Carson J. Bruns
Curriculum Vitae

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Assistant Professor
ATLAS Institute / Department of Mechanical Engineering
University of Colorado, Boulder
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Education

Doctor of Philosophy — *Northwestern University*
Field: Organic Chemistry — December 2013

Bachelor of Arts *magna cum laude* — *Luther College*
Majors: Chemistry, Religion — May 2008
Minor: Mathematics

Research Experience

Miller Research Fellow — September 2014–August 2017
University of California, Berkeley — *Faculty Host*: Matthew B. Francis

Postdoctoral Researcher — January–August 2014
Northwestern University — *Advisors*: Samuel I. Stupp & J. Fraser Stoddart

Graduate Research Assistant — September 2008–December 2013
Northwestern University — *Advisors*: Samuel I. Stupp & J. Fraser Stoddart

NSF East Asia and Pacific Summer Institutes (EAPSI) — June–August 2013
JSPS Summer Program Fellow — *Advisor*: Makoto Fujita
University of Tokyo

World Class University Project Visiting Student — November–December 2011
Korea Advanced Institute of Science and Technology — *Advisor*: J. Fraser Stoddart

Global Center of Excellence Visiting Student — January–March 2010
University of Tokyo — *Advisor*: Makoto Fujita

NSF Research Experience for Undergraduates — June–August 2007
Chulabhorn Research Institute, Bangkok, Thailand — *Advisor*: Nopporn Thasana

NSF Research Experience for Undergraduates — June–August 2006
Coe College — *Advisor*: Scott J. Stoudt

Teaching Experience

MCEN 1024: Chemistry for Energy and Materials Science — Spring 2018
Department of Mechanical Engineering, CU Boulder

ATLS 4419/5519: Color — Fall 2017
ATLAS Institute, CU Boulder

Teaching Assistant — September 2008–December 2009
Integrated Molecular Structure Research and Education Center, Northwestern University

Math and Science Tutor — February 2007–May 2008
Student Academic Support Services, Luther College

Awards and Honors

Miller Research Fellowship — 2014–2017
Miller Institute, University of California, Berkeley

NSF Graduate Research Fellowship — June 2010–2013
National Science Foundation

Graduate Assistance in Areas of National Need Fellowship — September 2008–2009
U.S. Department of Education

John G. and Mildred Breiland Fellowship — May 2007–2008
Luther College Department of Chemistry

Regents Scholarship — August 2004–May 2008
Luther College

Books

Bruns, C. J.; Stoddart, J. F. *The Nature of the Mechanical Bond: From Molecules to Machines*. Hoboken: John Wiley & Sons, 2016. 761 pp. ISBN: 9781119044000

Book Chapters

2. **Bruns, C. J.**; Stoddart, J. F. Mechanically Interlaced and Interlocked Donor-Acceptor Foldamers. *Adv. Polym. Sci.* **2013***, 261*, 271–294.

1. **Bruns, C. J.**; Stoddart, J. F. The Mechanical Bond: A Work of Art. *Top. Curr. Chem.* **2012**, 323, 19–72.

Publications

*Asterisks denote equal contribution

29. Sluysmans, D.; Devaux, F.; **Bruns, C. J.**; Stoddart, J. F.; Duwez, A.-S. Dynamic Force Spectroscopy of Synthetic Oligorotaxane Foldamers. *Proc. Natl. Acad. Sci. U.S.A*. **2018**, DOI: 10.1073/pnas.1712790115.

28. Sluysmans, D.; Hubert, S.; **Bruns, C. J.**; Zhu, Z.; Stoddart, J. F.; Duwez, A.-S. Synthetic Oligorotaxanes Exert High Forces when Folding Under Mechanical Load. *Nature Nanotech.* **2018**, DOI: 10.1038/s41565-017-0033-7.

27. Loser, S.; Lou, S. J.; Savoie, B. M.; **Bruns, C. J.**; Timalsina, A.; Leonardi, M. J.; Harschneck, T.; Turrisi, R.; Zhou, N.; Stern, C. L.; Sarjeant, A. A.; Facchetti, A.; Chang, R. P. H.; Stupp, S. I.; Ratner, M. A.; Chen, L. X.; Marks, T. J. Systematic Evaluation of Structure-Property Relationships in Heteroacene-Diketopyrrolopyrrole Molecular Donors for Organic Solar Cells. *J. Mater. Chem. A* **2017***, 5*, 9217–9232.

26. Slack, C. C.; Finbloom, J. A.; Jeong, K.; **Bruns, C. J.**; Wemmer, D. B.; Pines, A.; Francis, M. B. Rotaxane Probes for Protease Detection by ^{129}Xe HyperCEST NMR. *Chem. Commun*. **2017**, *53*, 1076–1079.

25. **Bruns, C. J.**; Liu, H.; Francis, M. B. Near-Quantitative Aqueous Synthesis of Rotaxanes via Bioconjugation to Oligopeptides and Proteins. *J. Am. Chem. Soc.* **2016**, *138*, 15307–15310.

24. Finbloom, J. A.; Slack, C. C.; **Bruns, C. J.**; Jeong, K.; Wemmer, D. E.; Pines, A.; Francis, M. B. Rotaxane-Mediated Suppression and Activation of Cucurbit[6]uril for Molecular Detection by ^{129}Xe HyperCEST NMR. *Chem. Commun.* **2016**, *52*, 3119–3122.

23. Aytun, T.; Santos, P. J.; **Bruns, C. J.**; Huang, D.; Koltonow, A. R.; Olvera de la Cruz, M.; Stupp, S. I. Self-Assembling Tripodal Small-Molecule Donors for Bulk Heterojunction Solar Cells. *J. Phys. Chem. C* **2016**, *120*, 3602–3611.

22. Hou, X.*; Ke, C.*; **Bruns, C.**; McGonigal, P. R.; Pettman, R. B.; Stoddart, J. F. Tunable Solid-State Fluorescent Materials for Supramolecular Encryption. *Nature Commun.* **2015**, *6,* 6884.

21. **Bruns, C. J.***; Fujita, D.*; Hoshino, M.; Sato, S.; Stoddart, J. F.; Fujita, M. Emergent Ion-Gated Binding of Cationic Host-Guest Complexes Within Cationic $M_{12}L_{24}$ Molecular Flasks. *J. Am. Chem. Soc.* **2014**, *136*, 12027–12034

20. **Bruns, C. J.**; Stoddart, J. F. Rotaxane-Based Molecular Muscles. *Acc. Chem. Res.* **2014**, *47*, 2186–2199.

19. **Bruns, C. J.**; Frasconi, M.; Iehl, J.; Hartlieb, K. J.; Schneebeli, S. T.; Cheng, C.; Stupp,

S. I.; Stoddart, J. F. Redox Switchable Daisy Chains Driven by Radical-Radical Interactions. *J. Am. Chem. Soc.* **2014**, *136*, 4714–4723. ***Featured in JACS Spotlights***

18. **Bruns, C. J.**; Li, J.; Frasconi, M.; Schneebeli, S. T.; Iehl, J.; Jacquot de Rouville, H.-P.; Stupp, S. I.; Voth, G. A.; Stoddart, J. F. An Electrochemically and Thermally Switchable Donor-Acceptor [*c*2]Daisy Chain Rotaxane. *Angew. Chem., Int. Ed.* **2014**, *53*, 1953–1958.

17. Fahrenbach, A. C.; **Bruns, C. J.**; Li, H.; Trabolsi, A.; Coskun, A.; Stoddart, J. F. Ground-State Kinetics of Bistable Redox-Active Donor-Acceptor Mechanically Interlocked Molecules. *Acc. Chem. Res.* **2014**, *47*, 482–493.

16. **Bruns, C. J.*;** Herman, D. J.*; Minuzzo, J. B.; Lehrman, J. A.; Stupp, S. I. Rationalizing Molecular Design in the Electrodeposition of Anisotropic Lamellar Nanostructures. *Chem. Mater.* **2013**, *25*, 4330–4339.

15. Ruiz-Carretero, A.; Aytun, T.; **Bruns, C. J.**; Newcomb, C. J.; Tsai, W.-W.; Stupp, S. I. Stepwise Self-Assembly to Improve Solar Cell Morphology. *J. Mat. Chem. A* **2013**, *1*, 11674–11681.

14. Guerrero, A.; Loser, S. C.; Garcia-Belmonte, G.; **Bruns, C. J.**; Smith, J.; Miyauchi, H.; Stupp, S. I.; Marks, T. J.; Bisquert, J. Solution-Processed Small Molecule: Fullerene Bulk-Heterojunction Solar Cells: Impedance Spectroscopy Deduced Bulk and Interfacial Limits to Fill-Factor. *Phys. Chem. Chem. Phys.* **2013**, *15*, 16456–16462.

13. Juriček, M.*; Barnes, J. C.*; Dale, E. J.; Liu, W.-G.; Strutt, N. L.; **Bruns, C. J.**; Vermeulen, N. A.; Ghooray, K.; Sarjeant, A. A.; Stern, C. L.; Botros, Y. Y.; Goddard, W. A. III; Stoddart, J. F. Ex^2Box: Interdependent Modes of Binding in a Two-Nanometer-Long Synthetic Receptor. *J. Am. Chem. Soc.* **2013**, *135*, 12736–12746.

12. **Bruns, C. J.**; Stoddart, J. F. Molecular Machines Muscle Up. *Nature Nanotechnol.* **2013**, *8*, 9–10.

11. Zhu, Z.; **Bruns, C. J.**; Li, H.; Lei, J.; Ke, C.; Liu, Z.; Shafaie, S.; Colquhoun, H. M.; Stoddart, J. F. Synthesis and Solution-State Dynamics of Donor-Acceptor Oligorotaxane Foldamers. *Chem. Sci.* **2013**, *4*, 1470–1483.

10. Barnes, J. C.*; Juriček, M.*; Strutt, N. L.; Frasconi, M.; Sampath, S.; Giesener, M. A.; McGrier, P. L.; **Bruns, C. J.**; Stern, C. L.; Sarjeant, A. A.; Stoddart, J. F. ExBox: A Polycyclic Aromatic Hydrocarbon Scavenger. *J. Am. Chem. Soc.* **2013**, *135*, 183–192.

9. Gothard, C. M.*; **Bruns, C. J.***; Gothard, N. A.; Grzybowski, B. A.; Stoddart, J. F. Modular Synthesis of Bipyridinium Oligomers and Corresponding Donor-Acceptor Oligorotaxanes with Crown Ethers. *Org. Lett.* **2012**, *14*, 5066–5069.

8. Jacquot de Rouville, H.-P.; Iehl, J.; **Bruns, C. J.**; McGrier, P. L.; Frasconi, M.; Sarjeant, A. A.; Stoddart, J. F. A Neutral Naphthalene Diimide [2]Rotaxane. *Org. Lett.* **2012**, *14*, 5188–5191.

7. Basuray, A. N.; Jacquot de Rouville, H.-P.; Hartlieb, K. J.; Kikuchi, T.; Strutt, N. L.; **Bruns, C. J.**; Ambrogio, M. W.; Avestro, A.-J.; Schneebeli, S. T.; Fahrenbach, A. C.; Stoddart, J. F. The Chameleonic Nature of Diazopyrenium Recognition Processes. *Angew. Chem., Int. Ed.* **2012**, *51*, 11872–11879.

6. Fahrenbach, A. C.; Hartlieb, K. J.; Sue, C.-H.; **Bruns, C. J.**; Barin, G.; Basu, S.; Olson, M. A.; Botros, Y. Y.; Bagabas, A.; Khdary, N.; Stoddart, J. F. Rapid Thermally Assisted Donor-Acceptor Catenation. *Chem. Commun.* **2012**, 48, 9141–9143.

5. Fahrenbach, A. C.; **Bruns, C. J.**; Cao, D.; Stoddart, J. F. Ground-State Thermodynamics of Redox-Active Donor-Acceptor Mechanically Interlocked Molecules. *Acc. Chem. Res.* **2012**, *45*, 1581–1592.

4. Loser, S.; **Bruns, C. J.**; Miyauchi, H.; Ponce Ortiz, R.; Facchetti, A.; Stupp, S. I.; Marks, T. J. A Naphthodithiophene-Diketopyrrolopyrrole Donor Molecule for Efficient Solution-Processed Solar Cells. *J. Am. Chem. Soc.* **2011**, *133,* 8142–8145.

3. **Bruns, C. J.**; Basu, S.; Stoddart, J. F. Improved Synthesis of 1,5-Dinaphtho[38]Crown-10. *Tetrahedron Lett.* **2010**, *51*, 983–986.

2. Forgan, R. S.; Friedman, D. C.; Stern, C. L.; **Bruns, C. J.** Stoddart, J. F. Directed Self-Assembly of a Ring-in-Ring Complex. *Chem. Commun.* **2010**, 5861–5863. ***Front Cover***

1. Boonya-Udtayan, S.; Yotapan, N.; Woo, C.; **Bruns, C. J.**; Ruchirawat, S.; Thasana, N. Synthesis and Biological Activities of Azalamellarins. *Chem. Asian J.* **2010**, *5*, 2113–2123.

Oral Presentations

5. Biochemical Applications of Rotaxanes
Molecular Rotors, Motors, and Switches Conference. Telluride Science Research Center, Telluride, Colorado 21 July 2016

4. Host-Guest Chemistry Inside of Large, Self-Assembled Molecular Flasks
5th Interdisciplinary Science Forum of the JSPS-US-AA The University of Florida, Gainesville 7 November 2014

3. Emergent Ion-Gated Binding of Host-Guest Complexes Within $M_{12}L_{24}$ Molecular Flasks
248th ACS National Meeting and Exposition, San Francisco 13 August 2014

2. The Art and Science of (re)Presentation and the Mechanical Bond
Molecular Rotors, Motors, and Switches Workshop. Telluride Science Research Center, Telluride, Colorado, United States 1 July 2014

1. Self-Assembly of Organic-Inorganic Hybrids
Northwestern University Department of Chemistry Organic Seminar 1 March 2011

Poster Presentations

9. **Bruns, C. J.**; Liu, H.; Finbloom, J. A.; Slack, C. C.; Jeong, K.; Wemmer, D. E.; Pines, A.; Francis, M. B. Utilizing the Mechanical Bonds of Rotaxanes in Bioconjugation and Controlled-Release Applications
11th International Symposium on Macrocyclic & Supramolecular Chemistry (ISMSC), Seoul, South Korea 10–14 July 2016

8. **Bruns, C. J.**; Liu, H.; Francis, M. B. Protein Mounted Rotaxanes.
10th International Symposium on Macrocyclic & Supramolecular Chemistry (ISMSC), Strasbourg, France 28 June–2 July 2015
Selected as a winner of the Springer ISMSC2015 Poster Prize

7. **Bruns, C. J.**; Frasconi, M.; Zhu, Z.; Sluysmans, D.; Stupp, S.; Duwez, A.-S.; Stoddart, J. F. Rotaxane-Based Molecular Muscles
Gordon Research Conference on Artificial Molecular Switches and Motors, Easton, Massachusetts, USA 7–12 June 2015

6. **Bruns, C. J.**; Frasconi, M.; Zhu, Z.; Sluysmans, D.; Stupp, S.; Duwez, A.-S.; Stoddart, J. F. Rotaxane-Based Molecular Muscles
2015 MRS Spring Meeting, San Francisco, USA 6–10 April 2015

5. **Bruns, C. J.**; Stoddart, J. F. Molecular Switches and Machines with Mechanical Bonds
Molecular Rotors, Switches, and Machines Workshop, Telluride Science Research Center, Telluride, Colorado, USA 30 June–4 July 2014

4. **Bruns, C. J.**; Frasconi, M.; Li, J.; Schneebeli, S. T.; Iehl, J.; Jacquot de Rouville, H.-P.; Hartlieb, K. J.; Cheng, C.; Stupp, S. I.; Voth, G. A.; Stoddart, J. F. Donor-Acceptor Daisy Chain Rotaxanes: Thermally and Electrochemically Switchable Molecular Muscles
RSC Macrocyclic and Supramolecular Chemistry Meeting. 16–17 December
University of Glasgow, Scotland 2013

3. **Bruns, C. J.**; Tayi, A. S.; Stupp, S. I.; Stoddart, J. F. From Switchable Mechanical Molecules to Artificial Muscles
DOE Energy Frontiers Research Centers Review: Non-Equilibrium Energy Research Center. *Baltimore, Maryland, USA* 5 April 2012

2. **Bruns, C. J.**; Fahrenbach, A. C.; Fujita, D.; Basu, S.; Fujita, M.; Stoddart, J. F. Pseudorotaxanation Within an Electrostatically-Gated $M_{12}L_{24}$ Coordination Sphere.
5th International Symposium on Macrocyclic & Supramolecular Chemistry (ISMSC), Nara, Japan 6–10 June 2010
Selected as a winner of the Springer ISMSC2010 Poster Prize

1. **Bruns, C. J.**; Thasana, N. Cu^{I}-Mediated Microwave-Assisted Synthesis of Azalamellarins
235th National ACS Meeting. *New Orleans, Louisiana, USA* 6–10 April 2008

Students Mentored	**Dates**	**Current Position**
Karan Dikshit	January 2018-present	Graduate Research Assistant
Phillip Vo	January 2018-present	Undergraduate Researcher
Jesse Butterfield, *CU Boulder*	September 2017–present	Graduate Research Assistant
Brett Anderson, *Northwestern*	September 2011–May 2012	Radiology Specialist, US Army
Peter J. Santos, *Northwestern*	December 2012–May 2014	Graduate Student, MIT
Hanwei Liu, *UC Berkeley*	March 2015–June 2016	Graduate Student, Caltech

Professional Memberships

Phi Beta Kappa Honors Society	Inducted 2008
Phi Lambda Upsilon Honorary Chemical Society *Alpha Gamma Chapter, Northwestern University*	Inducted 2010
JSPS-US Fellows Alumni Association	Inducted 2013
American Chemical Society	2011–Present
Materials Research Society	2015–Present
American Institute of Chemical Engineers	2015–Present

Service

CU Boulder CEAS Soft Materials Faculty Search Committee	September 2017-present
ATLAS Institute ARPAC Self-Study Committee	September 2017-present
Northwestern Gelowitz Award Selection Committee	May 2013
Miller Institute Multidisiplinary Symposium Planning Committee	2015–2016

Referee for *JACS*, *Nature Chemistry*, *Nature Communications, Advanced Materials, PNAS, Journal of Chemical Physics*

Responsible Conduct of Research Training August 2011/January 2014
www.citiprogram.org

Boulder, Colorado **January 2018**