Christopher C. Cummins

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Education

Ph.D. Inorganic Chemistry, Massachusetts Institute of Technology, 1993. Thesis advisor: Richard R. Schrock

A.B. Chemistry, Cornell University, 1989. Undergraduate research mentor: Peter T. Wolczanski

Experience

Massachusetts Institute of Technology, Henry Dreyfus Professor of Chemistry, 2015–present

Massachusetts Institute of Technology, Professor, 1996–present

Massachusetts Institute of Technology, Assistant Professor, 1993–1996

Research Interests

Exploratory synthesis and reactivity studies involving elements from across the periodic table. Some particular research themes are as follows: synthesis stemming from the elements nitrogen and phosphorus, small molecule activation, the generation and study of reactive intermediates, new inorganic molecules and ligands, carbon dioxide utilization, electronic structure and chemical bonding, anion receptor coordination and cryptand chemistry.

Honors and Awards

Honorary Professor of the Institute, IISER Kolkata, 2018-2021

Linus Pauling Medal, 2017

National Academy of Sciences, Elected Member 2017

Fellow, Hagler Institute for Advanced Study at Texas A&M University, 2016-2017

RSC Ludwig Mond Award 2013

Inaugural ACS-DIC *Inorganic Chemistry* Lectureship Award 2013

American Academy of Arts and Sciences, Elected Member 2008

Raymond and Beverly Sackler Prize in the Physical Sciences 2007

ACS F. Albert Cotton Award in Synthetic Inorganic Chemistry 2007

Corresponding Member, Akademie der Wissenschaften zu Göttingen 2005

Alexander von Humboldt Research Award 2002

Dannie-Heineman Preis of the Akademie der Wissenschaften zu Göttingen 2001

Technology Review Magazine TR100 Award 1999

NSF Alan T. Waterman Award 1998

ACS Award in Pure Chemistry 1998

Phi Lambda Upsilon National Fresenius Award 1997

Alfred P. Sloan Foundation Fellowship 1997

E. Bright Wilson Prize, Harvard University 1995

Packard Foundation Fellowship 1995

Lectureships

Xing-Da Lecture, Peking University, Beijing, China, 2018

Neil Bartlett Memorial Lecture, University of California Berkeley, 2018

Inorganic McElvain Speaker, University of Wisconsin Madison, 2017

The Ramabrahmam and Balamani Guthikonda Lecture, Columbia University, 2017

Rayson Huang Visiting Lectureship in Chemistry, Hong Kong University, 2016

Reeves Lecture, Juniata College, 2015

Shore Lecture, The Ohio State University, 2015

Lee Lecture, University of Chicago, 2015

Moses Gomberg Lecture, University of Michigan, 2014

Otto M. Smith Lecture sponsored by the Alpha Delta Chapter of Phi Lambda Upsilon, Oklahoma State University, 2014

Inaugural ACS-DIC *Inorganic Chemistry* Lectureship Award Lecture, Indiana, 2013

Walton Lecture, Purdue University, 2013

Probst Lectures, Southern Illinois University Edwardsville, 2013

Ray Q. Brewster Lecture, University of Kansas, 2012

Frontiers Lectures, Texas A&M University, 2011

Taube Lecture, Stanford University, 2009

Welch Lecture Series, Texas, 2008

Inaugural Gordon-Kenan Lecture, Organometallic Chemistry *Graduate Research Seminar*, Rhode Island, 2007

MacLean Lectures, Student-Invited Seminar, McMaster U., Canada, 2007

Raymond and Beverly Sackler Prize Lecture, Tel Aviv University, Israel, 2007

ACS F. Albert Cotton Award in Inorganic Synthesis Award Lecture, Chicago, 2007

Pederson Lecture, DuPont, Wilmington, DE. 2007

Dow Lecture in Organometallic Chemistry, Caltech, 2006

The Grandpierre Memorial Lecture, Columbia University, 2006

Dalton Lecture, University of California Berkeley, 2005

Reilly Lectures, University of Notre Dame, 2000

Professional Activities

MIT Chemistry Committee on Space, 2019–

MIT Task Force on Open Access, 2017–

MIT Chemistry ChemFlex Major Committee, 2016–2017

SusPhos External Advisory Board member, Dec 2014–Feb 2017

Chair-Elect, ACS-DIC Organometallic Subdivision, Jan. 1, 2015–Dec. 31, 2015. Chair, Jan. 1, 2016–Dec. 31, 2016

MIT Faculty Newsletter Editorial Board Member, Elected 2014

MIT Campus Planning Committee, 2014–2017

Participant, ACS Invitational Conference on Graduate Education, Atlanta, Georgia, September 22-24, 2013

Inorganic Chemistry Editorial Advisory Board member, 2013–2015

MIT Task Force on Graduate Student Professional Development, 2012

ACS DIC Executive Committee Member at Large, 2011–2013

Chemical & Engineering News Advisory Board Member, 2011–2013

Chemical Science Associate Editor for Inorganic and Organometallic Chemistry, 2010–present

Chemistry World International Advisory Board member, 2009–present

MIT Department of Chemistry Chemical Hygeine Committee, 2009–present

Inorganica Chimica Acta Editorial Board member, 2007–present

Inorganic Syntheses Editorial Advisory Board member, 2006–present

Organometallics Editorial Advisory Board member, 2006-2008

MIT Commencement Committee and Associate Faculty Marshal, 2003–2015

MIT Committee on Academic Performance (CAP), 1999-2001

ACS Committee on Education (SOCED)

MIT Department of Chemistry UROP (Undergraduate Research Opportunities Program) Coordinator, 1996–2017

Teaching

5.03 Principles of Inorganic Chemistry I

5.04 Principles of Inorganic Chemistry II

5.05 Principles of Inorganic Chemistry III, Main Group Element Chemistry

5.061 Principles of Organometallic Chemistry

5.112 Principles of Chemical Science

5.37 Organic and Inorganic Laboratory

Publications

[1] Geeson, M. B.; Ríos, P.; Transue, W. J.; Cummins, C. C., Orthophosphate and sulfate utilization for C–E (E = P, S) bond formation via trichlorosilyl phosphide and sulfide anions. *J. Am. Chem. Soc.* **2019**, *141*, 0000–0000. URL https://doi.org/10.1021/jacs.9b01475.

[2] Szkop, K. M.; Geeson, M. B.; Stephan, D. W.; Cummins, C. C., Synthesis of acyl(chloro)phosphines enabled by phosphinidene transfer. *Chem. Sci.* **2019**, *10*, 3627–3631. URL https://doi.org/10.1039%2Fc8sc05657a.

[3] Shepard, S.; Cummins, C. C., Functionalization of intact trimetaphosphate: A triphosphorylating reagent for C, N, and O nucleophiles. *J. Am. Chem. Soc.* **2019**, *141*, 1852–1856. URL https://doi.org/10.1021/jacs.8b12204.

[4] Transue, W. J.; Nava, M.; Terban, M. W.; Yang, J.; Greenberg, M. W.; Wu, G.; Foreman, E. S.; Mustoe, C. L.; Kennepohl, P.; Owen, J. S.; Billinge, S. J. L.; Kulik, H. J.; Cummins, C. C., Anthracene as a launchpad for a phosphinidene sulfide and for generation of a phosphorus-sulfur material having the composition P_2S, a vulcanized red phosphorus that is yellow. *J. Am. Chem. Soc.* **2019**, *141*, 431–440. URL https://doi.org/10.1021%2Fjacs.8b10775.

[5] Transue, W. J.; Yang, J.; Nava, M.; Sergeyev, I. V.; Barnum, T. J.; McCarthy, M. C.; Cummins, C. C., Synthetic and spectroscopic investigations enabled by modular synthesis of molecular phosphaalkyne precursors. *J. Am. Chem. Soc.* **2018**, *140*, 17985–17991. URL https://doi.org/10.1021%2Fjacs.8b09845.

[6] Paparo, A.; Silvia, J. S.; Spaniol, T. P.; Okuda, J.; Cummins, C. C., Countercation effect on CO_2 binding to oxo titanate with bulky anilide ligands. *Chem.–Eur. J.* **2018**, *24*, 17072–17079. URL https://doi.org/10.1002%2Fchem.201803265.

[7] qin Yuan, Q.; Yang, Z.; zhong Li, R.; Transue, W. J.; peng Li, Z.; Jiang, L.; Govind, N.; Cummins, C. C.; Wang, X.-B., Magnetic-bottle and velocity-map imaging photoelectron spectroscopy of APS^- (A=C_14H_10 or anthracene): Electron structure, spin-orbit coupling of APS•, and dipole-bound state of APS^-. *Chin. J. Chem. Phys.* **2018**, *31*, 463–470. URL https://doi.org/10.1063%2F1674-0068%2F31%2Fcjcp1805114.

[8] Ghosh, S. K.; Cummins, C. C.; Gladysz, J. A., A direct route from white phosphorus and fluorous alkyl and aryl iodides to the corresponding trialkyl- and triarylphosphines. *Org. Chem. Front.* **2018**. URL https://doi.org/10.1039%2Fc8qo00943k.

[9] Joost, M.; Nava, M.; Transue, W. J.; Martin-Drumel, M.-A.; McCarthy, M. C.; Patterson, D.; Cummins, C. C., Sulfur monoxide thermal release from an anthracene-based precursor, spectroscopic identification, and transfer reactivity. *Proc. Natl. Acad. Sci. U. S. A.* **2018**, *115*, 5866–5871. URL https://doi.org/10.1073%2Fpnas.1804035115.

[10] Geeson, M. B.; Cummins, C. C., Phosphoric acid as a precursor to chemicals traditionally synthesized from white phosphorus. *Science* **2018**, *359*, 1383–1385. URL https://doi.org/10.1126%2Fscience.aar6620.

[11] Stauber, J. M.; Zhang, S.; Gvozdik, N.; Jiang, Y.; Avena, L.; Stevenson, K. J.; Cummins, C. C., Cobalt and vanadium trimetaphosphate polyanions: Synthesis, characterization, and electrochemical evaluation for non-aqueous redox-flow battery applications. *J. Am. Chem. Soc.* **2018**, *140*, 538–541.

[12] Joost, M.; Transue, W. J.; Cummins, C. C., Diazomethane umpolung atop anthracene: an electrophilic methylene transfer reagent. *Chem. Sci.* **2018**, *9*, 1540–1543. URL https://doi.org/10.1039%2Fc7sc04506a.

[13] Knopf, I.; Courtemanche, M.-A.; Cummins, C. C., Cobalt complexes supported by cis-macrocyclic diphosphines: Synthesis, reactivity, and activity toward coupling carbon dioxide and ethylene. *Organometallics* **2017**, *36*, 4834–4843. URL https://doi.org/10.1021%2Facs.organomet.7b00734.

[14] Joost, M.; Nava, M.; Transue, W. J.; Cummins, C. C., An exploding N-isocyanide reagent formally composed of anthracene, dinitrogen and a carbon atom. *Chem. Commun.* **2017**, *53*, 11500–11503. URL https://doi.org/10.1039%2Fc7cc06516g.

[15] Joost, M.; Transue, W. J.; Cummins, C. C., Terminal tungsten pnictide complex formation through pnictaethynolate decarbonylation. *Chem. Commun.* **2017**, *53*, 10731–10733. URL https://dx.doi.org/10.1039/c7cc06841g.

[16] Transue, W. J.; Velian, A.; Nava, M.; Garca-Iriepa, C.; Temprado, M.; Cummins, C. C., Mechanism and scope of phosphinidene transfer from dibenzo-7-phosphanorbornadiene compounds. *J. Am. Chem. Soc.* **2017**, *139*, 10822–10831. URL http://dx.doi.org/10.1021/jacs.7b05464, pMID: 28703579.

[17] Stauber, J. M.; Alliger, G. E.; Nocera, D. G.; Cummins, C. C., Second-coordination-sphere assisted selective colorimetric turn-on fluoride sensing by a mono-metallic Co(II) hexacarboxamide cryptand complex. *Inorg. Chem.* **2017**, *56*, 7615–7619. URL http://dx.doi.org/10.1021/acs.inorgchem.7b01335, pMID: 28665117.

[18] Zhang, S.; Nava, M. J.; Chow, G.; Lopez, N.; Wu, G.; Britt, R. D.; Nocera, D. G.; Cummins, C., On the incompatibility of lithium-O_2 battery technology with CO_2. *Chem. Sci.* **2017**, *8*, 6117–6122. URL http://dx.doi.org/10.1039/C7SC01230F.

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[22] Knopf, I.; Tofan, D.; Beetstra, D.; Al-Nezari, A.; Al-Bahily, K.; Cummins, C., A family of cis-macrocyclic diphosphines: modular, stereoselective synthesis and application in catalytic CO_2/ethylene coupling. *Chem. Sci.* **2017**, *8*, 4163–4168. URL http://dx.doi.org/10.1039/C6SC03614G.

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[25] Hou, G.-L.; Chen, B.; Transue, W. J.; Hrovat, D. A.; Cummins, C. C.; Borden, W. T.; Wang, X.-B., A joint experimental and computational study of the negative ion photoelectron spectroscopy of the 1-phospha-2,3,4-triazolate anion, $HCPN_3^-$. *J. Phys. Chem. A* **2016**, *120*, 6228–6235. URL http://dx.doi.org/10.1021/acs.jpca.6b06343.

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[29] Hou, G.-L.; Chen, B.; Transue, W. J.; Hrovat, D. A.; Cummins, C. C.; Borden, W. T.; Wang, X.-B., Negative ion photoelectron spectroscopy of $P_2N_3^-$: electron affinity and electronic structures of $P_2N_3\cdot$. *Chem. Sci.* **2016**, *7*, 4667–4675. URL http://dx.doi.org/10.1039/C5SC04667J.

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[36] Velian, A.; Cummins, C. C., Synthesis and characterization of $P_2N_3^-$: An aromatic ion composed of phosphorus and nitrogen. *Science* **2015**, *348*, 1001–1004. URL http://www.sciencemag.org/content/348/6238/1001.abstract.

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[39] Diaconescu, P. L.; Cummins, C. C., Radical anionic versus neutral 2,2′-bipyridyl coordination in uranium complexes supported by amide and ketimide ligands. *Dalton Trans.* **2015**, *44*, 2676–2683. URL http://dx.doi.org/10.1039/C4DT02422B.

[40] Majumdar, S.; Stauber, J. M.; Palluccio, T. D.; Cai, X.; Velian, A.; Rybak-Akimova, E. V.; Temprado, M.; Captain, B.; Cummins, C. C.; Hoff, C. D., Role of axial base coordination in isonitrile binding and chalcogen atom transfer to vanadium(III) complexes. *Inorg. Chem.* **2014**, *53*, 11185–11196. URL http://dx.doi.org/10.1021/ic5017005.

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[49] Manna, C. M.; Nassar, M. Y.; Tofan, D.; Chakarawet, K.; Cummins, C. C., Facile synthesis of mononuclear early transition-metal complexes of κ^3 *cyclo*-tetrametaphosphate ($[P_4O_{12}]^{4-}$) and *cyclo*-trimetaphosphate ($[P_3O_9]^{3-}$). *Dalton Trans.* **2014**, *43*, 1509–1518. URL http://dx.doi.org/10.1039/C3DT52526K.

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[53] Palluccio, T. D.; Rybak-Akimova, E. V.; Cai, X.; Majumdar, S.; Chui, M.; Temprado, M.; Silvia, J. S.; Cozzolino, A. F.; Tofan, D.; Cummins, C. C.; Captain, B.; Hoff, C. D., Thermodynamic and kinetic study of cleavage of the N–O bond of N-oxides by a vanadium(III) complex: Enhanced oxygen atom transfer reaction rates for adducts of nitrous oxide and mesityl nitrile oxide. *J. Am. Chem. Soc.* **2013**, *135*, 11357–11372. URL http://dx.doi.org/10.1021/ja405395z.

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