

Patrick L. Holland

Professor of Chemistry

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Professional Positions

Yale University

Professor of Chemistry (2013-)

Conkey P. Whitehead Professor of Chemistry (2021-)

University of Rochester

Professor of Chemistry (2010-2013)

Associate Professor of Chemistry (2005-2010)

Assistant Professor of Chemistry (2000-2005)

University of Minnesota (1997-2000)

National Institutes of Health Postdoctoral Fellow

Advisor: Prof. William B. Tolman

Education

University of California, Berkeley (1993-1997)

Ph.D. in Chemistry, September 1997

Advisors: Profs. Robert G. Bergman and Richard A. Andersen

Princeton University (1989-1993)

A.B. *magna cum laude* (high honors) in Chemistry, June 1993

Awards

Award for Excellence in Peer Reviewing, Petroleum Research Fund, 2021

Watkins Visiting Professor, Wichita State University, 2019

Xingda Lectureship, Peking University, 2017

Friedrich Wilhelm Bessel Research Award of the Humboldt Foundation, 2016

Fellow of the American Association for the Advancement of Science, 2015

Blavatnik Award for Young Scientists, 2013

Fulbright Scholar Award, 2012

ACS Rochester Section Volunteerism Award, 2010

Sloan Research Fellowship, 2003

NSF CAREER Award, 2002

NIH Postdoctoral Fellowship, University of Minnesota, 1997-1999

American Institute of Chemists Student Awardee, 1993

Phi Beta Kappa, Princeton University, 1993

Memberships in Learned Societies

Member, American Chemical Society

Member, Royal Society of Chemistry

Fellow, American Association for the Advancement of Science
Member, Inorganic Syntheses

Service to Chemistry Community

Volume Editor for *Comprehensive Organometallic Chemistry IV* (to be published 2022)
Guest Editor of *Chemical Reviews* Issue: "Reactivity of Nitrogen from the Ground to the Atmosphere" (2020)
Editorial Board of *Chemical Science* (2019-)
Editorial Board of *Chemical Society Reviews* (2019-)
Co-organizer of William B. Tolman Award Symposium at National ACS Meeting, San Francisco, CA (2017)
Chair of Inorganic Reaction Mechanisms Gordon Research Conference (2017)
Participant in DOE N₂ Fixation Workshop (2016)
Participant in NSF Nitrogen Cycle Workshop (2015)
Vice-Chair of Inorganic Reaction Mechanisms Gordon Research Conference (2015)
Participant in *Organometallics* Roundtable (2013)
Member, *Inorganic Syntheses* (2013-present)
Editorial Board of *Inorganic Chemistry* (2012-2014)
Editorial Board of *Journal of Biological Inorganic Chemistry* (2009-2012)
Awards Co-Chair, ACS Inorganic Division (2010-2012)
Chair, Harrison Howe Award Committee, ACS Rochester Section (2007-2009)
Organized symposium ("New Faces of Biomimetic Coordination Chemistry") at National ACS Meeting, Washington, DC (2009)
Co-organized symposium ("Beta-Diketiminates: A Renaissance of Reaction Chemistries") at National ACS Meeting, Washington, DC (2005)
Discussion leader at Gordon-Kenan Graduate Research Seminar in Bioinorganic Chemistry (2005 and 2012)
ad hoc member of many panels for NIH, DOE, and NSF grant review

Research Interests

Synthesis, electronic structure, geometry, and mechanisms of iron and cobalt complexes, with a particular focus on low-coordinate and high-spin complexes. Activation of small molecules, particularly alkenes, arenes, and N₂. Organometallic and bioinorganic catalysis.

Publications

h-index = 63. Total citations = 12,320.

Journal and Book Publications from Independent Career

177. K. L. Skubi, R. X. Hooper, B. Q. Mercado, M. M. Bollmeyer, S. N. MacMillan, K. M. Lancaster, P. L. Holland, "Iron Complexes of a Proton-Responsive SCS Pincer Ligand with Sensitive Electronic Structure," submitted.
176. D. Kim, D. W. N. Wilson, M. S. Fataftah, B. Q. Mercado, P. L. Holland, "Spin states,

- bonding and magnetism in mixed valence iron(0)-iron(II) complexes," submitted.
175. G. P. Connor, D. Delony, J. E. Weber, B. Q. Mercado, J. B. Curley, S. Schneider, J. M. Mayer, P. L. Holland, "Facile Conversion of Ammonia to a Nitride in a Rhenium System that Cleaves Dinitrogen," submitted.
 174. J. E. Weber, S. M. Bhutto, A. T.-Y. Genoux, P. L. Holland, "Dinitrogen Binding and Functionalization," in *Comprehensive Organometallic Chemistry IV* (Eds. K. Meyer, D. O'Hare, G. Parkin), in press.
 173. L. S. Yamout, M. Ataya, F. Hasanayn, P. L. Holland, A. J. M. Miller, A. S. Goldman, "Understanding Terminal versus Bridging End-on N₂ Coordination in Transition Metal Complexes," *J. Am. Chem. Soc.* **2021**, *143*, 9744-9757.
 172. D. W. N. Wilson, P. L. Holland, "Nitrogenases and model complexes in bioorganometallic chemistry," in *Comprehensive Organometallic Chemistry IV* (Eds. K. Meyer, D. O'Hare, G. Parkin), in press.
 171. J. E. Weber, F. Hasanayn, M. S. Fataftah, B. Q. Mercado, R. H. Crabtree, P. L. Holland, "Electronic and Spin-State Effects on Dinitrogen Splitting to Nitrides in a Rhenium Pincer System," *Inorg. Chem.* **2021**, *60*, 6115-6124.
 170. D. J. DiPrimio, P. L. Holland, "Repurposing Metalloproteins as Mimics of Natural Metalloenzymes for Small-Molecule Activation," *J. Inorg. Biochem.* **2021**, *219*, 111430.
 169. J. W. Peters, O. Einsle, D. R. Dean, S. DeBeer, B. M. Hoffman, P. L. Holland, L. C. Seefeldt, "Comment on 'Structural evidence for a dynamic metallocofactor during N₂ reduction by Mo-nitrogenase'," *Science* **2021**, *371*, eabe5481.
 168. D. Kim, G. Pillon, D. J. DiPrimio, P. L. Holland, "Highly Z-Selective Double Bond Transposition in Simple Alkenes and Allylarenes Through A Spin-Accelerated Allyl Mechanism," *J. Am. Chem. Soc.* **2021**, *143*, 3070–3074.
 167. A. L. Speelman, K. L. Skubi, B. Q. Mercado, P. L. Holland, "Synthesis and Reactivity of Iron Complexes with a Biomimetic SCS Pincer Ligand," *Inorg. Chem.* **2021**, *60*, 1965-1974.
 166. S. L. Shevick, C. V. Wilson, S. Kotesova, D. Kim, P. L. Holland, R. A. Shenvi, "Catalytic hydrogen atom transfer to alkenes: a roadmap for metal hydrides and radicals," *Chem. Sci.* **2020**, *11*, 12401-12422.
 165. A. L. Nagelski, M. S. Fataftah, M. M. Bollmeyer, S. F. McWilliams, S. N. MacMillan, B. Q. Mercado, K. M. Lancaster, P. L. Holland, "The Influences of Carbon Donor Ligands on Biomimetic Multi-Iron Complexes for N₂ Reduction," *Chem. Sci.* **2020**, *11*, in press.
 164. Q. J. Bruch, G. P. Connor, N. D. McMillan, A. S. Goldman, F. Hasanayn, P. L. Holland, A. J. M. Miller, "Considering Electrocatalytic Ammonia Synthesis via Bimetallic Dinitrogen Cleavage," *ACS Catal.* **2020**, *10*, 10826-10846.
 163. S. M. McWilliams, D. L. J. Broere, C. J. V. Halliday, S. M. Bhutto, B. Q. Mercado, P. L. Holland, "Coupling Dinitrogen and Hydrocarbons through Aryl Migration," *Nature* **2020**, *584*, 221-226. [Featured](#) in *Chem. Eng. News* "Year in Chemistry 2020" as one of the "Sensational Syntheses of 2020." Featured in [Org. Chem. Highlights](#).

162. D. Kim, C. Chen, B. Q. Mercado, D. J. Weix, P. L. Holland, "Mechanistic Study of Alkene Hydrosilylation Catalyzed by a β -Dialdiminate Cobalt(I) Complex," *Organometallics* **2020**, *39*, 2415-2424.
161. P. L. Holland, "Introduction: Reactivity of Nitrogen from the Ground to the Atmosphere," *Chem. Rev.* **2020**, *120*, 4919-4920.
160. G. Hochman, A. S. Goldman, F. A. Felder, J. M. Mayer, A. J. M. Miller, P. L. Holland, L. A. Goldman, P. Manocha, Z. Song, S. Aleti, "The potential economic feasibility of direct electrochemical nitrogen reduction as a route to ammonia," *ACS Sustainable Chem. Eng.* **2020**, *8*, 8938-8948.
159. Q. J. Bruch, G. P. Connor, C.-H. Chen, P. L. Holland, J. M. Mayer, F. Hasanayn, A. J. M. Miller, "Dinitrogen Reduction to Ammonium at Rhenium Utilizing Light and Proton-Coupled Electron Transfer," *J. Am. Chem. Soc.* **2019**, *141*, 20198-20208.
158. K. C. MacLeod, I. M. DiMucci, E. P. Zovinka, S. F. McWilliams, B. Q. Mercado, K. M. Lancaster, P. L. Holland, "Masked Radicals: Iron Complexes of Trityl, Benzophenone, and Phenylacetylene," *Organometallics* **2019**, *38*, 4224-4232.
157. A. L. Speelman, I. Coric, C. Van Stappen, S. DeBeer, B. Q. Mercado, P. L. Holland, "Nitrogenase-Relevant Reactivity of a Synthetic Iron-Sulfur-Carbon Site," *J. Am. Chem. Soc.* **2019**, *141*, 13148-13157.
156. G. P. Connor, B. Q. Mercado, H. M. C. Lant, J. M. Mayer, P. L. Holland, "Chemical oxidation of a coordinated PNP-pincer ligand forms unexpected Re-nitroxide complexes with reversal of nitride reactivity," *Inorg. Chem.* **2019**, *58*, 10791-10801.
155. D. E. DeRosha, V. G. Chilkuri, C. Van Stappen, E. Bill, B. Q. Mercado, S. DeBeer, F. Neese, P. L. Holland, "Planar three-coordinate iron sulfide in a synthetic [4Fe-3S] cluster with biomimetic reactivity," *Nature Chem.* **2019**, *11*, 1019-1025.
154. G. P. Connor, D. Kim, A. L. Nagelski, E. O. Schmidt, T. Hass-Mitchell, J. T. Atwater, S. A. Tridenti, S. Sohn, P. L. Holland, "Implementation of an Accessible Gas Chromatography Laboratory Experiment for High School Students," *J. Chem. Ed.* **2019**, *96*, 1707-1713.
153. D. E. DeRosha, N. A. Arnet, B. Q. Mercado, P. L. Holland, "A [2Fe-1S] Complex that Affords Access to Bimetallic and Higher Nuclearity Iron-Sulfur Clusters," *Inorg. Chem.* **2019**, *58*, 8829-8834.
152. D. Kim, S. M. W. Rahaman, B. Q. Mercado, R. Poli, P. L. Holland, "Roles of Iron Complexes in Catalytic Radical Alkene Cross-Coupling: A Computational and Mechanistic Study," *J. Am. Chem. Soc.* **2019**, *141*, 7473-7485.
151. S. M. Bhutto, P. L. Holland, "Dinitrogen Activation and Functionalization using β -Diketiminato Iron Complexes," *Eur. J. Inorg. Chem.* **2019**, 1861-1869.
150. L. Roy, M. H. Al-Afyouni, D. E. DeRosha, B. Mondal, I. M. DiMucci, K. M. Lancaster, J. Shearer, E. Bill, W. W. Brennessel, F. Neese, S. Ye, P. L. Holland, "Reduction of CO₂ by a Masked Two-Coordinate Cobalt(I) Complex and Characterization of a Proposed Oxidocobalt(II) Intermediate," *Chem. Sci.* **2019**, *10*, 918-929.
149. S. F. McWilliams, P. C. Bunting, V. Kathiresan, B. Q. Mercado, B. M. Hoffman, J. R.

- Long, P. L. Holland, "Isolation and Characterization of a High-Spin Mixed-Valent Iron Dinitrogen Complex," *Chem. Commun.* **2018**, *54*, 13339-13342.
148. S. F. McWilliams, E. Bill, G. Lukat-Rodgers, K. R. Rodgers, B. Q. Mercado, P. L. Holland, "Effects of N₂ Binding Mode on Iron-Based Functionalization of Dinitrogen to Form an Iron(III) Hydrazido Complex," *J. Am. Chem. Soc.* **2018**, *140*, 8586-8598.
147. K. L. Skubi, P. L. Holland, "So Close, Yet Sulfur Away: Opening the Nitrogenase Cofactor Structure Creates a Binding Site," *Biochemistry* **2018**, *57*, 3540-3541.
146. V. Pelmentschikov, L. B. Gee, H. Wang, K. C. MacLeod, S. F. McWilliams, K. L. Skubi, S. P. Cramer, P. L. Holland, "High-Frequency Fe-H Vibrations in a Bridging Hydride Complex Characterized by NRVs and DFT," *Angew. Chem.* **2018**, *57*, 9367-9371.
145. J. G. Chen, R. M. Crooks, L. C. Seefeldt, K. L. Bren, R. M. Bullock, M. Y. Darensbourg, P. L. Holland, M. J. Janik, A. K. Jones, M. G. Kanatzidis, P. King, K. M. Lancaster, S. V. Lymar, P. Pfromm, W. F. Schneider, R. R. Schrock, "Beyond fossil-fuel-driven nitrogen transformations," *Science* **2018**, *359*, 873.
144. S. J. Bonyhady, D. E. DeRosh, J. Vela, D. J. Vinyard, R. E. Cowley, B. Q. Mercado, W. W. Brennessel, P. L. Holland, "Iron and Cobalt Diazoalkane Complexes Supported by β -Diketiminato Ligands: A Synthetic, Spectroscopic and Computational Investigation," *Inorg. Chem.* **2018**, *57*, 5959-5972.
143. D. E. DeRosh, P. L. Holland, "Incorporating Light Atoms Into Synthetic Analogues of FeMoco," *Proc. Natl. Acad. Sci. USA* **2018**, *115*, 5054-5056.
142. D. L. J. Broere, B. Q. Mercado, J. T. Lukens, A. C. Vilbert, G. Banerjee, H. M. C. Lant, S. H. Lee, E. Bill, S. Sproules, K. M. Lancaster, P. L. Holland, "Reversible Ligand-Centered Reduction in Low-Coordinate Iron Formazanate Complexes," *Chem. Eur. J.* **2018**, *24*, 9417-9425.
141. D. L. J. Broere, B. Q. Mercado, P. L. Holland, "Selective Conversion of CO₂ to Isocyanate by Low-Coordinate Iron," *Angew. Chem. Int. Ed.* **2018**, *57*, 6507-6511.
140. D. L. J. Broere, B. Q. Mercado, E. Bill, K. M. Lancaster, S. Sproules, P. L. Holland, "Alkali Cation Effects on Redox-Active Formazanate Ligands in Iron Chemistry," *Inorg. Chem.* **2018**, *57*, 9580-9591.
139. D. L. J. Broere, P. L. Holland, "Boron compounds tackle dinitrogen," *Science* **2018**, *359*, 871.
138. E. Rozen, Y. Erlich, M. E. Reesbeck, P. L. Holland, C. N. Sukenik, "Functionalized Self-Assembled Monolayers Bearing Diiminato Complexes Immobilized through Covalently Anchored Ligands," *Langmuir* **2018**, *34*, 13472-13480.
137. G. P. Connor, N. Lease, A. Casuras, A. S. Goldman, P. L. Holland, J. M. Mayer, "Protonation and electrochemical reduction of rhodium- and iridium-dinitrogen complexes in organic solution," *Dalton Trans.* **2017**, *46*, 14325-14330.
136. N. A. Arnet, S. F. McWilliams, D. E. DeRosh, B. Q. Mercado, P. L. Holland, "Synthesis and Mechanism of Formation of Hydride-Sulfide Complexes of Iron," *Inorg. Chem.* **2017**, *56*, 9185-9193.
135. M. Horitani, K. Grubel, S. F. McWilliams, B. D. Stubbert, B. Q. Mercado, Y. Yu, P. M.

- Gurubasavaraj, N. S. Lees, P. L. Holland, B. M. Hoffman, "ENDOR Characterization of an Iron-Alkene Complex Provides Insight into a Corresponding Organometallic Intermediate of Nitrogenase," *Chem. Sci.* **2017**, *8*, 5941-5948.
134. S. F. McWilliams, E. Brennan-Wydra, K. C. MacLeod, P. L. Holland, "Density Functional Calculations for Prediction of ^{57}Fe Mössbauer Isomer Shifts and Quadrupole Splittings in β -Diketiminato Complexes," *ACS Omega* **2017**, 2594-2606.
133. P. L. Holland, "Reaction: Opportunities for Sustainable Catalysts," *Chem* **2017**, *2*, 443-444.
132. D. L. J. Broere, I. Čorić, A. Brosnahan, P. L. Holland, "Quantitation of the THF Content in $\text{Fe}[\text{N}(\text{SiMe}_3)_2]_2 \cdot x\text{THF}$," *Inorg. Chem.* **2017**, *56*, 3140-3143.
131. J. C. Lo, D. Kim, C.-M. Pan, J. T. Edwards, Y. Yabe, J. Gui, T. Qin, S. Gutiérrez, J. Giacoboni, M. W. Smith, P. L. Holland, P. S. Baran, "Fe-Catalyzed C-C Bond Construction from Olefins via Radicals," *J. Am. Chem. Soc.* **2017**, *139*, 2484-2503.
130. D. E. DeRoshia, B. Q. Mercado, G. Lukat-Rodgers, K. R. Rodgers, P. L. Holland, "Enhancement of C-H Oxidizing Ability in Co-O₂ Complexes through an Isolated Heterobimetallic Oxo Intermediate," *Angew. Chem. Int. Ed.* **2017**, *56*, 3211-3215.
129. M. E. Reesbeck, K. Grubel, D. Kim, W. W. Brennessel, B. Q. Mercado, P. L. Holland, "Diazoalkanes in Low-Coordinate Iron Chemistry: Bimetallic Diazoalkyl and Alkylidene Complexes of Iron(II)," *Inorg. Chem.* **2017**, *56*, 1019-1022.
128. K. C. MacLeod, R. A. Lewis, D. E. DeRoshia, B. Q. Mercado, P. L. Holland, "C-H and C-N Activation at Redox-Active Pyridine Complexes of Iron," *Angew. Chem. Int. Ed.* **2017**, *56*, 1069-1072.
127. A. M. Speelman, P. L. Holland, "Sulfur-Supported Iron Complexes for Understanding N₂ Reduction," *Top. Organomet. Chem.*, **2017**, *60*, 197-214.
126. G. P. Connor, P. L. Holland, "Coordination chemistry insights into the role of alkali metal promoters in dinitrogen reduction," *Catalysis Today* **2017**, *286*, 21-40.
125. Y. Liu, D. J. Vinyard, M. E. Reesbeck, T. Suzuki, K. Manakongtreecheep, P. L. Holland, G. W. Brudvig, D. Söll, "A [3Fe-4S] cluster is required for tRNA thiolation in archaea and eukaryotes," *Proc. Natl. Acad. Sci. USA* **2016**, *113*, 12703-12708.
124. S. M. Bellows, N. A. Arnet, P. M. Gurubasavaraj, W. W. Brennessel, E. Bill, T. R. Cundari, P. L. Holland, "The Mechanism of N-N Double Bond Cleavage by an Iron(II) Hydride Complex," *J. Am. Chem. Soc.* **2016**, *138*, 12112-12123.
123. K. C. MacLeod, F. S. Menges, S. F. McWilliams, S. M. Craig, B. Q. Mercado, M. A. Johnson, P. L. Holland, "Alkali-Controlled C-H Activation or N-C Bond Formation from N₂-Derived Iron Nitrides and Imides," *J. Am. Chem. Soc.* **2016**, *138*, 11185-11191.
122. K. C. MacLeod, S. F. McWilliams, B. Q. Mercado, P. L. Holland, "Stepwise N-H Bond Formation From N₂-Derived Iron Nitride, Imide and Amide Intermediates to Ammonia," *Chem. Sci.* **2016**, *7*, 5736-5746.
121. I. Čorić, P. L. Holland, "Insight into the FeMoco of nitrogenase from synthetic iron complexes with sulfur, carbon, and hydride ligands," *J. Am. Chem. Soc.* **2016**, *138*, *138*, 7200-7211.

120. S. M. Bellows, W. W. Brennessel, P. L. Holland, "Effects of Ligand Halogenation on the Electron Localization, Geometry and Spin State of Low-Coordinate β -Diketiminato Iron Complexes," *Eur. J. Inorg. Chem.* **2016**, 3344-3355.
119. S. F. McWilliams, K. R. Rodgers, G. Lukat-Rodgers, B. Q. Mercado, K. Grubel, P. L. Holland, "Alkali Metal Variation and Twisting of the FeNNFe Core in Bridging Diiron Dinitrogen Complexes," *Inorg. Chem.* **2016**, *55*, 2960-2968.
118. C. Chen, M. Hecht, A. Kavara, W. W. Brennessel, B. Q. Mercado, D. J. Weix, P. L. Holland, "Rapid, Regioconvergent, Solvent-Free Alkene Hydrosilylation with a Cobalt Catalyst," *J. Am. Chem. Soc.* **2015**, *137*, 13244-13247.
117. N. A. Arnet, T. R. Dugan, F. S. Menges, B. Q. Mercado, W. W. Brennessel, E. Bill, M. A. Johnson, P. L. Holland, "Synthesis, Characterization, and Nitrogenase-Relevant Reactions of an Iron Sulfide Complex with a Bridging Hydride," *J. Am. Chem. Soc.* **2015**, *137*, 13220-13223.
116. I. Čorić, B. Q. Mercado, E. Bill, D. J. Vinyard, P. L. Holland, "Binding of dinitrogen to an iron-sulfur-carbon site," *Nature* **2015**, *526*, 96-99.
115. C. Chen, S. M. Bellows, P. L. Holland, "Tuning Steric and Electronic Effects in Transition-Metal β -Diketiminato Complexes," *Dalton Trans.* **2015**, *44*, 16654-16670.
114. S. F. McWilliams, P. L. Holland, "Dinitrogen Binding and Cleavage by Multinuclear Iron Complexes," *Acc. Chem. Res.* **2015**, *48*, 2059-2065.
113. M. H. Al-Afyouni, E. Bill, D. E. DeRoshia, W. W. Brennessel, P. L. Holland, "Spin Isomers and Ligand Isomerization in a Three-Coordinate Cobalt(I) Carbonyl Complex," *J. Am. Chem. Soc.* **2015**, *137*, 10689-10699.
112. M. E. Reesbeck, M. M. Rodriguez, W. W. Brennessel, B. Q. Mercado, D. J. Vinyard, P. L. Holland, "Oxidized and Reduced [2Fe-2S] Clusters from an Iron(I) Synthon," *J. Biol. Inorg. Chem.* **2015**, *20*, 875-883.
111. P. L. Holland, "Distinctive Reaction Pathways at Base Metals in High-Spin Organometallic Catalysts," *Acc. Chem. Res.* **2015**, *48*, 1696-1702.
110. S. J. Bonyhady, J. M. Goldberg, N. Wedgwood, T. R. Dugan, A. G. Eklund, W. W. Brennessel, P. L. Holland, "Electronic structure and N-N cleavage reactivity of a redox-active cobalt diazoalkane complex," *Inorg. Chem.* **2015**, *54*, 5148-5150.
109. A. Das, Z. Han, W. W. Brennessel, P. L. Holland, R. Eisenberg, "Nickel Complexes for Robust Light-Driven and Electrocatalytic Hydrogen Production from Water," *ACS Catal.* **2015**, *5*, 1397-1406.
108. K. Grubel, W. W. Brennessel, B. Q. Mercado, P. L. Holland, "Alkali Metal Control over N-N Cleavage in Iron Complexes," *J. Am. Chem. Soc.* **2014**, *136*, 16807-16816.
107. T. E. Machonkin, M. D. Boshart, J. A. Schofield, M. R. Rodriguez, K. Grubel, D. Rokhsana, W. W. Brennessel, P. L. Holland, "Structural and Spectroscopic Characterization of Iron(II), Cobalt(II), and Nickel(II) *ortho*-Dihalophenolate Complexes: Insights into Metal-Halogen Secondary Bonding," *Inorg. Chem.* **2014**, *53*, 9837-9848.
106. R. A. Lewis, K. C. MacLeod, B. Q. Mercado, P. L. Holland, "Geometric and redox flexibility of pyridine as a redox-active ligand that can reversibly accept one or two

- electrons," *Chem. Commun.* **2014**, 50, 11114-11117.
105. K. C. MacLeod, D. J. Vinyard, P. L. Holland, "A Multi-Iron System Capable of Rapid N₂ Formation and N₂ Cleavage," *J. Am. Chem. Soc.* **2014**, 136, 10226-10229.
 104. J. A. Gladysz, R. B. Bedford, M. Fujita, F. P. Gabbaï, K. I. Goldberg, P. L. Holland, J. L. Kiplinger, M. J. Krische, J. Louie, C. C. Lu, J. R. Norton, M. A. Petrukhina, T. Ren, S. S. Stahl, T. D. Tilley, C. E. Webster, M. C. White and G. T. Whiteker, "Organometallics Roundtable 2013-2014," *Organometallics* **2014**, 33, 1505-1527.
 103. T. R. Dugan, E. Bill, K. C. MacLeod, W. W. Brennessel, P. L. Holland, "Synthesis, Spectroscopy and Hydrogen/Deuterium Exchange in High-Spin Iron(II) Hydride Complexes," *Inorg. Chem.* **2014**, 53, 2370-2380.
 102. C. Chen, T. R. Dugan, W. W. Brennessel, D. J. Weix, P. L. Holland, "Z-Selective Alkene Isomerization by High-Spin Cobalt(II) Complexes," *J. Am. Chem. Soc.* **2014**, 136, 945-955.
 101. K. P. Chiang, S. M. Bellows, W. W. Brennessel, P. L. Holland, "Multimetallic cooperativity in activation of dinitrogen at iron-potassium sites," *Chem. Sci.* **2014**, 5, 267-274.
 100. W. Yao, P. M. Gurubasavaraj, P. L. Holland, "All-Ferrous Iron-Sulfur Clusters," *Struct. Bonding* **2014**, 160, 1-37.
 99. R. E. Cowley, M. R. Golder, N. A. Eckert, M. Al-Afyouni, P. L. Holland, "Mechanism of Catalytic Nitrene Transfer from Iron(I)-Isocyanide Complexes," *Organometallics* **2013**, 32, 5289-5298.
 98. S. M. Bellows, T. R. Cundari, P. L. Holland, "Spin Crossover during β -Hydride Elimination in High-Spin Iron(II)- and Cobalt(II)-Alkyl Complexes," *Organometallics* **2013**, 32, 4741-4751.
 97. Z. Han, L. Shen, W. W. Brennessel, P. L. Holland, R. Eisenberg, "Nickel Pyridylthiolate Complexes for the Photocatalytic Production of Hydrogen from Aqueous Solutions in Noble-Metal-Free Systems," *J. Am. Chem. Soc.* **2013**, 135, 14659-14669.
 96. C. J. Pollock, K. Grubel, P. L. Holland, S. DeBeer, "Experimentally Quantifying Small Molecule Bond Activation Using Valence-to-Core X-ray Emission Spectroscopy," *J. Am. Chem. Soc.* **2013**, 135, 11803-11808.
 95. T. R. Dugan, K. C. MacLeod, W. W. Brennessel, P. L. Holland, "Cobalt-Magnesium and Iron-Magnesium Complexes with Weakened Dinitrogen Bridges," *Eur. J. Inorg. Chem.* **2013**, 3891-3897.
 94. B. D. Stubbert, J. Vela, W. W. Brennessel, P. L. Holland, "A Sulfide-Bridged Diiron(II) Complex with an N₂H₄ Ligand," *Z. Anorg. Allg. Chem.* **2013**, 639, 1351-1355.
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12. D. J. E. Spencer, N. W. Aboeella, A. M. Reynolds, P. L. Holland, W. B. Tolman, " β -Diketiminato Ligand Backbone Structural Effects on Cu(I)/O₂ Reactivity: Unique Copper-Superoxo and Bis(μ -oxo) Complexes," *J. Am. Chem. Soc.* **2002**, *124*, 2108-2109.
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10. D. W. Randall, S. DeBeer, P. L. Holland, B. Hedman, K. O. Hodgson, W. B. Tolman, E. I. Solomon, "Spectroscopic and Electronic Structure Studies of Blue Copper Model Complexes. 2. Comparison of 3- and 4-Coordinate Cu(II) Thiolate Complexes and Fungal Laccase," *J. Am. Chem. Soc.* **2000**, *122*, 11632-11648.
9. E. Meggers, P. L. Holland, W. B. Tolman, F. E. Romesberg, P. G. Schultz, "A Novel Copper-Mediated DNA Base Pair," *J. Am. Chem. Soc.* **2000**, *122*, 10714-10715.
8. B. M. T. Lam, J. A. Halfen, V. G. Young, Jr., J. R. Hagadorn, P. L. Holland, A. Lledós, L. Cucurull-Sánchez, J. J. Novoa, S. Alvarez, W. B. Tolman, "Ligand Macrocyclic Structural Effects on Copper-Dioxygen Reactivity," *Inorg. Chem.* **2000**, *39*, 4059-4072.
7. P. L. Holland, W. B. Tolman, "A Structural Model of the Type 1 Copper Protein Active Site: N₂S(thiolate)S(thioether) Ligation in a Cu(II) Complex," *J. Am. Chem. Soc.* **2000**, *122*, 6331-6332.

6. P. L. Holland, C. J. Cramer, E. C. Wilkinson, S. Mahapatra, K. R. Rodgers, S. Itoh, M. Taki, S. Fukuzumi, L. Que, Jr., W. B. Tolman, "Resonance Raman Spectroscopy as a Probe of the Bis(μ -oxo)dicopper Core," *J. Am. Chem. Soc.* **2000**, *122*, 792-802.
5. S. Itoh, M. Taki, H. Nakao, P. L. Holland, W. B. Tolman, L. Que, Jr., S. Fukuzumi, "Aliphatic Hydroxylation by a Bis(μ -oxo)dicopper Complex," *Angew. Chem. Int. Ed.* **2000**, *39*, 398-400.
4. P. L. Holland, W. B. Tolman, "Three-Coordinate Cu(II) Complexes: Structural Models of Trigonal-Planar Type 1 Copper Protein Active Sites," *J. Am. Chem. Soc.* **1999**, *121*, 7270-7271.
3. P. L. Holland, W. B. Tolman, "Dioxygen Activation by Copper Sites: Stability and Reactivity of Peroxo- and Bis(μ -oxo)dicopper Cores," *Coord. Chem. Rev.* **1999**, *190-192*, 855-869.
2. J. Cahoy, P. L. Holland, W. B. Tolman, "Experimental Studies of the Interconversion of Peroxo- and Bis(μ -oxo)dicopper Complexes," *Inorg. Chem.* **1999**, *38*, 2161-2168.
1. P. L. Holland, K. R. Rodgers, W. B. Tolman, "Is the Bis(μ -oxo)dicopper Core Capable of Hydroxylating an Arene?" *Angew. Chem. Int. Ed.* **1999**, *38*, 1139-1142.

Publications from Berkeley (Graduate Student)

6. P. L. Holland, R. A. Andersen, R. G. Bergman, "Application of the *E-C* Approach to Understanding the Bond Energies of Late-Metal Complexes: An Alternative to $p\pi/d\pi$ Repulsion," *Comments Inorg. Chem.* **1999**, *21*, 115-129.
5. P. L. Holland, R. A. Andersen, R. G. Bergman, "Cyclopentadienyl and Imide Ligand Transfer From Zirconium to Iridium: Can Early-Metal Imido Compounds Be Used as Imide Transfer Reagents?" *Organometallics* **1998**, *17*, 433-437.
4. J. T. Golden, T. H. Peterson, P. L. Holland, R. G. Bergman, R. A. Andersen, "Adduct Formation and Single and Double Deprotonation of $Cp^*(PMe_3)Ir(H)_2$ with Main Group Metal Alkyls and Aryls: Synthesis and Structure of Three Novel Ir-Al and Ir-Mg Heterobimetallics," *J. Am. Chem. Soc.* **1998**, *120*, 223-224.
3. P. L. Holland, R. A. Andersen, R. G. Bergman, J. Huang, S. P. Nolan, "Monomeric Cyclopentadienylnickel Methoxo and Amido Complexes: Synthesis, Characterization, Reactivity, and Use for Exploring the Relationship Between H-X and M-X Bond Energies," *J. Am. Chem. Soc.* **1997**, *119*, 12800-12814.
2. P. L. Holland, M. E. Smith, R. A. Andersen, R. G. Bergman, "X-ray Crystal Structures of $Cp^*Ni(PEt_3)X$. Understanding Distortions and Trans Influences in Cyclopentadienyl Complexes," *J. Am. Chem. Soc.* **1997**, *119*, 12815-12823.
1. P. L. Holland, R. A. Andersen, R. G. Bergman, "Synthesis, Characterization, and Reactivity of Dimeric Amidonickel Complexes," *J. Am. Chem. Soc.* **1996**, *118*, 1092-1104.

Patents

3. C. Chen, D. J. Weix, P. L. Holland, "Diketiminato Cobalt Catalysts and Methods for Alkene Hydrosilylation," U.S. Provisional Patent Application 62/204,149, **2015**.
2. P. L. Holland, D. J. Weix, C. Chen, T. R. Dugan, "Z-Selective Alkene Isomerization by High-Spin Cobalt(II) Complexes," U.S. Provisional Patent Application 61/985,761, **2014**.

1. T. D. Krauss, R. Eisenberg, P. L. Holland, F. Qiu, Z. Han, "Methods for Producing Hydrogen Using Nanoparticle Catalyst Mixtures," U.S. Patent #10,471,409, issued Nov. 12, 2019.

Funding

Current Research Funding

- "Center for Hybrid Approaches in Solar Energy to Liquid Fuels (CHASE)"
Basic Energy Sciences, Department of Energy, DE-SC0021173, \$40,000,000
32 PIs; Holland is Institute Coordinator for Yale
9/20-8/25
- "CAS: Electrochemical approaches to sustainable dinitrogen fixation"
National Science Foundation, CHE-1954254, \$321,010
PI: Patrick Holland (collaboration with Robert Crabtree, Alex Miller and Alan Goldman)
8/20-7/23
- "Tandem Catalytic C-H activation and N₂ activation using iron complexes"
Basic Energy Sciences, Department of Energy, DE-SC0020315, \$550,000
PI: Patrick Holland
9/19-8/22
- "Mechanistically guided improvement in radical alkene coupling by base metal catalysts"
National Institutes of Health, R01 GM-129081, \$1,164,862
PI: Patrick Holland
4/19-4/23
- "Low-coordinate synthetic models for nitrogenase activity"
National Institutes of Health, R01 GM-065313, \$1,303,066
PI: Patrick Holland
8/18-7/22

Past Research Funding

- "INFEWS: Evaluating the Prospects of Electrochemical Nitrogen Reduction Using Pincer Catalysts"
National Science Foundation, CHE-1665137, \$300,000
PIs: Patrick Holland, Alex Miller, James Mayer and Alan Goldman
9/17-8/20
- "RUI: The Sources of Substrate Specificity in Hydroquinone Dioxygenases"
National Science Foundation, CHE-1506458, \$97,870 subcontract
PI: Timothy Machonkin
9/15-9/19
- "SusChem: Catalytic Alkene Transformations Using High-Spin Cobalt Complexes"
National Science Foundation, CHE-1465017, \$500,000
PI: Patrick Holland
9/15-1/19
- "Low-Coordinate Synthetic Models for Nitrogenase Activity"

- National Institutes of Health, R01 GM-065313, \$1,988,802
 PI: Patrick Holland
 9/14-7/18
- “Enabling Nitrogen Reduction Catalysis through Surface Immobilization”
 United States-Israel Binational Science Foundation, 2009541, \$164,000 total
 co-PIs: Chaim Sukenik (Bar Ilan University) and Patrick Holland
 10/11-9/15
 - “Low-Coordinate Synthetic Models for Nitrogenase Activity”
 National Institutes of Health, R01 GM065313, \$1,211,567
 PI: Patrick Holland
 6/10-9/14
 - "Modular Nanoscale and Biomimetic Assemblies for Photocatalytic Hydrogen Generation"
 Department of Energy, DE-FG02-09ER16121, \$880,000
 co-PIs: Kara Bren, Richard Eisenberg, Patrick Holland, Todd Krauss
 9/12-6/13 (left group)
 - "RUI: The Sources of Substrate Specificity in Hydroquinone Dioxygenases"
 National Science Foundation, CHE-0951999, \$25,778 subcontract
 PI: Timothy Machonkin
 4/10-4/13
 - "Nitrene Transfer Reactions with Iron Complexes"
 National Science Foundation, CHE-0911314, \$430,000
 PI: Patrick Holland, co-PI: Brian Edelbach (Monroe Community College)
 8/09-6/13
 - "High-Spin Cobalt Hydrides for Catalysis"
 Department of Energy, DE-FG-02-09ER16089, \$670,000
 PI: Patrick Holland
 9/09-6/13
 - "Modular Nanoscale and Biomimetic Assemblies for Photocatalytic Hydrogen Generation"
 Department of Energy, DE-FG02-09ER16121, \$1,680,000
 co-PIs: Kara Bren, Richard Eisenberg, Patrick Holland, Todd Krauss
 9/09-9/12
 - “Characterization of Catalytic Imide Group Transfer Reactions with Iron Catalysts”
 Petroleum Research Fund, 44942-AC, \$80,000
 PI: Patrick Holland
 9/06-9/08
 - “Low-Coordinate Synthetic Models for Nitrogenase Activity”
 National Institutes of Health, R01 GM065313, \$1,073,394
 PI: Patrick Holland
 4/04-3/10
 - “Synthetic Models of the Catalytic Nickel-Copper Site of Acetyl Coenzyme A”
 Petroleum Research Fund, 38275-G, \$35,000
 PI: Patrick Holland
 9/02-8/05

- “CAREER: Reactive Low-Coordinate Compounds of the Late Transition Metals”
National Science Foundation, CHE-0134658, \$495,000
PI: Patrick Holland
1/02-12/06

Equipment, Education

- "MRI: Development of a Hybrid Mass Spectrometry Platform with Mass-Selective Optical Spectroscopy of Cryogenic Ions"
National Science Foundation, CHE-1828190
7/18
- “CRIF: Acquisition of A Matrix-Assisted Laser Desorption/Ionization Time of Flight (MALDI-TOF) Mass Spectrometer”
National Science Foundation, CHE-0840410, \$279,643
8/09
- “GAANN: Graduate Assistance in Chemistry”
Department of Education, P200A060048, \$540,000
8/06-8/09
- “CRIF: Purchase of a Gas Chromatograph-Mass Spectrometer”
National Science Foundation, CHE-0443581, \$104,174
2/05
- “CRIF: Upgrade of an X-ray Diffractometer”
National Science Foundation, CHE-0342508, \$121,750
2/04

Invited Lectures at Universities & Colleges

Hamilton College (Clinton, NY) – January 2001
 Trinity College (Hartford, CT) – February 2001
 West Chester University (West Chester, PA) – September 2001
 Nazareth College (Pittsford, NY) – January 2002
 SUNY Buffalo (Buffalo, NY) – February 2002
 Carnegie Mellon University (Pittsburgh, PA) – April 2002
 University of West Virginia (Morgantown, WV) – September 2002
 SUNY Fredonia (Fredonia, NY) – September 2002
 Colgate University (Hamilton, NY) – October 2002
 Rochester Institute of Technology (Rochester, NY) – October 2002
 SUNY Brockport (Brockport, NY) – November 2002
 Purdue University (West Lafayette, IN) – February 2003
 Rose-Hulman Institute of Technology (Terre Haute, IN) – February 2003
 Indiana University (Bloomington, IN) – February 2003
 University of Minnesota (Minneapolis, MN) – September 2003
 St. John's University and College of St. Benedict (St. Cloud, MN) – September 2003
 Yale University (New Haven, CT) – September 2003

Alfred University (Alfred, NY) – September 2003
Princeton University (Princeton, NJ) – October 2003
Notre Dame University (Notre Dame, IN) – October 2003
University of California-Berkeley (Berkeley, CA) – October 2003
Utah University (Salt Lake City, UT) – October 2003
Utah State University (Logan, UT) – October 2003
Fordham University (New York, NY) – December 2003
University of Chicago (Chicago, IL) – January 2004
University of Guelph (Guelph, ON) – March 2004
Syracuse University (Syracuse, NY) – March 2004
University of California-San Diego (La Jolla, CA) – April 2004
University of California-Irvine (Irvine, CA) – May 2004
California Institute of Technology (Pasadena, CA) – May 2004
University of Southern California (Los Angeles, CA) – May 2004
University of California-Riverside (Riverside, CA) – May 2004
James Madison University (Harrisonburg, VA) – July 2004
University of Rochester (Rochester, NY) – September 2004
Northwestern University (Evanston, IL) – October 2004
Messiah College (Grantham, PA) – October 2004
Haverford College (Haverford, PA) – October 2004
Boston University (Boston, MA) – November 2004
Brandeis University (Waltham, MA) – November 2004
University of Toronto-Mississauga (Mississauga, ON) - November 2004
Massachusetts Institute of Technology (Cambridge, MA) - January 2005
University of North Carolina (Chapel Hill, NC) - January 2005
North Carolina State University (Raleigh, NC) - January 2005
University of Akron (Akron, OH) - January 2005
University of Delaware (Newark, DE) - March 2005
University of Seattle (Seattle, WA) - May 2005
University of British Columbia (Vancouver, BC) - May 2005
University of Washington (Seattle, WA) - May 2005
Miami University (Oxford, OH) - October 2005
University of Cincinnati (Cincinnati, OH) - October 2005
Bucknell University (Lewisburg, PA) - October 2005
Juniata College (Huntingdon, PA) - October 2005
Dickinson College (Carlisle, PA) - October 2005
University of North Texas (Denton, TX) - January 2006
University of North Carolina (Charlotte, NC) - February 2006
Duke University (Durham, NC) - February 2006
University of Albany (Albany, NY) - March 2006
University of Wisconsin (Madison, WI) - April 2006
University of Illinois (Urbana-Champaign, IL) - April 2006
University of Florida (Gainesville, FL) - April 2006

Max Planck Institute for Bioinorganic Chemistry (Mülheim, Germany) - September 2006
Ithaca College (Ithaca, NY) - October 2006
University of Victoria (Victoria, BC) - October 2006
Simon Fraser University (Vancouver, BC) - October 2006
SUNY Cortland (Cortland, NY) - November 2006
McGill University (Montreal, QC) - November 2006
Monroe Community College (Rochester, NY) - December 2006
Gustavus Adolphus College (St. Peter, MN) - February 2007
Duquesne University (Pittsburgh, PA) - October 2007
Tsukuba University (Tsukuba, Japan) - November 2007
Osaka University (Osaka, Japan) - November 2007
Osaka City University (Osaka, Japan) - November 2007
Buffalo State College (Buffalo, NY) - November 2007
Dartmouth College (Hanover, NH) - May 2008
University of Pennsylvania (Philadelphia, PA) - September 2008
SUNY Geneseo (Geneseo, NY) - September 2008
SUNY New Paltz (New Paltz, NY) - September 2008
Johns Hopkins University (Baltimore, MD) - October 2008
Georgetown University (Washington, DC) - October 2008
Brock University (St. Catharine's, ON) - October 2008
University of Toronto (Toronto, ON) - November 2008
Bloomsburg University (Bloomsburg, PA) - November 2008
New Mexico State University (Las Cruces, NM) - November 2008
University of Texas (Austin, TX) - May 2009
University of Montreal (Montreal, QC) - September 2009
University of Oregon (Eugene, OR) - October 2009
Columbia University (New York, NY) - November 2009
Pennsylvania State Erie (Erie, PA) - November 2009
West Chester University (West Chester, PA) - November 2009
York University (Toronto, ON) - December 2009
Marquette University (Milwaukee, WI) - January 2010
University of Wyoming (Laramie, WY) - September 2010
Colorado State University (Fort Collins, CO) - September 2010
Northwestern University (Evanston, IL) - October 2010
LeMoyne College (Syracuse, NY) - October 2010
Pennsylvania State University (University Park, PA) - October 2010
University of North Carolina (Chapel Hill, NC) - January 2011
East Carolina University (Greenville, NC) - February 2011
University of North Carolina (Charlotte, NC) - March 2011
Temple University (Philadelphia, PA) - March 2011
Virginia Polytechnic Institute (Blacksburg, VA) - April 2011
Yale University (New Haven, CT) - September 2011
Ithaca College (Ithaca, NY) - September 2011

University of Illinois (Chicago, IL) - September 2011
University of Oklahoma (Norman, OK) - October 2011
University of Kansas (Lawrence, KS) - October 2011
Princeton University (Princeton, NJ) - November 2011
University of Illinois (Urbana-Champaign, IL) - December 2011
University of Miami (Coral Gables, FL) - December 2011
Weizmann Institute (Rehovot, Israel) - January 2012
Bar Ilan University (Ramat Gan, Israel) - January 2012
University of Wisconsin (Madison, WI) - January 2012
University of Göttingen (Göttingen, Germany) - April 2012
University of Münster (Münster, Germany) - April 2012
Max-Planck-Institut für Kohlenforschung (Mülheim, Germany) - April 2012
University of Kiel (Kiel, Germany) - May 2012
Humboldt University - Berlin (Berlin, Germany) - May 2012
ETH (Zürich, Switzerland) - May 2012
University of Basel (Basel, Switzerland) - May 2012
Friedrich Alexander University - Erlangen-Nürnberg (Erlangen, Germany) - June 2012
SUNY Potsdam (Potsdam, NY) - October 2012
University of Toledo (Toledo, OH) - November 2012
University of Georgia (Athens, GA) - January 2013
North Carolina State University (Raleigh, NC) - February 2013
University of Tennessee (Knoxville, TN) - February 2013
Valparaiso University (Valparaiso, IN) - April 2013
Brandeis University (Boston, MA) - January 2014
Carleton College (Northfield, MN) - January 2014
University of West Virginia (Morgantown, WV) - February 2014
Shanghai Institute of Organic Chemistry (Shanghai, China) - March 2014
Fudan University (Shanghai, China) - March 2014
Brown University (Providence, RI) - May 2014
Tufts University (Medford, MA) - September 2014
College of the Holy Cross (Worcester, MA) - October 2014
Swarthmore College (Swarthmore, PA) - October 2014
University of California (Santa Barbara, CA) - October 2014
University of Southern California (Los Angeles, CA) - October 2014
University of California (Irvine, CA) - October 2014
University of Missouri (St. Louis, MO) - December 2014
Wayne State University (Detroit, MI) - February 2015
University of New Mexico (Albuquerque, NM) - February 2015
Whitman College (Walla Walla, WA) - March 2015
University of Washington (Seattle, WA) - March 2015
Indiana University (Bloomington, IN) - April 2015
University of Houston (Houston, TX) - October 2015
Emory University (Atlanta, GA) - October 2015

Georgia Tech University (Atlanta, GA) - October 2015
Georgetown University (Washington, DC) - February 2016
Ursinus College (Collegeville, PA) - April 2016
University of Pennsylvania (Philadelphia, PA) - September 2016
Iowa State University (Ames, IA) - October 2016
University of Göttingen (Göttingen, Germany) - January 2017
Laboratoire de Chimie de Coordination (Toulouse, France) - January 2017
Universitat de Girona (Girona, Spain) - February 2017
Institut Català d'Investigació Química (Tarragona, Spain) - February 2017
Friedrich-Alexander-Universität (Erlangen-Nuremberg, Germany) - February 2017
Peking University (Beijing, China) - April 2017
Philips-Universität Marburg (Marburg, Germany) - May 2017
TU Braunschweig (Braunschweig, Germany) - May 2017
HU Berlin (Berlin, Germany) - May 2017
TU München (Munich, Germany) - May 2017
Uppsala University (Uppsala, Sweden) - May 2017
University of Regensburg (Regensburg, Germany) - May 2017
Max Planck Institute for Chemical Energy Conversion (Mülheim/Ruhr, Germany) - June 2017
University of Amsterdam (Amsterdam, Netherlands) - June 2017
Aix Marseille Université (Marseille, France) - June 2017
Rutgers University (New Brunswick, NJ) - September 2017
University of California (San Diego, CA) - October 2017
Scripps Research Institute (La Jolla, CA) - October 2017
University of Oklahoma (Norman, OK) - October 2017
University of California (Berkeley, CA) - January 2018
Massachusetts Institute of Technology (Cambridge, MA) - April 2018
Northwestern University (Evanston, IL) - May 2018
Simon Fraser University (Vancouver, BC) - October 2018
University of Victoria (Victoria, BC) - October 2018
Cornell University (Ithaca, NY) - December 2018
Indiana University (Bloomington, IN) - January 2019
University of Michigan (Ann Arbor, MI) - February 2019
University of Notre Dame (Notre Dame, IN) - February 2019
Calvin College (Grand Rapids, MI) - February 2019
Hope College (Holland, MI) - February 2019
Wichita State University (Wichita, KS) - March 2019
McGill University (Montreal, ON) - March 2019
Indiana University Purdue University at Indianapolis (Indianapolis, IN) - April 2019
Rutgers University - Newark (Newark, NJ) - May 2019
University of Chicago (Chicago, IL) - May 2019
University of Kassel (Kassel, Germany) - June 2019
University of Utrecht (Utrecht, Netherlands) - June 2019
James Madison University (Harrisonburg, VA) - June 2019

University of Freiburg (Freiburg, Germany) - August 2019
Brown University (Providence, RI) - September 2019
University of Utah (Salt Lake City, UT) - October 2019
University of Lausanne (online) - May 2020
Global Inorganic Discussion Weekend Virtual Symposium (online) - June 2020
St. Louis University (online) - September 2020
Iowa Wesleyan (online) - October 2020
University of Graz (online) - January 2021
University of Basel (online) - March 2021
Marburg University (online) - June 2021
Creighton University (online) - September 2021
Auburn University (online) - October 2021
Vanderbilt University (Nashville, TN) - November 2021
University of Hamburg (online) - January 2022
Connecticut College (New London, CT) – February 2022

Lectures at Meetings/Conferences (Invited)

Bergman Symposium (Berkeley, CA) – June 2002
Nitrogen Fixation Gordon Conference (New London, NH) – June 2002
International Conference on Coordination Chemistry (Heidelberg, Germany) – July 2002
Metals in Biology Gordon Conference (Ventura, CA) – February 2003
Eisenberg/Jones Symposium, National ACS Meeting (New Orleans, LA) – March 2003
Symposium on Non-Heme Iron in Biology, National ACS Meeting (Anaheim, CA) – March 2004
Nitrogen Fixation Gordon Conference (New London, NH) – June 2004
Organometallic Chemistry Gordon Conference (Newport, RI) – July 2004
European Biological Inorganic Chemistry Conference (EUROBIC 7) (Garmisch-Partenkirchen, Germany) - August 2004
Inorganic Reaction Mechanisms Gordon Conference (Ventura, CA) - February 2005
PacifiChem (Honolulu, HI) - December 2005
Rochester Section ACS Dinner (Rochester, NY) - January 2006
Wieghardt Symposium, National ACS Meeting (Atlanta, GA) - March 2006
Iron-Sulfur Enzymes Gordon Conference (New London, NH) - June 2006
Inorganic Chemistry Gordon Conference (Newport, RI) - July 2006
International Workshop on Bioinorganic and Organometallic Perspectives in Activation of Small Molecules (Nagoya, Japan) - November 2007
Que Symposium, National ACS Meeting (New Orleans, LA) - April 2008
Symposium on Integration of Research and Education at the Frontiers of Inorganic Chemistry, National ACS Meeting (New Orleans, LA) - April 2008
Symposium on Organometallic Chemistry of the Group 15 Elements, Northeast Regional ACS Meeting (Burlington, VT) - June 2008
Symposium on Activation of Dinitrogen, National ACS Meeting (Philadelphia, PA) - August 2008

Metals in Biology Gordon Conference (Ventura, CA) - January 2009
International Conference on Biological Inorganic Chemistry, ICBIC (Nagoya, Japan) - July 2009
Iron-Sulfur Enzymes Gordon Conference (New London, NH) - June 2010
Symposium on Ligand Design, National ACS Meeting (Boston, MA) - August 2010
Wieghardt Retirement Symposium (Mülheim, Germany) - November 2010
Pacifichem (Honolulu, HI) - December 2010
Metal Hydrides Workshop (Oxford, England) - March 2012
Fulbright Berlin Conference (Berlin, Germany) - March 2012
Iron Symposium (Regensburg, Germany) - June 2012
Inorganic Chemistry Gordon Conference (Biddeford, ME) - June 2012
Andersen Symposium (Berkeley, CA) – October 2012
Inorganic Reaction Mechanisms Gordon Conference (Galveston, TX) - March 2013
Symposium on Hydrogen Production, Storage, and Utilization, National ACS Meeting (New Orleans, LA) - April 2013
International Conference on Biological Inorganic Chemistry, ICBIC (Grenoble, France) - July 2013
Symposium on Base Metal Catalysis, National ACS Meeting (Indianapolis, IN) - September 2013
Werner Nobel Centenary Symposium, National ACS Meeting (Indianapolis, IN) - September 2013
New York ACS Section: Frontiers of Inorganic and Organometallic Chemistry (New York, NY) - September 2013
Fusion Conference on Molecules and Materials for Artificial Photosynthesis (Cancun, Mexico) - February 2014
Canadian Chemistry Conference (Vancouver, BC) - June 2014
Rigaku Symposium (New Haven, CT) - June 2014
Fusion Conference on Small Molecule Activation (Chicago, IL) - July 2014
Western Canadian Undergraduate Chemistry Conference (Kelowna, BC) - May 2015
National ACS Meeting (Boston, MA) - August 2015
International Conference on Nitrogen Fixation (Monterey, CA) - October 2015
Pacifichem (Honolulu, HI) - December 2015
National ACS Meeting (San Diego, CA) - March 2016
Metallocofactors Gordon Conference (Easton, MA) - June 2016
Telluride Conference on Small Molecule Activation (Telluride, CO) - June 2016
International Conference on Coordination Chemistry (Brest, France) - July 2016
National ACS Meeting (Philadelphia, PA) - August 2016
SABIC Frontiers in Inorganic Chemistry (Kolkata, India) - January 2017
ECOST: Control over Spin States in Technology and Biochemistry (Lisbon, Portugal) - March 2017
National ACS Meeting (San Francisco, CA) - April 2017
Boston Regional Inorganic Colloquium (Boston, MA) - February 2018
National ACS Meeting (New Orleans, LA) - March 2018
Blavatnik Science Symposium (New York, NY) - June 2018

National ACS Meeting (Orlando, FL) - March 2019
 Canadian Chemistry Conference (Quebec, QC) - June 2019
 International Conference on Biological Inorganic Chemistry (Interlaken, Switzerland) - August 2019
 Annual Meeting of the Israel Chemical Society (Jerusalem, Israel) - February 2020
 National ACS Meeting (San Diego, CA) - March 2022
 Fusion Conference on Small Molecule Activation (Cancun, Mexico) - May 2022
 International Hydrogenase Conference (Walla Walla, WA) - June 2022
 Singapore International Chemistry Conference (Singapore) - December 2022

Lectures at Meetings/Conferences (Contributed)

National ACS Meeting (Chicago, IL) - August 2001
 Inorganic Discussion Weekend (Waterloo, ON) - October 2001
 National ACS Meeting (Boston, MA) - August 2002
 Organometallic Chemistry Gordon Conference (Newport, RI) - July 2003
 National ACS Meeting (New York, NY) - September 2003
 NSF Inorganic Workshop (Sedona, AZ) - June 2004
 Northeast Regional ACS Meeting (Rochester, NY) - November 2004
 Beta-Diketiminates Symposium, National ACS Meeting (Washington, DC) - August 2005
 International Meeting of the IMBG (Autrans, France) - September 2006
 International Conference on Biological Inorganic Chemistry, ICBIC (Vienna, Austria) - July 2007
 International Conference on Biological Inorganic Chemistry, ICBIC (Vancouver, Canada) - August 2011
 National ACS Meeting (San Francisco, CA) - August 2014
 EuCheMS Inorganic Chemistry Conference (Copenhagen, Denmark) – July 2017

Research Trainees

Doctoral

Name	Degree/Year	Most Recent Known Position
Nathan Eckert	Ph.D. 2005	R&D Leader, Shepherd Chemical Co., Cincinnati, OH
Javier Vela	Ph.D. 2005	Professor, Iowa State U., Ames, IA
Ying Yu	Ph.D. 2007	Master's program in Information Systems
Keying Ding	Ph.D. 2009	Associate Professor, Middle Tennessee State Univ.
Sara Rocks	Ph.D. 2009	Assistant Professor, Utah Valley U., Orem, UT
Matthew McLaughlin	Ph.D. 2011	Principal Process Engineer, GlobalFoundries
Ryan Cowley	Ph.D. 2011	Research Chemist, ThermoFisher, Sunnyvale, CA
Karen Chiang	Ph.D. 2011	Lecturer, U. San Diego, San Diego, CA

Thomas Dugan	Ph.D. 2012	Sr. Research Chemist, Evonik, Allentown, PA
Meghan (Clark) Rodriguez	Ph.D. 2012	Research Investigator, Emphascience, Rochester, NY
Zhiji Han	Ph.D. 2014	Professor, Sun Yat-Sen Univ.
Sarina Bellows	Ph.D. 2014	Thermo Fisher Scientific, Rochester, NY
Chi Chen	Ph.D. 2016	Catalytic Innovations, Adamsville, RI
Megan Reesbeck	Ph.D. 2016	Horace Mann School, New York, NY
Nicholas Arnet	Ph.D. 2016	Nevada State College, Henderson, NV
Sean McWilliams	Ph.D. 2019	Ab Initio, Boston, MA
Daniel DeRosha	Ph.D. 2019	Postdoctoral, Columbia (Owen)
Dongyoung Kim	Ph.D. 2020	Postdoctoral, POSTECH (Hwang)
Daniel Kim	Ph.D. 2020	Postdoctoral, KAIST (Chang)
Gannon Connor	Ph.D. pending	Consultant, ClearView Healthcare Partners, Boston, MA
Samuel Bhutto	current student	Expected completion 2022
Alexandra Nagelski	current student	Expected completion 2022
Jeremy Weber	current student	Expected completion 2022
Conner Wilson	current student	Expected completion 2022
Reagan Hooper	current student	Expected completion 2023
Savannah Mason	current student	Expected completion 2024
Alexander Hegg	current student	Expected completion 2025
Juan Serviano	current student	Expected completion 2025
Linda Zuckerman	current student	Expected completion 2025

Master's

Name	Degree/Year	Most Recent Known Position
Elizabeth Gregory	M.S. 2004	Assistant Director of EH&S, SUNY Brockport
Travis Hebden	M.S. 2005	Engineer, Intel Corp., Portland, OR
Liwei Zhu	M.S. 2007	Senior Associate, Discover Financial Services, Chicago, IL
Tawana Robinson	M.S. 2008	Baylor Genome Sequencing Center, Waco, TX
Wenwen Yao	M.S. 2011	Ph.D. student in environmental engineering, Worcester Polytechnic Inst.
Malik Al-Afyouni	M.S. 2013	Analytical Chemist, Eastman Chemical, Akron, OH
Anna Brosnahan	M.S. 2016	Analyst, Dean & Co., Vienna, VA
Nan (Ken) Xie	M.S. 2020	Teacher
Jessica Armstrong	M.S. 2020	Teacher, St. Timothy's School, Stevenson, MD
Dan DiPrimio	M.S. 2021	Graduate Student, Harvard Univ., Cambridge, MA

Postdoctoral

Name	Time in Group	Most Recent Known Position
Jeremy Smith	2000-2003	Professor, Indiana U.

Savariraj Kingsley	2002-2003	Scientist, ChemRoutes Corp., Edmonton, Canada
Wilda Vargas-Gregory	2004-2005	Adjunct Professor, POPAC Nursing School, Mayaguez, PR
Jérôme Elhaïk	2005-2006	Free-lance translator, France
Azwana Sadique	2004-2007	Adjunct faculty, Monroe Community College, Rochester, NY
Bryan Stubbert	2006-2007	Senior Chemist, Dow Corp., Midland, MI
Benjamin Dible	2006-2009, 2010	Patent Analyst, Sanofi, Bridgewater, NJ
Aydin Kavara	2010-2011	Research Scientist, Jordi Labs, Kalamazoo, MI
P. M. Gurubasavaraj	2010-2011	Assistant Professor, Rani Chennamma University, India
William McNamara	2010-2012	Associate Professor, William & Mary College, Williamsburg, VA
Katarzyna Grubel	2011-2014	Scientist, Pacific Northwest National Laboratory, Richland, WA
Simon Bonyhady	2013-2015	Chemist, JM Huber, Atlanta, GA
Richard Lewis	2013-2015	Technical Reviewer, FDA, Washington, DC
Cory MacLeod	2012-2016	Senior Chemist, Chemtura Corp., Naugatuck, CT
Ilija Coric	2013-2016	Group Leader, Univ. Zürich
Daniel Broere	2016-2018	Assistant Professor, U. of Utrecht
Amy Speelman	2016-2019	Postdoctoral, Pacific Northwest National Lab
Kazimer Skubi	2017-2020	Assistant Professor, Skidmore College
Majed Fataftah	2019-	Currently in group
Daniel Wilson	2020-	Currently in group
Erik Phipps	2020-	Currently in group
Alexandre Genoux	2021-	Currently in group

Undergraduate Theses

Name	Degree/Year	Most Recent Known Position
Emily Bones Abbott	B.S. 2001	Education Special Projects Lead, ACS, Washington, DC
Lanyn Perez Taliaferro	B.S. 2002	Program Officer, NIAID, Bethesda, MD
Nicole Ketterer	B.S. 2003	Research Scientist, Chevron, Richmond, CA
Travis Hebden	B.S. 2004	Engineer, Intel, Portland, OR
Benjamin Gilston	B.S. 2005	Research Scientist, KBI Biopharma, NC
Pamela Barrett	B.S. 2006	Postdoctoral, Australian National University
Amanda Mack	B.S. 2008	Teacher, Pingree School, South Hamilton, MA
Matthew Golder	B.S. 2010	Assistant Professor, U. Washington, Seattle, WA
Ethan Kaplan	B.A. 2010	Associate, PricewaterhouseCoopers, New York, NY

Jonathan Goldberg	B.S. 2012	Senior Research Chemist, Materia, Pasadena, CA
Maxwell Hecht	B.S. 2013	Chemist, Jordi Labs, Mansfield, MA
Emma Brennan-Wydra	B.S. 2015	Assessment Program Manager, Yale Medical School, New Haven, CT
Bechir-Auguste Pierre	B.S. 2015	Consultant, Bain & Company
David Minoli	B.S. 2016	Chemistry Teacher, Los Angeles
Emily Silva	B.S. 2017	Teacher in WorldTeach, Ecuador
Mackenzie Adelberg	B.S. 2017	Environmental Laboratories, Inc., Cincinnati, OH
Kuan Jiang	B.S. 2019	Teach for America
Josef Lawrence	B.S. 2020	Graduate Student, Princeton Univ., Princeton, NJ
Kaitlin Porter	B.S. 2020	Hebert School of Medicine, Bethesda, MD
Dan DiPrimio	B.S. 2021	Graduate Student, Harvard Univ., Cambridge, MA

Course Teaching at Rochester (rating out of 5 in parentheses; NA = not available)

Chemistry 131 ("General Chemistry"): 2012 (3.4)
 Chemistry 211 ("Inorganic Chemistry"): 2002 (NA), 2003 (3.6), 2004 (4.0)
 Chemistry 234 ("Advanced Synthetic Techniques"): 2007 (4.0), 2008 (4.9), 2009 (4.5), 2010 (4.5)
 Chemistry 411 ("Advanced Inorganic Chemistry"): 2000 (NA), 2001 (NA), 2002 (NA), 2003 (NA), 2004 (NA)
 Chemistry 412 ("Inorganic Spectroscopy"): 2002 (3.7), 2003 (4.1), 2004 (4.3)
 Chemistry 414 ("Bioinorganic Chemistry"): 2005 (4.7), 2006 (4.7), 2007 (4.4), 2008 (4.1), 2009 (4.6)
 Chemistry 415 ("Group Theory"): 2010 (5.0)
 Chemistry 421 ("Basic Organometallic Chemistry"): 2011 (4.5), 2012 (4.5)
 Chemistry 422 ("Advanced Organometallic Chemistry"): 2012 (3.9)
 Chemistry 424 ("Inorganic Spectroscopy"): 2010 (4.8)

Course Teaching at Yale (rating out of 5 in parentheses)

Chemistry 457/557 ("Modern Coordination Chemistry"): 2013 (NA), 2014 (4.5)
 Chemistry 554 ("Bioinorganic Chemistry"): 2015 (4.2), 2018 (3.5), 2019 (2.5)
 Chemistry 161 ("General Chemistry I"): 2015 (2.8), 2016 (2.9), 2017 (3.0), 2018 (2.8)
 - initiated use of active learning strategies to move beyond the traditional lecture format
 - enrollment increased from 211 (in 2015) to 305 (in 2018)
 Chemistry 555 or 505 ("Inorganic Reaction Mechanisms"): 2016 (3.8), 2020 (4.4)

Chemistry 550 ("Physical Methods in Inorganic Chemistry"): 2019 (4.3)

Chemistry 502 ("Transition Metal Chemistry"): 2020 (4.0), 2021

Chemistry 252 ("Inorganic Chemistry"): 2022

Other Pedagogy:

- Short course on Organometallic Chemistry (Eastman Kodak Co.): 2002
- created website for sharing group exercises on inorganic chemistry
- invited talk in national symposium for VIPeR (Virtual Inorganic Pedagogical Electronic Resource), April 2008.
- B. A. Reisner, J. L. Stewart, B. S. Williams, L. A. Goj, P. L. Holland, H. J. Eppley, A. R. Johnson, "Virtual Inorganic Pedagogical Electronic Resource Learning Objects in Organometallic Chemistry," *J. Chem. Educ.* **2012**, *89*, 185-187.
- leader for presentation on "Writing Effective Workshop Problems" at Rochester Cluster of Leadership in Education, January 2013.
- National Academies Education Short Course, May 2015.
- led faculty discussion on active learning methods in large classes, Yale Center for Teaching & Learning, April 2016.
- Yale Center for Teaching and Learning Faculty Forum "How Faculty are Using Technology to Meet Pedagogical Goals," October 2017.
- Panelist for "How to Make Your Fellowship Application Stand Out," Graduate Writing Lab at Yale, April 2018.

Highlights of Departmental Service

- UR: Headed redesign of departmental Web page (2002)
- UR: Faculty supervisor for crystallography facility (2003-2013)
 - in charge of hiring new crystallographer on two occasions
 - wrote equipment grant for upgrade of detector
- UR: Chair of Graduate Studies (2005-2008)
 - established system for feedback to all TAs
 - initiated regular town-hall meetings with students
 - established "First-Year Graduate Seminar" for ethics and acculturation, expanded grad student orientation to include more TA training
 - changed graduate student fellowship system to be merit-based
 - added students to departmental committees for greater empowerment
- UR: Chair of Synthesis/Catalysis Mechanism Research Cluster (2009-2012)
 - organized annual retreat of synthetic groups
 - organized regular meetings of faculty to discuss research synergies
- Yale: Director of Graduate Studies (2015-2016)
 - initiated town-hall meetings of students and established student committee for feedback

- initiated student Joint Safety Team, overhauled department safety training to be hands-on
- initiated student surveys to assess, improve departmental climate
- organized full-department meetings to discuss sexual harassment prevention
(highlighted: Wang, L.; Widener, A. "Confronting sexual harassment in chemistry," *Chem. Eng. News* **2017**, 95 (37), 28-37).
- after my official role ended, continued to informally support these efforts
- Yale: Director of Graduate Student Climate & Diversity (2018-present)
 - originator of this position, which focuses on supporting student climate, mental health, diversity, and training experiences for our graduate students
 - advise student Climate & Diversity Committee and student Professional Development Network
 - coordinating recruiting at conferences/fairs for underrepresented minorities
 - interface with university-level diversity and wellness resources
 - implemented annual workshops on proposal writing and mentoring for students
 - organized student/staff faculty partners who created a Diversity Action Plan
 - organized anti-bias workshop for department, 2020
 - organized departmental symposium and display on Women in Chemistry
 - applied to ACS Bridge Site program
 - advised students establishing DEI Advocates program: peers to help community members with concerns

Other University Service - Yale

- Chemical Safety Committee (2014-2016)
 - organized visit of William Tolman for seminar describing safety culture and Joint Safety Teams (JST) between students, faculty, EHS; this initiative resulted in formation of a JST group at Yale Chemistry, which is now student-run (<https://jst.chem.yale.edu>)
 - helped to bring about new model for chemical safety training with "Safety Day," which features rotating stations with student-led training on different aspects of safety.
- University-Wide Committee on Sexual Misconduct (2016-2020)
 - departmental Title IX representative
 - panelist on cases involving student or faculty misconduct
- Fellow of Ezra Stiles College (2014-present)
 - advisor to numerous undergraduate students
 - participant in events that bring together science and humanities
 - member of committee to choose new Head of House (2020)
- Climate and Inclusion Committee, Graduate School of Arts & Sciences (2019-present)
 - Reviewing and testing materials & initiatives for the Graduate School across departments.
- Interviews with *Yale Daily News* (student newspaper)

- I have been interviewed several times for perspectives on teaching (large general chemistry course), research, and departmental innovations.