

WILLIAM B CARPENTER

The Ohio State University
Department of Chemistry and Biochemistry
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APPOINTMENTS

Assistant Professor 2024-present
The Ohio State University, Department of Chemistry and Biochemistry

- Division of Physical Chemistry

Postdoctoral Researcher 2020-2024
Stanford University, Department of Chemistry

- Advisor: W.E. Moerner

EDUCATION

University of Chicago 2014-2020
Chicago, IL

- Thesis title: *Aqueous proton structures and dynamics observed with nonlinear infrared spectroscopy*
- Advisor: Andrei Tokmakoff
- Ph.D. in Chemistry, August 2020
- M.S. in Chemistry, December 2015

University of California, Berkeley 2009-2013
Berkeley, CA

- B.S. Chemistry with High Honors
- Minor in Mathematics
- Research advisor: Rich Saykally

RESEARCH SUPPORT

The Ohio State University 2024-present

- Startup funding from the College of Arts and Sciences

PUBLICATIONS

[Google Scholar](#)

1. **W.B. Carpenter**, A.A. Lavania, A.H. Squires, and W.E. Moerner, "Label-free anti-Brownian trapping of single nanoparticles in solution," *J. Phys. Chem. C* **2024**, *128*, 20275.
2. **W.B. Carpenter**, A.A. Lavania, J.S. Borden, L.M. Oltrogge, D. Perez, P.D. Dahlberg, D.F. Savage, and W.E. Moerner, "Monitoring physical and chemical properties of individual carboxysomes trapped in solution," *Proc. SPIE Optical Trapping and Optical Micromanipulation XX*, **2023**, *12649*, 4.
3. J.H. Hack, N.H.C. Lewis, **W.B. Carpenter**, and A. Tokmakoff, "Amplification of mid-IR continuum for broadband 2D IR spectroscopy," *Opt. Lett.*, **2023**, *48*, 960.

4. **W.B. Carpenter**, A.A. Lavania, J.S. Borden, L.M. Oltrogge, D. Perez, P.D. Dahlberg, D.F. Savage, and W.E. Moerner, "Ratiometric Sensing of Redox Environments Inside Individual Carboxysomes Trapped in Solution," *J. Phys. Chem. Lett.* **2022**, *13*, 4455.
5. A.A. Lavania, **W.B. Carpenter**, L.M. Oltrogge, D. Perez, J.B. Turnsek, D.F. Savage, and W.E. Moerner, "Exploring masses and internal mass distributions of single carboxysomes in free solution using fluorescence and interferometric scattering in an anti-Brownian trap," *J. Phys. Chem. B*, **2022**, *126*, 8747.
6. J.H. Hack, J.P. Dombrowski, X. Ma, Y. Chen, N.H.C. Lewis, **W.B. Carpenter**, C. Li, G.A. Voth, H.H. Kung, and A. Tokmakoff, "Structural Characterization of Protonated Water Clusters Confined in HZSM-5 Zeolites," *J. Am. Chem. Soc.* **2021**, *143*, 10203.
7. B. Dereka, Q. Yu, N.H.C. Lewis, **W.B. Carpenter**, J.M. Bowman, and A. Tokmakoff, "Crossover from Hydrogen to Chemical Bonding," *Science*, **2021**, *371*, 160.
Press Release: "Where the hydrogen bond ends and the covalent bond begins," *Chemical & Engineering News*. January 7, 2021. <https://cen.acs.org/physical-chemistry/chemical-bonding/hydrogen-bond-ends-covalent-bond/99/i2>
8. **W.B. Carpenter**, Q. Yu, J.H. Hack, B. Dereka, J.M. Bowman, and A. Tokmakoff, "Decoding the 2D IR Spectrum of the Aqueous Proton with High-Level VSCF/VCI Calculations," *J. Chem. Phys.* **2020**, *153*, 124506.
9. **W.B. Carpenter**, N.H.C. Lewis, J.A. Fournier, and A. Tokmakoff, "Entropic Barriers in the Kinetics of Aqueous Proton Transfer," *J. Chem. Phys.* **2019**, *151*, 034501.
10. Q. Yu, **W.B. Carpenter**, N.H.C. Lewis, A. Tokmakoff, and J.M. Bowman, "High-Level VSCF/VCI Calculations Decode the Vibrational Spectrum of the Aqueous Proton," *J. Phys. Chem. B* **2019**, *123*, 7214.
11. **W.B. Carpenter**, J.A. Fournier, N.H.C. Lewis, and A. Tokmakoff, "Picosecond Proton Transfer Kinetics in Water Revealed with Ultrafast IR Spectroscopy," *J. Phys. Chem. B* **2018**, *122*, 2792.
12. N.H.C. Lewis, J.A. Fournier, **W.B. Carpenter**, and A. Tokmakoff, "Direct Observation of Ion Pairing in Aqueous Nitric Acid Using 2D Infrared Spectroscopy," *J. Phys. Chem. B* **2018**, *123*, 225.
13. J.A. Fournier, **W.B. Carpenter**, N.H.C. Lewis, and A. Tokmakoff, "Broadband 2D IR Spectroscopy Reveals Dominant Asymmetric H_5O_2^+ Proton Hydration Structures in Acid Solutions," *Nature Chem.* **2018**, *10*, 932.
Press Release: "New study reveals proton hydration structures are asymmetric," *Phys.org*. August 10, 2018. <https://phys.org/news/2018-08-reveals-proton-hydration-asymmetric.html>
14. **W.B. Carpenter**, J.A. Fournier, R. Biswas, G.A. Voth, and A. Tokmakoff, "Delocalization and Stretch-Bend Mixing of the HOH Bend in Liquid Water," *J. Chem. Phys.* **2017**, *147*, 084503.
15. R. Biswas, **W.B. Carpenter**, G.A. Voth, and A. Tokmakoff, "IR Spectral Assignments for the Hydrated Excess Proton in Liquid Water," *J. Chem. Phys.* **2017**, **2017**, 154507.
16. R. Biswas, **W.B. Carpenter**, G.A. Voth, and A. Tokmakoff, "Molecular Modeling and Assignment of IR Spectra of the Hydrated Excess Proton in Isotopically Dilute Water," *J. Chem. Phys.* **2016**, *145*, 154504.
17. L. De Marco, J.A. Fournier, M. Thämer, **W.B. Carpenter**, and A. Tokmakoff, "Anharmonic excitation dynamics and energy dissipation in liquid water from two-dimensional infrared spectroscopy," *J. Chem. Phys.* **2016**, *145*, 094501.

18. J.A. Fournier, **W.B. Carpenter**, L. De Marco, and A. Tokmakoff, “Interplay of Ion–Water and Water–Water Interactions within the Hydration Shells of Nitrate and Carbonate Directly Probed with 2D IR Spectroscopy,” *J. Amer. Chem. Soc.* **2016**, *138*, 9634.
19. L. De Marco, **W.B. Carpenter**, H. Liu, R. Biswas, J.M. Bowman, and A. Tokmakoff, “Differences in the Vibrational Dynamics of H₂O and D₂O: Observation of Symmetric and Antisymmetric Stretching Vibrations in Heavy Water,” *J. Phys. Chem. Lett.* **2016**, *7*, 1769.

PRESENTATIONS

SPIE Optics and Photonics in San Diego, CA, USA

August 21, 2023

Optical Trapping and Optical Micromanipulation XX

- *Oral presentation*: “Monitoring physical and chemical properties of individual carboxysomes trapped in solution”

ACS Fall National Meeting in San Francisco, CA, USA

August 15, 2023

PHYS Symposium: Optical Spectroscopy and Microscopy Across Biological Scales

- *Oral presentation*: “Ratiometric sensing of redox environments inside individual carboxysomes trapped in solution”

Biophysical Society Annual Meeting in San Diego, CA, USA

February 21, 2023

Platform Session: Single-Molecule Spectroscopy

- *Oral presentation*: “Ratiometric sensing of redox environments inside individual carboxysomes trapped in solution”

Squires Lab Invited Seminar at UChicago

October 31, 2022

- *Seminar Title*: “Measuring redox chemistry and masses of single carboxysomes trapped in solution”

Western Photosynthesis Conference (virtual)

March 24, 2022

- *Poster presentation*: “Ratiometric redox measurements inside individual carboxysomes trapped in solution”
- *Awarded Best Postdoctoral Poster*

Biophysical Society Annual Meeting in San Francisco, CA, USA

February 20, 2022

Subgroup: Bioenergetics and Photosynthesis

- *Poster presentation*: “Ratiometric redox measurements inside individual carboxysomes trapped in solution”

Liquid Crystals Group Presentation at University of Ghent (virtual)

May 19, 2021

- *Seminar Title*: “Extended Single-Molecule and Single-Particle Measurements with Anti-Brownian Electrokinetic Traps”

American Chemical Society Spring National Meeting in Orlando, FL, USA

April 2, 2019

Division of Physical Chemistry: Frontiers in Vibrational Spectroscopy

- *Oral presentation*: “Uncovering the Structure and Dynamics of the Aqueous Proton with Ultrafast Infrared Spectroscopy”

Gordon Research Conference on Water and Aqueous Solutions in Holderness, NH, USA

July 22, 2018

- *Poster presentation*: “An asymmetric Zundel-like hydrated proton and picosecond proton transfer kinetics observed with ultrafast IR spectroscopy”

Time Resolved Vibrational Spectroscopy Meeting in Cambridge, UK July 16, 2017

- *Poster presentation:* “Delocalization of the H₂O Bend and Long-Lived Anisotropy of the Aqueous Proton Bend”

Gordon Research Conference on Water and Aqueous Solutions in Holderness, NH, USA

August 5, 2016

- *Poster presentation:* “Direct Observation of Aqueous Proton Dynamics using Broadband 2DIR Spectroscopy”

AWARDS

Best Postdoctoral Fellow Poster Presentation 2022

- Western Photosynthesis Conference

Albert J. Cross Prize for Excellence in Research, Teaching, and Departmental Citizenship 2019

- University of Chicago, Department of Chemistry

NSF Graduate Research Fellowship 2016, 2014

- Honorable Mention

Nathan Sugarman Teaching Award for General Chemistry 2015

- University of Chicago, Department of Chemistry

Freud Graduate Fellowship in Chemistry 2014

- University of Chicago, Department of Chemistry

Saegebarth Undergraduate Research Prize in Chemistry 2013

- University of California, Berkeley, Department of Chemistry

Cal Alumni Association Leadership Scholarship 2012

- University of California, Berkeley

Rose Fills Foundation Summer Undergraduate Research Fellowship 2012

- University of California, Berkeley

Regents and Chancellor’s Scholarship 2009-2013

- University of California, Berkeley

Eagle Scout 2007

- Boy Scouts of America, Troop 737

TEACHING

The Ohio State University Fall 2024

Assistant Professor

- CHEM 7580: *Lasers, Optics, and Optical Instrumentation* (graduate student course)

Stanford Chemistry

Spring 2022

Guest Lecture, *Advanced Physical Chemistry - Single Molecules and Light*

- Presented a 30-minute pedagogical introduction to the fundamentals of anti-Brownian electrokinetic traps for the graduate-level course of 13 students.

University of Chicago

Fall 2016-Winter 2017

Problem-Solving Session Teaching Assistant, *General Chemistry*

- Guided two biweekly sessions of 15 students each for collaborative problem-solving in chemistry.

University of Chicago

2013-2014

Teaching Assistant General Chemistry, *General Chemistry*

- Attended lecture, hosted discussion section, hosted private and group office hours, graded problem sets and exams, proctored labs for 15 students.

SERVICE

American Chemical Society Spring 2025 Meeting

March 17-23, 2025

ANYL Symposium Co-chair: Frontiers in Spectroscopy

- Evaluated abstracts and designed sessions for oral presentations.

Ohio State Optica Student Symposium

September 27, 2024

Judge for Oral Presentations

- Evaluated and engaged with student research presentations.

Biophysical Society Meeting

February 21, 2023

Session Co-Chair: Single-Molecule Spectroscopy Platform Session

- Managed set-up, time-keeping, and Q&A for oral presentation session.

Journal Peer Reviewer

- Nature Nanotechnology
- Optics Express
- Journal of Physical Chemistry Letters

University of Chicago

Winter 2020

Inaugural Tigger Talk Seminar Series Coordinator

- Established and hosted speaker series for chemistry graduate students to present their experiences to peers in a humorous, low-stakes environment.

University of Chicago

Spring 2019

Curriculum Design: Summer Lunch and Learn Program

- Designed learning objectives for inaugural summer bridge program for incoming chemistry graduate students.
- Guided and oversaw lecture and problem set construction by 18 graduate student and postdoctoral instructors.

University of Chicago

2019-2020

Graduate Recruitment Initiative Team (GRIT): Under-Represented Minority Committee Member

- Participated in organizing speaker and cultural events
- Represented the chemistry department to facilitate collaboration across departments and academic divisions

OUTREACH AND EXTRACURRICULAR ACTIVITIES

Stanford Splash Volunteer Teacher

December 3, 2022

- Co-taught single chemistry lecture for local high schools students: “The Chemistry of Color: Light, molecules, and you”
- Delivered 30-minute lecture and hands-on demonstrations exploring colorimetric indicators, fluorescence, scattering, and color perception

Artifice NFP

2014-2020

- Board Member and Volunteer Coordinator, 2016-2020
- Recruited and coordinated 15 volunteers annually
- Designed weekly electronics/robotics lessons at three elementary schools for 30 students annually
- Fundraised with grants to expand programs
- Coached *First LEGO League* robotics team of six 4th graders

Chicago Public Schools Student Science Fair

Winter 2015

- Judged science fair posters for middle school students in South Chicago

Reef Check Volunteer Diver - Central California Region

2022-Present

- Surveying coastal subtidal ecosystems for annual monitoring of kelp forest habitats
- Collecting population density and sizing data on various indicator species: fish, kelp, invertebrates

Divemaster: Learn Scuba Chicago NFP

2016-2020

- Volunteer instruction assistant for confined and open water training dives
- Co-Chair of gear committee, leading a team of five volunteers in gear repair and maintenance
- NAUI Professional Certifications: Divemaster, First Aid for Dive Professionals