites. *Chem. Mater.* (2017), 29(23), 10168-10177. [doi]
40. D. Olds, P. F. Peterson, M. K. Crawford, J. R. Neilson, H.-W. Wang, P. S. Whitfield, K. Page., Combinatorial Appraisal of Transition States for in situ Pair Distribution Function Analysis. *J. Appl. Crystallogr.* (2017) 50, 1-10. [doi]
39. D. Olds, K. Page, A. Paecklar, P. Peterson, J. Liu, G. Rucker, M. Ruiz-Rodriguez, M. Olsen, M. Pawel, S. Overbury, and J. R. Neilson, A high precision gas flow cell for performing in situ neutron studies of local atomic structure in catalytic materials. *Rev. Sci. Inst.* (2017) 88, 034101. [doi]
38. A. J. Martinolich, J. R. Neilson, Towards Reaction-By-Design: Achieving Kinetic Control of Solid State Chemistry with Metathesis. *Chem. Mater.* (2017) 29(2), 479-489. (*Invited perspective*) [doi]
37. M. E. Marisa, S. Zhou, B. C. Melot, G. F. Peaslee, J. R. Neilson, Paracrystalline Disorder from Phosphate Ion Orientation and Substitution in Synthetic Bone Mineral. *Inorg. Chem.* (2016) 55(23), 12290-12298. [doi]
36. A. J. Martinolich, J. A. Kurzman, J. R. Neilson, Circumventing Diffusion in Kinetically-Controlled Solid-State Metathesis Reactions, *J. Am. Chem. Soc.* (2016), 138(34), 11031-11037. [doi]
35. A. E. Maughan, A. M. Ganose, M. M. Bordelon, E. M. Miller, D. O. Scanlon, and J. R. Neilson, Defect tolerance to intolerance in the vacancy-ordered double perovskite semiconductors Cs₂SnI₆ and Cs₂TeI₆. *J. Am. Chem. Soc.* (2016), 138(27), 8453-8464. [doi]
34. A. J. Martinolich, R. J. Higgins, M. P. Shores, J. R. Neilson, Lewis Base Mediated Polymorph Selectivity of Pyrite CuSe₂ Through Atom Transfer In Solid State Metathesis. *Chem. Mater.* (2016), 26(6), 1854-1860. [doi]



33. J. A. Kurzman, A. J. Martinolich, and J. R. Neilson. Influence of interstitial Mn on local structure and magnetism in $\text{Mn}_{1+\delta}\text{Sb}$. *Phys. Rev. B* (2015), 92, 184414. [arXiv],[doi]
32. K. A. Ross, M. M. Bordelon, G. S. Terho, J. R. Neilson, Nanosized helical magnetic domains in strongly frustrated $\text{Fe}_3\text{PO}_4\text{O}_3$. *Phys. Rev. B*, (2015), 92, 134419. [arXiv],[doi]
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30. M. Mourigal, S. Wu, M. B. Stone, J. R. Neilson, J. M. Caron, T. M. McQueen, C. L. Broholm, Block magnetic excitations in the orbitally-selective Mott insulator BaFe_2Se_3 , *Phys. Rev. Lett.*, (2015), 115, 047401. [arXiv],[doi]
29. J. A. Kurzman, K. E. Dettelbach, A. J. Martinolich, C. P. Berlinguette, J. R. Neilson, Structural Characteristics and Eutaxy in the Photo-Deposited Amorphous Iron Oxide Oxygen Evolution Catalyst. *Chem. Mater.*, (2015), 27(9), 3462–3470. [doi]
28. A. J. Martinolich, J. A. Kurzman, J. R. Neilson, Polymorph Selectivity of Superconducting CuSe_2 Through Kinetic Control of Solid-State Metathesis. *J. Am. Chem. Soc.*, (2015), 137(11), 3827–3833. [doi]
27. A. E. Maughan, J. A. Kurzman, J. R. Neilson, Hybrid Inorganic-Organic Materials with an Optoelectronically Active Aromatic Cation: $(\text{C}_7\text{H}_7)_2\text{SnI}_6$ and $\text{C}_7\text{H}_7\text{PbI}_3$. *Inorg. Chem.*, (2015), 54(1), 370–378. [doi]
26. J. P. Sheckleton, J. R. Neilson, T. M. McQueen, Electronic tunability of the frustrated triangular-lattice cluster magnet $\text{LiZn}_{2-x}\text{Mo}_3\text{O}_8$, *Mater. Horiz.*, (2015), 2, 76–80. [doi]
25. A. J. Martinolich, J. R. Neilson, Pyrite Formation via Kinetic Intermediates Through Low-Temperature Solid-State Metathesis, *J. Am. Chem. Soc.*, (2014), 136(44) 15654–15659. [doi]
24. J. R. Neilson, N. C. George, M. M. Murr, R. Seshadri, D. E. Morse, Mesostructure from hydration gradients in demosponge biosilica, *Chem. Eur. J.*, (2014), 20(17) 4956-4965. [doi]
23. P. Cottingham, D. C. Miller, J. P. Sheckleton, J. R. Neilson, M. Feyngenson, A. Huq, T. M. McQueen, Dynamic charge disproportionation in the 1D chain material PdTeI . *J. Mater. Chem. C*, (2014), 2, 3238–3246. [doi]
22. L. Tao, G. Rousse, J. R. Neilson, B. C. Melot, T. M. McQueen, C. Masquelier, Magnetic Structures of LiMBO_3 ($M = \text{Mn, Fe, Co}$) lithiated transition metal borates, *Inorg. Chem.*, (2013), 52 (20), 11966–11974. [doi]
21. W. A. Phelan, D. C. Wallace, K. E. Arpino, J. R. Neilson, K. J. Livi, C. R. Seabourne, A. J. Scott, T. M. McQueen, Stacking Variants and Superconductivity in the Bi-O-S System. *J. Amer. Chem. Soc.*, (2013), 135 (14) 5372–5374. [doi]
20. J. R. Neilson, A. Llobet, J. Wen, M. R. Suchomel, T. M. McQueen, Charge density wave fluctuations, heavy electrons, and superconductivity in KNi_2S_2 , *Phys. Rev. B*, (2013), 87, 045124. [arXiv],[doi]
19. J. R. Neilson, A. Llobet, A. V. Stier, L. Wu, J.-J. Wen, J. Tao, Y. Zhu, Z. B. Tesanovic, N. P. Armitage, T. M. McQueen, Mixed-valence-driven heavy-fermion behavior and superconductivity in KNi_2Se_2 , *Phys. Rev. B*, (2012), 86, 054512. [arXiv],[doi]



18. L. A. Bawazer, M. Izumi, D. Kolodin, J. R. Neilson, B. Schwenzer, D. E. Morse, Evolutionary selection of enzymatically synthesized semiconductors from biomimetic mineralization vesicles, *Proc. Natl. Acad. Sci. U.S.A.* (2012), 109 (26), E1705-E1714. [doi]
17. J. P. Sheckelton, J. R. Neilson, D. G. Soltan, T. M. McQueen, Possible valence bond condensation in the frustrated cluster magnet $\text{LiZn}_2\text{Mo}_3\text{O}_8$, *Nat. Mater.* (2012), 11, 493-496. [doi],[arXiv]
16. J. M. Caron, J. R. Neilson, D. C. Miller, K. Arpino, A. Llobet, T. M. McQueen, Orbital Selective Magnetism in the Spin-Ladder Iron Selenides $\text{Ba}_{1-x}\text{K}_x\text{Fe}_2\text{Se}_3$, *Phys. Rev. B*, (2012), 85, 180405(R). [arXiv], [doi] 
15. J. R. Neilson, T. M. McQueen, Bonding, ion mobility, and rate-limiting steps in deintercalation reactions with ThCr_2Si_2 -type KNi_2Se_2 , *J. Am. Chem. Soc.* (2012), 134 (18), 7750-7757. [doi]
14. J. M. Caron, J. R. Neilson, D. C. Miller, A. Llobet, T. M. McQueen, Iron displacements and magnetoelastic coupling in the spin-ladder compound BaFe_2Se_3 , *Phys. Rev. B*, (2011), 84, 180409(R). [arXiv],[doi] 
13. J. R. Neilson, J. A. Kurzman, R. Seshadri, D. E. Morse, Ordering double perovskite hydroxides by kinetically controlled aqueous hydrolysis, *Inorg. Chem.*, (2011), 50, 3003-3009. [doi]
12. J. R. Neilson, B. C. Melot, D. P. Shoemaker, J. Kurzman, R. Seshadri, D. E. Morse, Understanding complex magnetic order in disordered cobalt hydroxides through analysis of the local structure, *Phys. Rev. B*, (2011), 80, 094418. [arXiv],[doi]
11. B. Schwenzer, J. R. Neilson, S. M. Jeffries, D. E. Morse, $\text{Cd}_{1-x}\text{Zn}_x\text{O}$ [$0.05 \leq x \leq 0.26$] synthesized by vapor-diffusion induced co-nucleation from aqueous metal salt solutions, *Dalton Trans.*, (2011), 40 (6), 1295-1301. [doi]
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9. K. Niesz, C. Reji, J. R. Neilson, R. C. Vargas, D. E. Morse, Unusual evolution of ceria nanocrystal morphologies promoted by a low-temperature vapor diffusion based process, *Cryst. Growth Des.*, (2010), 10 (10), 4485-4490. [doi]
8. J. R. Neilson, J. A. Kurzman, R. Seshadri, D. E. Morse, Cobalt coordination and clustering in $\alpha\text{-Co}(\text{OH})_2$ revealed by synchrotron X-ray total scattering, *Chem. Eur. J.* (2010), 16 (33), 9998-10006. [doi]
7. J. R. Neilson, B. Schwenzer, R. Seshadri, D. E. Morse, Kinetic control of intralayer cobalt coordination in layered hydroxides: $\text{Co}_{1-0.5x}^{\text{oct}}\text{Co}_x^{\text{tet}}(\text{OH})_2(\text{Cl})_x(\text{H}_2\text{O})_n$, *Inorg. Chem.* (2009), 48 (23), 11017-11023. [doi]
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4. A. Kovalskiy, J. R. Neilson, A. C. Miller, F. C. Miller, M. Vlček, and H. Jain, Comparative study of electron- and photo-induced structural transformations on the surface of $\text{As}_{35}\text{S}_{65}$ amorphous thin films, *Thin Solid Films* (2008) 516, 7511-7518. [doi]
3. J. R. Neilson, A. Kovalskiy, M. Vlček, H. Jain, and F. Miller, Fabrication of nano-gratings in arsenic sulphide films, *J. Non-Cryst. Solids* (2007) 353, 1427-1430. [doi]
2. A. Kovalskiy, H. Jain, J. R. Neilson, M. Vlček, C. M. Waits, W. Churaman, M. Dubey, On the mechanism of gray scale patterning of Ag-containing As_2S_3 thin films, *J. Phys. Chem. Solids* (2007) 68, 920-925. [doi]
1. S. N. Taraskin, S. I. Simdyankin, S. R. Elliot, J. R. Neilson, and T. Lo, Universal features of terahertz absorption in disordered materials, *Phys. Rev. Lett.* (2006) 97, 055504. [doi]

Professional and Honor societies

American Chemical Society, American Physical Society, Materials Research Society, American Crystallographic Association, Neutron Scattering Society of America, *Phi Beta Kappa*, *Tau Beta Pi*.