

S. Alex Kandel

Department of Chemistry & Biochemistry
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Notre Dame, IN 46556

Biographical

Born August 1, 1972 in Baltimore, MD, USA

Education

- Ph.D., Chemistry** *Stanford University, Stanford, CA*
1999 Dissertation title: "The impact of reagent vibrational excitation on chemical reactivity"
Research advisor: Richard N. Zare
- B.S., Chemistry** *Yale University, New Haven, CT*
1993 Research advisor: Patrick H. Vaccaro

Professional Experience

- Associate Professor Department of Chemistry & Biochemistry
2007–present University of Notre Dame, Notre Dame, IN
- Assistant Professor Department of Chemistry & Biochemistry
2001–2007 University of Notre Dame, Notre Dame, IN
- Postdoctoral Fellow Department of Chemistry
1999–2001 The Pennsylvania State University, University Park, PA
Research advisor: Paul S. Weiss

Honors & Awards

- 2015 Joyce Award for Excellence in Undergraduate Teaching
- 2003 NSF Faculty Early Career Development (CAREER) Award
- 2000 Union Carbide Student Innovation Recognition Program
- 2000 American Chemical Society Nobel Laureate Signature Award
in Graduate Education
- 1993–1996 NSF Graduate Fellowship in Chemistry

2 Publications

2.1 Peer-Reviewed Publications (current appointment begins at #21)

1. Qingguo Zhang, S. Alex Kandel, Thierry A. W. Wasserman, and Patrick H. Vaccaro, "Detection of stimulated emission pumping via degenerate four-wave mixing," *Journal of Chemical Physics* **96**, 1640–1643 (1992).
2. William R. Simpson, Andrew J. Orr-Ewing, S. Alex Kandel, T. Peter Rakitzis, and Richard N. Zare, "Core extraction for measuring state-to-state differential cross sections of bimolecular reactions," *Journal of Chemical Physics* **103**, 7299–7312 (1995).
3. William R. Simpson, T. Peter Rakitzis, S. Alex Kandel, Andrew J. Orr-Ewing, and Richard N. Zare, "Reaction of Cl with vibrationally excited CH₄ and CHD₃: State-to-state differential cross sections and steric effects for the HCl product," *Journal of Chemical Physics* **103**, 7313–7335 (1995).
4. William R. Simpson, T. Peter Rakitzis, S. Alex Kandel, Topaz Lev-On, and Richard N. Zare, "Picturing the transition-state region and understanding vibrational enhancement for the Cl+CH₄ → HCl+CH₃ reaction," *Journal of Physical Chemistry* **100**, 7938–7947 (1996).
5. S. Alex Kandel, T. Peter Rakitzis, Topaz Lev-On, and Richard N. Zare, "Dynamics for the Cl+C₂H₆ → HCl+C₂H₅ reaction examined through state-specific angular distributions," *Journal of Chemical Physics* **105**, 7550–7559 (1996).
6. Andrew J. Orr-Ewing, William R. Simpson, T. Peter Rakitzis, S. Alex Kandel, and Richard N. Zare, "Scattering-angle resolved product rotational alignment for the reaction of Cl with vibrationally excited methane," *Journal of Chemical Physics* **106**, 5961–5971 (1997).
7. S. Alex Kandel, T. Peter Rakitzis, Topaz Lev-On, and Richard N. Zare, "Dynamical effects of reagent vibrational excitation in the Cl+C₂H₆($\nu_5=1$) → HCl+C₂H₅ reaction," *Chemical Physics Letters* **265**, 121–128 (1997).
8. T. Peter Rakitzis, S. Alex Kandel, and Richard N. Zare, "Determination of differential-cross-section moments from polarization dependent product velocity distributions of photoinitiated bimolecular reactions," *Journal of Chemical Physics* **107**, 9382–9391 (1997).
9. T. Peter Rakitzis, S. Alex Kandel, Topaz Lev-On, and Richard N. Zare, "Differential cross section moments for the Cl+C₂D₆ → DCl($v'=0, J'=1$)+C₂D₅ and Cl+CD₄ → DCl($v'=0, J'=1$)+CD₃ reactions: Location of the D-atom transfer in the transition-state region," *Journal of Chemical Physics* **107**, 9392–9405 (1997).
10. S. Alex Kandel, T. Peter Rakitzis, Topaz Lev-On, and Richard N. Zare, "Angular distributions for the Cl+C₂H₆ → HCl+C₂H₅ reaction observed via multiphoton ionization of the C₂H₅ radical," *Journal of Physical Chemistry A* **102**, 2270–2273 (1998).

11. T. Peter Rakitzis, S. Alex Kandel, and Richard N. Zare, "Photolysis of ICl causes mass-dependent interference in the $\text{Cl}(^2\text{P}_{3/2})$ photofragment angular momentum distribution," *Journal of Chemical Physics* **108**, 8291–8294 (1998).
12. T. Peter Rakitzis, S. Alex Kandel, Andrew J. Alexander, Zee Hwan Kim, and Richard N. Zare, "Photofragment helicity caused by matter-wave interference from multiple dissociative states," *Science* **281**, 1346–1349 (1998).
13. S. Alex Kandel and Richard N. Zare, "Reaction dynamics of atomic chlorine with methane: Importance of methane bending and torsional excitation in controlling reactivity," *Journal of Chemical Physics* **109**, 9719–9727 (1998).
14. T. Peter Rakitzis, S. Alex Kandel, Andrew J. Alexander, Zee Hwan Kim, and Richard N. Zare, "Measurement of Cl-atom photofragment angular momentum distributions in the photodissociation of Cl_2 and ICl," *Journal of Chemical Physics* **110**, 3351–3359 (1998).
15. Zee Hwan Kim, Andrew J. Alexander, S. Alex Kandel, T. Peter Rakitzis, and Richard N. Zare, "Orientation as a probe of photodissociation dynamics," *Faraday Discussions* **113**, 27–36 (1999).
16. S. Alex Kandel, Andrew J. Alexander, Zee Hwan Kim, Richard N. Zare, F. Javier Aoiz, Luis Bañares, Jesús Fernández Castillo, and Vicente Sáez Rábanos, "Cl+HD($v=1; J=1,2$) reaction dynamics: Comparison between theory and experiment," *Journal of Chemical Physics* **112**, 670–685 (2000).
17. James G. Kushmerick, S. Alex Kandel, Patrick Han, Jennifer A. Johnson, and Paul S. Weiss, "Atomic-scale insights into hydrodesulfurization," *Journal of Physical Chemistry B* **104**, 2980–2988 (2000).
18. Andrew J. Alexander, Zee Hwan Kim, S. Alex Kandel, Richard N. Zare, T. Peter Rakitzis, Yukako Asano, and Satoshi Yabushita, "Oriented chlorine atoms as a probe of the nonadiabatic photodissociation dynamics of molecular chlorine," *Journal of Chemical Physics* **113**, 9022–9031 (2001).
19. S. Alex Kandel and Paul S. Weiss, "Binding and mobility of atomically resolved cobalt clusters on molybdenum disulfide," *Journal of Physical Chemistry B* **105**, 8102–8106 (2001).
20. E. Charles H. Sykes, Patrick Han, S. Alex Kandel, Kevin F. Kelly, Gregory S. McCarty, and Paul S. Weiss, "Substrate-mediated interactions and intermolecular forces between molecules adsorbed on surfaces," *Accounts of Chemical Research* **36**, 945–953 (2003).
21. Song Guo, Daniel P. Fogarty, Phillip M. Nagel, and S. Alex Kandel, "Thermal diffusion of C_{60} molecules and clusters on Au(111)," *Journal of Physical Chemistry B* **108**, 14074–14081 (2004).
22. Daniel P. Fogarty and S. Alex Kandel, "Design of a scanning tunneling microscope for *in situ* observation of the interactions of molecular beams with surfaces," *Review of Scientific Instruments* **76**, article #083708: 1–6 (2005).

23. Amanda L. Deering, Staci M. Van Lue, and S. Alex Kandel, "Ambient-pressure vapor deposition of octanethiol self-assembled monolayers," *Langmuir* **21**, 10260–10263 (2005).
24. Daniel P. Fogarty and S. Alex Kandel, "Structural changes of an octanethiol monolayer via hyperthermal rare-gas collisions," *Journal of Chemical Physics* **124**, article #111101: 1–4 (2006).
25. Zhongqing Wei, Song Guo, and S. Alex Kandel, "Observation of single dinuclear metal-complex molecules using scanning tunneling microscopy," *Journal of Physical Chemistry B* **110**, 21846–21849 (2006).
26. Daniel P. Fogarty and S. Alex Kandel, "Collision-induced annealing of octanethiol self-assembled monolayers by high-kinetic-energy xenon atoms," *Journal of Chemical Physics* **125**, article #174710: 1–8 (2006).
27. Amanda L. Deering and S. Alex Kandel, "Structural rearrangement of C₇₀ monolayers induced by octanethiol adsorption," *Langmuir* **22**, 10025–10031 (2006).
28. Daniel P. Fogarty, Amanda L. Deering, Song Guo, Zhongqing Wei, Natalie A. Kautz, and S. Alex Kandel, "Minimizing image-processing artifacts in scanning tunneling microscopy using linear-regression fitting," *Review of Scientific Instruments* **77**, article #126104: 1–3 (2006).
29. Song Guo, Phillip M. Nagel, Amanda L. Deering, Staci M. Van Lue, and S. Alex Kandel, "Scanning tunneling microscopy of surface-adsorbed fullerenes: C₆₀, C₇₀, and C₈₄," *Surface Science*, **66**, 994–1000 (2007).
30. Daniel P. Fogarty, Natalie A. Kautz, and S. Alex Kandel, "Collision-induced diffusion and vacancy migration in alkanethiol monolayers on Au(111)," *Surface Science* **601**, 2117–2124 (2007).
31. Natalie A. Kautz, Daniel P. Fogarty, and S. Alex Kandel, "Degradation of octanethiol self-assembled monolayers from hydrogen-atom exposure: A molecular-scale study using scanning tunneling microscopy," *Surface Science* **601**, L86–L90 (2007).
32. Song Guo and S. Alex Kandel, "Scanning tunneling microscopy studies of pulse deposition of dinuclear organometallic molecules on Au(111)," *Journal of Chemical Physics* **108**, article #014702: 1–5 (2008).
33. Natalie A. Kautz and S. Alex Kandel, "Alkanethiol/Au(111) self-assembled monolayers contain gold adatoms: Scanning tunneling microscopy before and after reaction with atomic hydrogen," *Journal of the American Chemical Society* **130**, 6908–6909 (2008).
34. Natalie A. Kautz and S. Alex Kandel, "Alkanethiol monolayers contain gold adatoms, and adatom coverage is independent of chain length," *Journal of Physical Chemistry C* **113**, 19286–19291 (2009).

35. Song Guo and S. Alex Kandel, "Scanning tunneling microscopy of mixed valence dinuclear organometallic cations and counter-ions on Au(111)," *Journal of Physical Chemistry Letters* **1**, 420–424 (2010).
36. Annette F. Raigoza, D. Andres Villalba, Natalie A. Kautz, and S. Alex Kandel, "Structure and self-assembly of sequentially adsorbed coronene/octanethiol monolayers," *Surface Science* **604**, 1584–1590 (2010).
37. Yuhui Lu, Rebecca C. Quardokus, Craig S. Lent, Frederic Justaud, Claude Lapinte, and S. Alex Kandel, "Charge localization in isolated mixed-valence complexes: An STM and theoretical study," *Journal of the American Chemical Society* **132**, 13519–13524 (2010).
38. Annette F. Raigoza, George Kolettis, D. Andres Villalba, and S. Alex Kandel, "Restructuring of octanethiolate and dialkyldithiocarbamate monolayers in the formation of sequentially adsorbed mixed monolayers," *Journal of Physical Chemistry C* **115**, 20274–20281 (2011).
39. Matthew M. Jobbins, Annette F. Raigoza, and S. Alex Kandel, "Adatoms at the sulfur-gold interface in 1-adamantanethiolate monolayers, studied using reaction with hydrogen atoms and scanning tunneling microscopy," *Journal of Physical Chemistry C* **115**, 25437–25441 (2011).
40. Rebecca C. Quardokus, Natalie A. Wasio, Yuhui Lu, Craig S. Lent, Frederic Justaud, Claude Lapinte, and S. Alex Kandel, "Through-bond versus through-space coupling in mixed-valence molecules: Observation of electron localization at the single-molecule scale," *Journal of the American Chemical Society* **134**, 1710–1714 (2012).
41. Annette F. Raigoza, George Kolettis, Sharon Brandt, Guido Caponigri-Guerra, Chris Agostino, and S. Alex Kandel, "Coadsorption of octanethiol and dialkyldithiocarbamate on Au(111)," *Journal of Physical Chemistry C*, **116** 1930–1934 (2012).
42. Natalie A. Kautz and S. Alex Kandel, "Reactivity of self-assembled monolayers: Local surface environment determines monolayer erosion rates," *Journal of Physical Chemistry C*, **116** 4725–4731 (2012).
43. Matthew M. Jobbins, Annette F. Raigoza, and S. Alex Kandel, "Note: Circuit design for DC and AC electrochemical etching of scanning probe microscopy tips," *Review of Scientific Instruments*, **83** article #036105: 1–3 (2012).
44. David Y. Lee, Matthew M. Jobbins, and S. Alex Kandel, "A resistive pyrolytic radical source for gas-surface reaction studies," *Review of Scientific Instruments*, **83** article #044101: 1–4 (2012).
45. Matthew M. Jobbins, David Y. Lee, and S. Alex Kandel, "Communication: Scanning tunneling microscopy study of the reaction of octanethiolate self-assembled monolayers with atomic chlorine," *Journal of Chemical Physics* **136**, article #141102: 1–4 (2012).
46. Natalie A. Wasio, Rebecca C. Quardokus, Yuhui Lu, Ryan P. Forrest, Steven A. Corcelli, Craig S. Lent, Frederic Justaud, Claude Lapinte, and S. Alex Kandel, "STM imaging of

- three-metal-center molecules: Comparison of experiment and theory for two mixed-valence oxidation states,” *Journal of Physical Chemistry C* **116**, 25486–25492 (2012).
47. Matthew M. Jobbins, Christopher J. Agostino, Jolai D. Michel, Guido Caponigri-Guerra, Sean B. Nees, and S. Alex Kandel, “Flash sample heating for scanning tunneling microscopy: Desorption of 1-octanethiolate self-assembled monolayers in air,” *Journal of Vacuum Science and Technology B* **31**, article #013201: 1–3 (2013).
 48. Rebecca C. Quardokus, Natalie A. Wasio, Ryan P. Forrest, Craig S. Lent, Steven A. Corcelli, John A. Christie, Kenneth W. Henderson, and S. Alex Kandel, “Adsorption of diferrocenylacetylene on Au(111) studied by scanning tunneling microscopy,” *Physical Chemistry Chemical Physics*, **15** 6973–6981 (2013).
 49. David Y. Lee, Matthew M. Jobbins, Ashley R. Gans, and S. Alex Kandel, “The role of defects in the reaction of chlorine atoms with alkanethiol self-assembled monolayers,” *Physical Chemistry Chemical Physics* **15** 18844–18854 (2013).
 50. David Y. Lee and S. Alex Kandel, “Communication: Site-dependent reactivity between chlorine atoms and mixed-chain-length alkanethiolate monolayers,” *Journal of Chemical Physics* **139**, article #161103: 1–4 (2013).
 51. Matthew M. Jobbins, Christopher J. Agostino, Jolai D. Michel, Ashley R. Gans, and S. Alex Kandel “Compact, single-tube scanning tunneling microscope with thermoelectric cooling,” *Review of Scientific Instruments* **84**, article #103706: 1–5 (2013).
 52. David Y. Lee, Natalie A. Kautz, and S. Alex Kandel, “Reactivity of gas-phase radicals with organic surfaces,” *Journal of Physical Chemistry Letters* **4** 4103–4112 (2013).
 53. Ashley R. Gans, Matthew M. Jobbins, David Y. Lee, and S. Alex Kandel, “Vacuum compatibility of silver and titanium parts made using three-dimensional printing,” *Journal of Vacuum Science and Technology A* **32**, article #023201: 1–2 (2014).
 54. Rebecca C. Quardokus, Natalie A. Wasio, and S. Alex Kandel, “The scanning Theremin microscope: A model scanning probe instrument for hands-on activities,” *Journal of Chemical Education* **91** 246–250 (2014).
 55. Natalie A. Wasio, Rebecca C. Quardokus, Ryan P. Forrest, Craig S. Lent, Steven A. Corcelli, John A. Christie, Kenneth W. Henderson, and S. Alex Kandel, “Self-assembly of hydrogen-bonded two-dimensional quasicrystals,” *Nature* **507** 86–89 (2014).
 56. Rebecca C. Quardokus, Natalie A. Wasio, John A. Christie, Kenneth W. Henderson, Ryan P. Forrest, Craig S. Lent, Steven A. Corcelli, and S. Alex Kandel, “Hydrogen-bonded clusters of ferrocenecarboxylic acid on Au(111),” *Chemical Communications* **50** 10229–10232 (2014).
 57. Rebecca C. Quardokus, Natalie A. Wasio, Ryan D. Brown, John A. Christie, Kenneth W. Henderson, Ryan P. Forrest, Craig S. Lent, Steven A. Corcelli, and S. Alex Kandel, “Hydrogen-bonded clusters of 1,1'-ferrocenedicarboxylic acid on Au(111) are initially formed in solution,” *Journal of Chemical Physics* **142**, article #101927 (2015).

58. Natalie A. Wasio, Rebecca C. Quardokus, Ryan D. Brown, Ryan P. Forrest, Craig S. Lent, Steven A. Corcelli, John A. Christie, Kenneth W. Henderson, and S. Alex Kandel, "Cyclic hydrogen bonding in indole carboxylic acid clusters," *Journal of Physical Chemistry C*, **119** 21011–21017 (2015).
59. John A. Christie, Ryan P. Forrest, Steven A. Corcelli, Natalie A. Wasio, Rebecca C. Quardokus, Ryan D. Brown, S. Alex Kandel, Yuhui Lu, Craig S. Lent, and Kenneth W. Henderson, "Synthesis of a neutral mixed-valence diferrocenyl carborane for molecular quantum-dot cellular automata applications," *Angewandte Chemie Int. Ed.* **54** 15448–15451 (2015).
60. Ryan D. Brown, Joseph M. Coman, John A. Christie, Ryan P. Forrest, Craig S. Lent, Steven A. Corcelli, Kenneth W. Henderson, and S. Alex Kandel, "The evolution of metastable clusters into ordered structures for 1,1'-ferrocenedicarboxylic acid on the Au(111) surface," *Journal of Physical Chemistry C* **121** 6191–6198 (2017).
61. Jacob P. Petersen and S. Alex Kandel, "Circuit design considerations for current preamplifiers for scanning tunneling microscopy," *Journal of Vacuum Science and Technology B* in press (2017).

2.2 Edited Conference Proceedings (current appointment begins at #64)

62. S. Alex Kandel, Thierry A. W. Wasserman, Qingguo Zhang, Hui Wang, Angela A. Arias, and Patrick H. Vaccaro, "Resonant four-wave mixing spectroscopy as a probe of molecular structure and dynamics in the regime of extreme vibrational excitation," *Proceedings of the SPIE — the International Society for Optical Engineering* **1858**, 126–137 (1993).
63. Thierry A. W. Wasserman, Angela A. Arias, S. Alex Kandel, David Hsu, and Patrick H. Vaccaro, "Sub-Doppler nonlinear spectroscopy as a probe of photodissociation dynamics," *Proceedings of the SPIE — the International Society for Optical Engineering* **2548**, 220–230 (1995).
64. Song Guo, Daniel P. Fogarty, Phillip M. Nagel, and S. Alex Kandel, "Structure and dynamics of fullerenes adsorbed on the Au(111) surface," *Proceedings of the SPIE — the International Society for Optical Engineering* **5513**, 185–195 (2004).
65. Craig S. Lent, Kenneth W. Henderson, S. Alex Kandel, Steven A. Corcelli, Gregory L. Snider, Alexei O. Orlov, Peter M. Kogge, Michael T. Niemier, Ryan C. Brown, John A. Christie, Natalie A. Wasio, Rebecca C. Quardokus, Ryan P. Forrest, Jacob P. Petersen, Angela Silski, David A. Turner, Enrique P. Blair, and Yuhui Lu, "Molecular cellular networks: A non-von-Neumann architecture for molecular electronics," *IEEE International Conference on Rebooting Computing* (2016).

3 Presentations

3.1 Invited Talks (current appointment begins at #6)

1. "Reactions of chlorine atoms and hydrocarbons: State and scattering distributions of HCl and hydrocarbon radical products," International Symposium on Free Radicals, Tällberg, Sweden, August 1997.
2. "Vibrational spectroscopy of single molecules with the scanning tunneling microscope," University of Akron, Department of Physics, Akron, OH, December 1999.
3. "Local surface electronic and chemical changes in molecular adsorption," 2nd COE Symposium on Atomic Scale Processing and Novel Properties in Nanoscopic Materials, Osaka, Japan, December 1999.
4. "Reaction dynamics of vibrationally excited molecules: Cl+CH₄($\nu_3=1$) and Cl+HD($\nu=1$)," American Chemical Society, 219th National Meeting, San Francisco, CA, March 2000.
5. "Atomic-scale insights into hydrodesulfurization," Union Carbide Innovation Recognition Program, Charleston, WV, May 2000.
6. "Investigating surface chemistry with the scanning tunneling microscope," Andrews University, Department of Chemistry, Berrien Springs, MI, March 2002.
7. "Structure and dynamics of C₆₀ on gold surfaces," State University of New York at Stony Brook, Department of Chemistry, Stony Brook, NY, December 2003.
8. "Studying diffusion at the molecular scale," College of William and Mary, Department of Chemistry, Williamsburg, VA, September 2004.
9. "Dynamics and structure of fullerenes on gold surfaces," University of Notre Dame, Department of Chemistry and Biochemistry, Notre Dame, IN, March 2005.
10. "Chemistry at the atomic scale: Observing physical processes, one molecule at a time," Wabash College, Department of Chemistry, Crawfordsville, IN, October 2005.
11. "Studying gas-surface collisions at the molecular scale," Yale University, Department of Chemistry, New Haven, CT, November 2005.
12. "Structure and dynamics of organic molecules, one molecule at a time," Indiana Microscopy Society, Spring Meeting, Notre Dame, IN, March 2006.
13. "Surface structure and stability at the molecular scale," Purdue University, Department of Chemistry, West Lafayette, IN, November 2006.
14. "Fullerenes adsorbed on Au(111): Structural polymorphism, diffusion, and self-assembly studied by scanning tunneling microscopy," Electrochemical Society, 211th National Meeting, Chicago, IL, May 2007

15. "The role of local surface structure in gas-surface collisions," XXI Dynamics of Molecular Collisions Meeting, Santa Fe, NM, July 2007.
16. "The role of local structure in surface chemistry," Tufts University, Department of Chemistry, Medford, MA, October 2007.
17. "A molecule-by-molecule view of gas-surface interactions," University of Oklahoma, Department of Physics and Astronomy, Norman, OK, October 2007.
18. "Kinetic constraints in multicomponent self-assembled systems," University of Oklahoma, Department of Physics and Astronomy, Norman, OK, October 2007.
19. "Gas-surface reactions of alkanethiol monolayers," 13th IACIS International Conference on Surface and Colloid Science and the 83rd ACS Colloid & Surface Science Symposium, New York, NY, June 2009.
20. "Scanning tunneling microscopy of mixed-valence dinuclear organometallics: Evaluation of candidates for molecular QCA," 1st International Workshop on Quantum-Dot Cellular Automata (IWQCA), Vancouver, BC, August 2009.
21. "Observing chemical change at the atomic scale," Grand Valley State University, Department of Chemistry, Grand Rapids, MI, October 2009.
22. "Mixed-valence molecules: Direct imaging of intramolecular charge distribution by STM," University of Oregon, Department of Chemistry, Eugene, OR, October 2010.
23. "Feedback," Mz. Wizard Day, University of Notre Dame, Notre Dame, IN, November 2010.
24. "Scanning tunneling microscopy of mixed-valence molecules for molecular electronics," Foundations of Nanotechnology (FNANO), Snowbird, UT, April 2013.
25. "QCA molecules imaged with scanning tunneling microscopy," CMOS and Emerging Technologies, Whistler, BC, July 2013.
26. "Self-assembly of hydrogen-bonded two-dimensional quasicrystals," University of Notre Dame, Department of Physics, Notre Dame, IN, September 2013.
27. "Self-assembled quasicrystalline monolayers," American Chemical Society, 247th National Meeting, Dallas, TX, March 2014.
28. "The scanning Theremin microscope," 23rd International Conference on Chemical Education, Toronto, ON, July 2014.
29. "Two-dimensional quasicrystals: Order, disorder, and none of the above," Calvin College, Department of Chemistry and Biochemistry, March 2015.
30. "Two-dimensional quasicrystals: Order, disorder, and none of the above," Hope College, Department of Chemistry, March 2015.
31. "Hydrogen-bonded quasicrystals," University of Illinois, Chicago, April 2015

32. "Self-assembly with cyclic hydrogen bonding," 2015 Joint Great Lakes and Central Regional Meeting, Grand Rapids, MI, May 2015.
33. "STM of mixed-valence molecules for QCA," IBM Research, Zürich, Switzerland, November 2015.
34. "Structural polymorphism from solution-mediated self-assembly," Department of Physics, Technische Universität München, Munich, Germany, November 2015.
35. "Clustering and crystallization under the microscope," Loyola University, Chicago, IL, February 2016.
36. "Polymorphism in hydrogen-bonded clusters," Purdue University, West Lafayette, IN, March 2016.
37. "Mixed-valence molecules: Direct imaging of intramolecular charge distribution by STM," American Chemical Society, 253rd National Meeting, San Francisco, CA, April 2017.

3.2 Contributed Talks (current appointment begins at #2)

1. "Atomically resolved cobalt and nickel clusters on molybdenum disulfide," American Vacuum Society, 47th International Symposium, Surface Science Post-Deadline Discovery Session, Boston, MA, October 2000.
2. "Structure and dynamics of fullerenes adsorbed on the Au(111) surface," SPIE International Symposium on Optical Science and Technology, Denver, CO, August 2004.
3. "Dynamics and structure of fullerenes on gold surfaces," American Chemical Society, 229th National Meeting, San Diego, CA, March 2005.
4. "Controlling the surface structure of mixed monolayers of fullerenes and alkanethiols," American Chemical Society, 230th National Meeting, Washington, DC, August 2005.
5. "Self-assembly of quasicrystalline monolayers," AVS Prairie Chapter Meeting, Chicago, IL, September 2014.

4 Funding

4.1 Current

"Surface heterogeneity and defects in gas-surface reactions"		
Sponsor: National Science Foundation	9/01/15 – 8/31/18	\$ 461,459
"NEB: Nanoelectronics with mixed-valence molecular QCA"		
Sponsor: National Science Foundation (NSF)	9/15/11 – 8/31/16	\$1,550,000
Kenneth Henderson, S. Alex Kandel, Craig Lent (PI), and Gregory Snider		

4.2 Past

“Gas-surface chemistry of self-assembled monolayers” Sponsor: National Science Foundation	2/01/09 – 1/31/13	\$ 413,414
“NIRT: Field effect switching of molecular charge configurations for QCA” Sponsor: National Science Foundation Thomas Fehlner, S. Alex Kandel, Craig Lent (PI), Marya Lieberman, and Greg Snider	8/01/04 – 7/31/08	\$1,300,000
“CAREER: Interactions of gas-phase atoms with self-assembled monolayers” Sponsor: National Science Foundation	2/01/04 – 1/31/09	\$471,000
“Oxidation of aluminum surfaces by energetic atoms and molecules” Sponsor: Petroleum Research Fund	9/01/02 – 8/31/04	\$35,000

5 Teaching

Spring 2016	Foundations of Chemistry
Fall 2015	Introduction to Chemical Principles 1M (General Chemistry I for Majors)
Spring 2015	Surface Science
Fall 2014	Introduction to Chemical Principles 1M
Spring 2014	Mathematical Methods for the Chemical Sciences
Fall 2013	Introduction to Chemical Principles 1M
Spring 2013	Molecular Spectroscopy
Fall 2012	Introduction to Chemical Principles 1M
Fall 2011	Introduction to Chemical Principles 1 (General Chemistry I for Non-Majors)
Spring 2011	Mathematical Methods for the Chemical Sciences
Fall 2010	Introduction to Chemical Principles 1
Spring 2010	Molecular Spectroscopy
Fall 2009	Introduction to Chemical Principles 1
Spring 2009	Surface Science
Fall 2008	Introduction to Chemical Principles 1
Spring 2008	Special Topics in Physical Chemistry: Scanning Probe Microscopy
Fall 2007	Quantum Mechanics I (Graduate)
Spring 2007	Physical Chemistry II
Fall 2006	Physical Chemistry I
Spring 2006	Physical Chemistry II
Fall 2005	Physical Chemistry I
Spring 2004	Physical Chemistry for Engineers
Fall 2003	Special Topics in Physical Chemistry: Scanning Probe Microscopy
Spring 2003	Physical Chemistry II
Fall 2002	Molecular Spectroscopy
Fall 2001	Special Topics in Physical Chemistry: Scanning Probe Microscopy