

Matthew D. Sonntag, Assistant Professor

Department of Chemistry & Biochemistry
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EDUCATION

Northwestern University , Evanston, IL	Ph.D. in Chemistry	June 2013
Coe College , Cedar Rapids, IA	B.A. in Chemistry, <i>cum laude</i>	May 2008

RESEARCH EXPERIENCE

Assistant Professor of Chemistry & Biochemistry 2014–present
Albright College, Reading, PA

- Spectroscopic and topographic characterization of novel ceramic materials
- Investigation of the fundamental mechanism of single-molecule surface-enhanced Raman spectroscopy

Postdoctoral Research Fellow 2013–2014
Northwestern University, Evanston, IL

Advisor: Professor Richard P. Van Duyne

- Successfully coupled ultrafast laser with tip-enhanced Raman spectroscopy with the goal of monitoring single molecule time-resolved dynamics with sub-diffraction limited spatial resolution
- Collaborated with commercial company to develop a combined scanning electrochemical microscope and tip-enhanced Raman spectroscopy microscope for simultaneously electrochemical, spectroscopic, and topographic characterization of nanometer scale samples

Graduate Research Fellow 2008–2013
Northwestern University, Evanston, IL

Advisors: Professors Tamar Seideman and Richard P. Van Duyne

- Constructed a unique tip-enhanced Raman (TER) scattering microscope for combining spectroscopic and topographic characterization
- Employed TER microscope for the detection of single molecules
- Designed a total internal reflection (TIR) atomic force microscope for the measurement of scattering spectra of metallic tips, which previously was not measurable
- Wrote Fortran based codes to simulate the interaction of light with 2 and 3 dimensional nano structures
- Developed code to optimize nanoparticle geometry in order to maximize electric field enhancement

Undergraduate Research Assistant 2004–2008
Coe College, Cedar Rapids, IA

Advisors: Professor Steven Singleton and Professor Mario Affatigato

- Synthesized ceramic materials and probed their spectroscopic and topographic properties using Raman spectroscopy, atomic absorption spectroscopy, and atomic force microscopy

TEACHING EXPERIENCE AND DEVELOPMENT

- Albright College**, Reading, PA 2014–present
- Chemistry 105 – General Analytical Chemistry I (Lecture & Lab)
 - Chemistry 106 – General Analytical Chemistry II (Lecture)
 - Chemistry 321 – Physical Chemistry I (Lecture & Lab)
 - Chemistry 322 – Physical Chemistry II (Lecture & Lab)
 - Chemistry 412 – Advanced Topics: Electrochemistry (Lab)
 - Interdisciplinary Studies 255 – Math for Chemistry and Physics (Lecture)
 - All courses have been taught within the past two years.
- Northwestern University**, Evanston, IL 2008–2010
- Chemistry 442 – Quantum Mechanics (Graduate Course, Teaching Assistant)
 - Chemistry 348 – Physical Chemistry (Teaching Assistant)
 - Chemistry 102 – General Inorganic Chemistry II (Laboratory Assistant)
 - Chemistry 101 – General Inorganic Chemistry I (Laboratory Assistant)
- Coe College**, Cedar Rapids, IA 2006–2008
- Chemistry 155 – Principles of Structural Chemistry (Laboratory Assistant)
 - Chemistry 145 – Introduction to Organic and Biological Chemistry (Laboratory Assistant)
- Searle Center Teaching Certificate Program** 2011–2012
- Created and delivered 3 guest lectures to a general chemistry class focusing on fundamentals and applications of nanotechnology
 - Designed and executed homework and a quiz related to nanotechnology
 - Led a discussion meeting with peers on impact of student backgrounds on pedagogy
 - Reviewed literature on the scholarship of teaching and learning
 - Participated in workshops: “Marketing your Teaching”, “Designing and Teaching a Freshman Seminar”, and “Teaching Majors and Non-Majors”

SERVICE TO THE PROFESSION

- All Scout Nano Day** 2009–2014
- Lead lab tours and demonstrations for Northwestern’s “All Scout Nano Day” Annual Event
 - Developed chemistry experiments and activities for local elementary schools
 - Encouraged students and parents to pursue science education
- Science in the Classroom** 2009–2013
- Performed hands on chemistry experiments with 3rd and 4th graders
 - Encouraged students to explore science and its impact on the world around them
- Science Demonstrations** 2017–2018
- Performed hands on chemistry experiments with preschool and kindergarten
 - Encouraged students to explore science and its impact on the world around them
- Journal Article Reviewer**
- Reviewed articles for Nature Nanotech., Nano Lett., JACS, JPCC, Chem. Phys. Chem, PCCP, ACS Nano, Adv. Mat., and Rev. Sci. Instrum.
- Grant Reviewer**
- Reviewer for the American Chemical Society Petroleum Research Fund

Chair and Organizer

Fall 2017

- Engaging Undergraduates with Raman Spectroscopy Session at National ACS Meeting

STUDENT RESEARCH COLLABORATIONS

Mia Felix '19	2017 Presentations	<i>Synthesis and Characterization of Borate Ceramics</i> LVACS Local Meeting (2018, Poster)
William Adams '19	2017 Funding: Presentations	<i>Development of a Upper Level Chemistry Laboratory to Increase Understanding of Selection Rules</i> 2017 Summer ACRE Disappearing Boundaries Summer Research Meeting (2017, Poster), LVACS Local Meeting (2018, Poster)
Sierra Lambeth '18	2015 - 2017 Funding: Presentations	<i>Investigating the Intensity Fluctuations in Single-Molecule Surface Enhanced Raman Spectroscopy</i> 2015 Summer ACRE, Jean Dreyfus Boissevain Lectureship for Undergraduate Institutions stipend Disappearing Boundaries Summer Research Meeting (2015, Poster), ACS National Meeting (Spring 2016, Poster), Undergraduate Research Day at the Capital (2016, Poster), LVACS Local Meeting (2016, Poster), Intercollegiate Student Chemists Convention (2016, Oral Presentation), ACS National Meeting (Fall 2016, Poster)
Ashley Lipshaw '18	2015 - 2017 Funding: Presentations	<i>Synthesis, Structural Characterization, and Leaching of Silicate and Borate Ceramics</i> 2015 Summer ACRE, Jean Dreyfus Boissevain Lectureship for Undergraduate Institutions stipend Disappearing Boundaries Summer Research Meeting (2015, Poster), ACS National Meeting (Spring 2016, Poster), LVACS Local Meeting (2016, Poster), Intercollegiate Student Chemists Convention (2016, Oral Presentation), ACS National Meeting (Fall 2016, Poster), LVACS Local Meeting (2018, Poster)
Evan Cuff '18	2016 - 2017 Presentations	<i>Structure and Leaching of Borate Ceramics</i> ACS National Meeting (Spring 2017, Poster), Undergraduate Research Day at the Capital (2017, Poster), LVACS Local Meeting (2017, Poster)
Vincent Torres '17	2015 - 2017 Presentations	<i>Synthesis, Structural Characterization, and Leaching of Borosilicates</i> ACS National Meeting (Spring 2017, Poster), Undergraduate Research Day at the Capital (2017, Poster), LVACS Local Meeting (2017, Poster)
Tyler Moseley '18	2016 Funding: Presentations	<i>Synthesis and Structural Characterization of Vanadate Ceramics</i> 2016 Summer ACRE ACS National Meeting (Fall 2016, Poster)
Shannon Miller '17	2015 - 2016	<i>Synthesis, Structural Characterization, and Leaching of Borosilicates</i>

CURRENT FUNDING

Jean Dreyfus Boissevain Lectureship for Undergraduate Institutions, \$18,500, 2015-2017

NSF s-STEM: Albright College Environmentally-oriented Sciences (ACES) Scholarship Program: Supporting the Study of the Environment through STEM Disciplines, \$ 627,322, 2014-2018

NSF MRI: Enabling materials chemistry at Central Pennsylvania PUIs through acquisition of a low-voltage TEM, \$ 125,000, 2017

HONORS AND AWARDS

- The Class of '49 Annadora Vesper Shirk Award for Faculty Scholarship
- Nominated for Faculty Teaching Award (2014-2015), (2015-2016)
- L. Carroll King Award for Excellence in 100-Level Teaching, Northwestern University
- Phi Beta Kappa
- Phi Kappa Phi
- Mortar Board National College Honor Society, Member
- Kesler Senior Chemistry Award
- Undergraduate Award for Achievement in Organic Chemistry
- Undergraduate Award for Achievement in General Chemistry
- Roy J. Carver Foundation Summer Research Fellowship (2004)
- Captain Varsity Soccer Team (2006-2007)
- Student Athletic Advisory Committee Member (2006-2008)
- Academic All-Conference Soccer (2005-2007)
- Dean's List, Coe College (2004-2007)
- Community Foundation Scholarship
- Coe College Presidential Scholarship
- Coe College Science Scholarship

PROFESSIONAL AFFILIATIONS

- American Chemical Society
- Phi Lambda Upsilon
- Coe College Chemistry Club Vice President (2007-2008)
- Coe College Chemistry Club Member (2004-2008)

PUBLICATIONS

1. Jardine, K.; Hill, K.; Jones, E.; Elia, R.; Gibbs, G.; **Sonntag, M.**; Tribe, L. "Synthesis and characterization of acetaminophen: An experimental and theoretical laboratory for the undergraduate curriculum." *J. Chem. Ed.* *submitted*.
2. Hamann, C. and **Sonntag, M.** "Introduction to Raman Spectroscopy in the Undergraduate Curriculum," Engaging Undergraduates with Raman Spectroscopy, *ACS Symposium Series*, *submitted*.
3. Hantz, E., **Sonntag, M.**, Hamann, C. "Connecting Organic and Physical Chemistry Students with Raman Spectroscopy," Engaging Undergraduates with Raman Spectroscopy, *ACS Symposium Series*, *submitted*.
4. Adams, W. and **Sonntag, M.** "Development of a Physical Chemistry Laboratory to Explore Vibrational Spectroscopy Selection Rules," Engaging Undergraduates with Raman Spectroscopy, *ACS Symposium Series*, *submitted*.
5. Adams, W. and **Sonntag, M.** "Vibrational Spectroscopy of Hexynes: A Combined Experimental and Computational Laboratory Experiment," *J. Chem. Ed.* **2018**, *95*, 1205-1210.
6. Wilson, H.; Koellner, C.; Hannan, Z.; Endy, C.; Bezpalko, M.; Piro, N.; Kassel, W.; **Sonntag, M.**; Graves, C. "Synthesis and Characterization of Neutral ligand α -Diimine Complexes of Aluminum with Tunable Redox Energetics," *Inorg. Chem.* *accepted*.
7. Pal, P. P.; Jiang, N.; **Sonntag, M. D.**; Chiang, N.; Foley, E.; Hersam, M.; Van Duyne, R. P.; and Seideman, T. "Plasmon Mediated Electron Transport in Tip-Enhanced Raman Spectroscopic Junctions," *J. Phys. Chem. Lett.* **2015**, *6*, 4210-4218.
8. **Sonntag, M. D.**; Pozzi, E. A.; Jiang, N.; Hersam, M.; and Van Duyne, R. P. "Recent Advances in Tip-Enhanced Raman Spectroscopy," *J. Phys. Chem. Lett.* **2014**, *5*, 3125-3130. *Invited Review*
9. Pozzi, E. A.; **Sonntag, M. D.**; Jiang, N.; Chiang, N.; Seideman, T.; Hersam, M.; and Van Duyne, R. P. "Ultrahigh Vacuum Tip-Enhanced Raman Spectroscopy with Picosecond Excitation," *J. Phys. Chem. Lett.* **2014**, *5*, 2657-2661.
10. Klingsporn, J. M.;* Jiang, N.;* Pozzi, E. A.; **Sonntag, M. D.**; Chulhai, D.; Seideman, T.; Jensen, L.; Hersam, M.; and Van Duyne, R. P. "Surface Interactions Elucidated with Low Temperature Ultrahigh Vacuum Tip-Enhanced Raman Spectroscopy," *J. Am. Chem. Soc.* **2014**, *136*, 3881-3887.
11. Klingsporn, J. M.;* **Sonntag, M. D.**;* Seideman, T.; and Van Duyne, R. P. "Tip-Enhanced Raman Spectroscopy with Picosecond Pulses," *J. Phys. Chem. Lett.*, **2014**, *5*, 106-110.
12. **Sonntag, M. D.**; Chulhai, D.; Seideman, T.; Jensen, L.; and Van Duyne, R. P. "The Origin of Relative Intensity Fluctuations in Single-Molecule Tip-Enhanced Raman Spectroscopy," *J. Am. Chem. Soc.*, **2013**, *135*, 17187-17192.
13. **Sonntag, M. D.**; Klingsporn, J. M.; Zrimsek, A. B.; Sharma, B.; Ruvuna, L. K.; and Van Duyne, R. P. "Molecular Plasmonics for Nanoscale Spectroscopy," *Chem. Soc. Rev.* **2014**, *43*, 1230-1247. *Invited*

Review.

14. Pozzi, E. A.; **Sonntag, M. D.**; Jiang, N.; Klingsporn, J. M.; Hersam, M. C.; and Van Duyne, R. P. "Tip-Enhanced Raman Imaging: An Emergent Tool for Probing Biology at the Nanoscale," *ACS Nano*. **2013**, *7*, 885-888.
15. Jiang, N.; Foley, E. T.; Klingsporn, J. M.; **Sonntag, M. D.**; Valley, N. A.; Dieringer, J. A.; Seideman, T.; Schatz, G. C.; Hersam, M. C.; and Van Duyne, R. P. "Observation of Multiple Vibrational Modes in Ultra-High Vacuum Tip-Enhanced Raman Spectroscopy Combined with Molecular-Resolution Scanning Tunneling Microscopy," *Nano Lett.* **2012**, *12*, 5061-5067. [cover].
16. **Sonntag, M. D.**; Klingsporn, J. M.; Garibay, L. K.; Roberts, J. M.; Dieringer, J. A.; Seideman, T.; Scheidt, K. A.; Jensen, L.; Schatz, G. C.; and Van Duyne, R. P. "Single-Molecule Tip-Enhanced Raman Spectroscopy," *J. Phys. Chem. C*. **2012**, *116*, 478-483.

PRESENTATIONS

From work at Albright College (undergraduate co-authors are underlined)

1. **Matthew D. Sonntag**, “Raman: It’s Not Just For Noodles Anymore,” Albright College, Reading, PA, November **2017**. (*Departmental Seminar*)
2. **Matthew D. Sonntag**, “Finding New Information in Single-Molecule Raman Spectra,” Villanova University, Villanova, PA, November **2017**. (*Invited Seminar*)
3. William Adams and **Matthew D. Sonntag** “Combining Raman, IR and Computational Chemistry to Understand Selection Rules,” *ACS National Meeting*. Washington DC, August **2017**. (*Oral*)
4. Eric Hantz, **Matthew D. Sonntag** and Christian Hamann “Engaging Undergraduate Students with Raman Spectroscopy. *ACS National Meeting* , Washington DC, August **2017** (*Poster*)
5. **Matthew D. Sonntag** “Combining Computational Chemistry with Vibrational Spectroscopy to Increase Insight into Selection Rules,” *Middle Atlantic Regional Meeting of the American Chemical Society*. Hershey, PA, June **2017**. (*Oral*)
6. **Matthew D. Sonntag** “Raman Spectroscopy in the Research Laboratory and the Classroom.” B&W Tek Seminar, Natick, MA, April **2017**. (*Invited Seminar*)
7. **Matthew D. Sonntag** “Investigating Glass Structure with Raman Spectroscopy.” To SERS with Love - A Symposium in Honor of Richard P. Van Duyne, Minneapolis, MN, September **2016**. (*Poster*)
8. **Matthew D. Sonntag** and Christian Hamann “Engaging Undergraduate Students with Raman Spectroscopy,” *Reaction Mechanisms Conference*. St. Louis, MO, June **2016**. (*Oral*)

Student Presentations

9. William H Adams and **Matthew D. Sonntag** “Development of a New Paradigm for Understanding Vibrational Spectroscopy,” *Lehigh Valley ACS Meeting*. Bethlehem, PA, April **2018**. (*Poster*)
10. Ashley L. Lipshaw, Mia A. Felix, and **Matthew D. Sonntag** “Structure and Reactivity of Glassy Materials,” *Lehigh Valley ACS Meeting*. Bethlehem, PA, April **2018**. (*Poster*)
11. William H Adams and **Matthew D. Sonntag** “Development of a New Paradigm for Understanding Vibrational Spectroscopy,” *Albright College Disappearing Boundaries Summer Research Meeting*. Reading, PA, July **2017**. (*Poster*)
12. Vincent Torres, Evan Cuff and **Matthew D. Sonntag** “Investigating Glass Structure with Raman Spectroscopy,” *Lehigh Valley ACS Meeting*. Bethlehem, PA, April **2017**. (*Poster*)
13. Eric Hantz, **Matthew D. Sonntag** and Christian Hamann “Engaging Undergraduate Students with Raman Spectroscopy. *18th Annual Higher Education Council of Berks County Undergraduate Research and Creativity Conference* , Penn State Berks, Reading, PA **2017** *Poster*

14. Vincent Torres, Evan Cuff and **Matthew D. Sonntag** “Investigating Glass Structure with Raman Spectroscopy,” *Undergraduate Research Day at the Capitol*. Harrisburg, PA, April **2017**. (*Poster*)
15. Vincent Torres and **Matthew D. Sonntag** “Investigating Glass Structure with Raman Spectroscopy,” *ACS National Meeting*. San Francisco, CA, April **2017**. (*Poster*)
16. Ashley L. Lipshaw and **Matthew D. Sonntag** “Structure and Reactivity of Glassy Materials,” *Annual National Conference on Undergraduate Research*. Memphis, TN, April **2017**. (*Poster*)
17. Sierra L. Lambeth and **Matthew D. Sonntag** “Spectral Fluctuations in Single-Molecule Surface-Enhanced Raman Spectroscopy,” *Annual National Conference on Undergraduate Research*. Memphis, TN, April **2017**. (*Poster*)
18. Ashley L. Lipshaw, Tyler A. Moseley, and **Matthew D. Sonntag** “Structure and Reactivity of Glassy Materials,” *ACS National Meeting*. Philadelphia, PA, August **2016**. (*Poster, Selected for Sci-Mix*)
19. Sierra L. Lambeth and **Matthew D. Sonntag** “Spectral Fluctuations in Single-Molecule Surface-Enhanced Raman Spectroscopy,” *ACS National Meeting*. Philadelphia, PA, August **2016**. (*Poster, Selected for Sci-Mix*)
20. Sierra L. Lambeth, Ashley L. Lipshaw, Tyler A. Moseley, and **Matthew D. Sonntag** “Raman Spectroscopy for Chemical Characterization,” *Lebanon Valley Disappearing Boundaries Summer Research Meeting*. Annville, PA, July **2016**. (*Poster*)
21. Sierra L. Lambeth and **Matthew D. Sonntag** “Probing Single Molecules with Raman Spectroscopy,” *Intercollegiate Student Chemists Convention*. Collegeville, PA, March **2016**. (*Oral*)
22. Ashley L. Lipshaw and **Matthew D. Sonntag** “The Effect of Composition on the Underlying Structure of Glassy Materials,” *Intercollegiate Student Chemists Convention*. Collegeville, PA, March **2016**. (*Oral*)
23. Sierra L. Lambeth, Ashley L. Lipshaw, and **Matthew D. Sonntag** “Raman Spectroscopy for Chemical Characterization,” *Lehigh Valley ACS Meeting*. Bethlehem, PA, March **2016**. (*Poster*)
24. Sierra L. Lambeth and **Matthew D. Sonntag** “Probing Single Molecules with Raman Spectroscopy,” *Undergraduate Research Day at the Capitol*. Harrisburg, PA, March **2016**. (*Poster*)
25. Sierra L. Lambeth, Ashley L. Lipshaw, and **Matthew D. Sonntag** “Raman Spectroscopy for Chemical Characterization,” *ACS National Meeting*. San Diego, CA, March **2016**. (*Poster*)
26. Sierra L. Lambeth, Ashley L. Lipshaw, and **Matthew D. Sonntag** “Raman Spectroscopy for Chemical Characterization,” *Lebanon Valley Disappearing Boundaries Summer Research Meeting*. Annville, PA, July **2015**. (*Poster*)

From work prior to Albright College

27. Pal, P.P.; **Sonntag, M.D.**; Jiang, N.; Chiang, N.; Van Duyne, R.P.; and Seideman, T. “Plasmon enhanced charge transport across STM tip-substrate junctions,” 2014 Midwest Theoretical Chemistry Conference, Evanston, IL, **2014**. (*Poster*)

28. Jiang, N.; **Sonntag, M. D.**; Klingsporn, J.; Pozzi, E.; Seideman, T.; Jensen, L.; Hersam, M.; and Van Duyne, R. P. “Advances in Tip-Enhanced Raman Spectroscopy,” NSF Center for Chemical Innovation Site Review, University of California, Irvine, **2013**. (*Poster*)
29. **Sonntag, M. D.**; Seideman, T.; and Van Duyne, R. P. “Advances in Tip-Enhanced Raman Spectroscopy,” Gordon Research Conference: Noble Metal Nanoparticles, Mount Holyoke College, **2012**. (*Poster*)
30. **Sonntag, M. D.** “Investigations of Tip-Enhanced Raman Spectroscopy.” Coe College, **2011**. (*Invited Presentation*)
31. **Sonntag, M. D.**; Van Duyne, R. P.; and Seideman, T. “Control of Light for Tip-Enhanced Optical Spectroscopies,” Gordon Research Conference: Quantum Control of Light and Matter, Mount Holyoke College, **2011**. (*Poster*)
32. **Sonntag, M. D.**; Van Duyne, R. P.; and Seideman, T. “Control of Light for Tip-Enhanced Optical Spectroscopies,” IGERT Poster Session, Northwestern University, **2011**. (*Poster*)
33. **Sonntag, M. D.** “Control of Light for Nanoscale Spectroscopy.” IGERT Seminar, Northwestern University, **2011**. (*Oral*)
34. **Sonntag, M. D.** “Light Guidance in the Nanoscale.” IGERT Seminar, Northwestern University, **2010**. (*Oral*)
35. **Sonntag, M. D.**; and Affatigato, M. “Mechanical Abrasion of Glass,” Coe College Undergraduate Research Symposium, Cedar Rapids, **2008**. (*Poster*)
36. **Sonntag, M. D.**; and Affatigato, M. “Mechanical Abrasion of Glass,” ACS Midwest Regional Meeting, Kansas City, **2007**. (*Poster*)