

432 W. Trillium Ct.
Stevens Point, WI 54481
email: MZach@uwsp.edu

Office: 715/346-3179
Home: 715/544-0286
<http://chemdept-nmr.uwsp.edu/~mzach/>

A. Academic History

1. Doctor of Philosophy in Chemistry, University of California, Irvine. 2002.
2. Masters of Science in Chemistry, University of California, Irvine. 2000.
3. Baccalaureate of Science, majoring in Chemistry (ACS certified) and Chemistry with Polymer Option, University of Wisconsin—Stevens Point. 1997.

B. Scientific Research and Teaching Related Employment History

1. Assistant Professor of Chemistry, University of Wisconsin – Stevens Point, signed contract for the 2006-2008 academic years. Joint Appointment with Argonne National Laboratory to continue research into hydrogen sensor development and combinatorial electrodeposition instrumentation/methods.
2. Glenn Seaborg Postdoctoral Fellow, Materials Science Division, Argonne National Laboratory, 2004 to 2006.
3. Miller Postdoctoral Fellow, Miller Institute for Basic Research in Science, University of California, Berkeley. 2002 to 2004. Joint Appointment with NASA/Ames Research Center 2003 to 2004.
4. Merck Fellow, American Chemical Society – Division of Analytical Chemistry Award, Sponsored by Merck and Company, 2001 to 2002
5. Head Teaching Assistant for Analytical, General and Nuclear Chemistry, UC, Irvine, various quarters during 1998 to 2001.
6. Research Assistant in the laboratory of Prof. Reginald Penner, UC, Irvine, 1997 to 2002.
7. Teaching Assistant for Analytical, General and Nuclear Chemistry, UC, Irvine, various quarters during 1997 to 2000.

C. Additional Employment History

1. Owner, Artist, Goldsmith, Gemologist
M.P. Zach – Hand-crafted Jewelry, Stevens Point, WI July 1994 – June 1997
2. Owner, Artist, Goldsmith, Gemologist
M. P. Zach Custom Design Jewelry, Monroe, WI November 1987 – June 1996
3. Apprentice to a religious monk - jeweler/sculptor. Jerome Cox, MFA, FSC
Fratelli della Scuola Cristiani, Florence, Italy June 1986 – September 1987

D. Honors and Awards

1. R&D100 Award. R&D Magazine editors and a panel of independent judges named Argonne's Ultrafast, Ultrasensitive Nanostructured Hydrogen Sensor as one of the 100 most technologically significant products added to the marketplace for 2006. This will be announced in the September 2006 issue of R&D Magazine. <http://www.rdmag.com/>
2. Micro/Nano25 Award. The Editors of R&D Magazine and MICRO/NANO Newsletter have selected Argonne's Nanostructured Hydrogen Sensor as one of the most innovative products of 2006.

3. Prominently featured research highlight in Argonne News concerning our research on the world's fastest, commercially-producible hydrogen sensor. This news story has been picked up by numerous sources and has received coverage by over 50 different news organizations ranging from physorg.com to the Iran Daily News
http://www.anl.gov/Media_Center/News/2005/news050525.html
4. Awarded Glenn Seaborg Postdoctoral Fellowship for post-doctoral research at Argonne National Laboratory. Started April 2004. Guaranteed funding for two years.
5. Elected to the American Association for the Advancement of Science, Pacific Division (AAAS-PD) Board of Directors as Council Member at Large. Term 2002 -2005.
6. AAAS-PD, Larus Travel Award to compete at the National AAAS meeting in Boston, February 2002.
7. Awarded the Miller Research Fellowship for post-doctoral research at University of California, Berkeley. Awarded December 2001. Started July 2002. Guaranteed funding for up to three years.
8. Second Place Poster, (\$125 cash award), Microscopy and Microanalysis, National Meeting, Awarded August 2001.
9. First Place Poster Presentation in Engineering and Industrial Chemistry Division (\$175 cash award), AAAS-PD, Pacific Division Regional Meeting, June 2001.
10. Presidential Award (\$175 cash award), AAAS-PD, Pacific Division Regional Meeting, June 2001.
11. E.K.C. Lee Memorial Award, UCI Chemistry Department's highest award given to graduate students, (\$1000 cash award) Awarded May 2001.
12. Awarded Merck Fellowship (\$15,000 stipend, national award), American Chemical Society - Division of Analytical Chemistry Graduate Student Fellowship, June 2001 to March 2002.
13. Second Place Student Paper, (\$300 cash award), Southern California Chapter of the American Vacuum Society October 2000.
14. Departmental Award for Outstanding Teaching Assistant, Honorable Mention for 1998-1999, University of California, Irvine.
15. Departmental Award for Outstanding Teaching Assistant for 1997-1998 (\$100 cash award), University of California, Irvine.
16. Named Head Teaching Assistant for Analytical, Nuclear, and General Chemistry Courses, various quarters 1998-2000, University of California, Irvine.
17. Chancellor's Leadership Award, University of Wisconsin - Stevens Point, 1997.
18. Graduation with Honors, University of Wisconsin - Stevens Point, 1997.
19. Eagle Scout, Boy Scouts of America, Troop 115, Monroe, WI, 1982.

E. Professional Affiliations

1. American Chemical Society.
2. The Electrochemical Society.
3. American Association for the Advancement of Science (AAAS).
4. Microscopy Society of America.
5. Mineralogical Society of America.
6. State Microscopical Society of Illinois

F. Extracurricular Activities

1. Given numerous chemical demonstrations and talked about being a research scientist to Milwaukee School of Engineering, Chicago's Morgan Park Academy, University of Wisconsin – Stevens Point, Argonne's DEP video outreach to Chicago's Agricultural School, Illinois Valley Community College, Argonne's DEP Science Careers in Search of Women Conference and Monroe High School.
2. Interacted with students Charles Ziemer from Milwaukee School of Engineering (MSOE) and Alexandria Surasky-Ysasi from Brown University and Dr. Anne-Marie Nickel from MSOE in MSOE Rapid Prototyping Center's Research Experience for Undergraduates Program. 2005
3. Provided support for State Microscopy Society of Illinois's outreach programs to help teach light microscopy techniques to middle school students and teachers and will soon be providing a program for their meeting. 2004-2006
4. Mentored Irvine's University High School student Jeff Chen with a project of making micro and nanorods of semiconductor materials through controlled diffusion and precipitation of aqueous precursors within Nucleopore membranes. With this project, his research was recognized with numerous local, regional and state awards for science including Irvine Unified School District Science Fair-Division 1st Place (Physical Sciences), Orange County Science and Engineering Fair, 2nd Place (Chemistry Senior Division) 1st Place in the Special Award (American Vacuum Society), The Beckman/Coulter Award, 4th Place in State Fair competition (Physical Sciences) and semi-finalist for the national Siemens-Westinghouse Competition. 2001-2002.
5. Judged for the Orange County Science and Engineering Fair. 2000-2002.
6. Served with the local organizing committee for the Microscopy and Microanalysis 2001 national meeting of the Microscopy Society of America 2000-2001.
7. Audubon Society Workshops on Exploring Nature using Microscopy, Study of detailed structures on natural objects ranging from rocks to fern spores, and water fleas to adaptations on bird feathers. 1999-2003.
8. Enabled elementary school teachers to incorporate science into their classrooms by developing projects and materials using microscopy to get kids excited about exploring the world around them. The emphasis was mostly focused on critters that one might find in "pond scum." Learning English Through Science (LETS) Program, 1999-2002.
9. Point Reyes Bird Observatory – Monitoring Avian Population and Survivorship (MAPS) Study, Perennial study of breeding birds using mist netting and banding as a method to monitor songbird natural history – Audubon Starr Ranch, Orange County. 1999-2002.
10. Aided in bat research as part of the Stephanie Remington's Master's Thesis: The Distribution and Diversity of Bats in Orange County, CalPoly-Pomona 1998-2000.
11. Aided Sea and Sage Audubon Society's Education Naturalist Program by collecting pond samples weekly for school marsh tours. 2001-2002.
12. California Alliance for Minority Participation (CAMP). Helped minority students make the transition from high school by providing intensive remedial chemistry instruction. 1997-1998.

G. Research Interests

1. **Electrodeposition:** My research has focused on the size and morphological control of nanometer to micron sized structures for a variety of materials. The centerpiece of this research is development of a combinatorial electrodeposition system designed to precisely control and automate tedious tasks needed for systematically changing the parameters that have an effect on the morphology of electrodeposited crystals. By discovering the rules of how nature wants to make organized patterns such as crystals from individual atoms and ions, it is my hope we can manufacture items with better properties by intelligently providing the right set of conditions for self assembly using low energy methods.
2. **Micro and nanospheres for drug delivery:** Chemotherapy agents are often effective against tumors, but are also known for their toxicity to healthy tissue. One proposed method for minimizing the sickening side effects is to treat only the tumor instead of the whole body. By encapsulating the drugs along with magnetic nanoparticles within hollow biodegradable polymer spheres the body's circulatory system can be used to circulate these capsules throughout the body. A localized strong magnetic field can be used to trap the particles at the site of the tumor until the polymer casings can be broken down by the body to release their contents. This method of drug delivery increases the effectiveness of delivery by reducing the overall dose, while increasing the dose delivered to the target site. To make capsules suitable for injection, both the size and the wall thickness must be carefully controlled so these particles will all have uniform properties. Previous methods for encapsulation have not been suitable because they result in spheres that have a large distribution of sizes. Novel flow-through cell designs for making the particles are yielding tighter distributions of sizes than are currently being made by the emulsion methods.
3. **Hydrogen Sensors:** Research for finding alternatives to fossil fuels is often suggesting hydrogen as the future energy transfer medium of choice. Many technical hurdles exist before hydrogen can be used in our cars, homes and businesses. Hydrogen is a colorless, tasteless gas that is flammable in the range of 4 to 75% concentration with air and between 18 to 53% in air hydrogen will detonate. Currently available sensors use technology that is both expensive and slow with response times that are in the range of 10s of seconds to minutes. If a leak is present, rapid response at levels below the lower explosion limit may be needed to prevent a catastrophic event. By using thin films of palladium on a surface that has been treated with a surface bound lubricant like a siloxane, the World's fastest, commercially-producible hydrogen sensors have been created here at Argonne National Laboratory. These sensors have response times of about 70 milliseconds and can detect concentrations as low as 25ppm.

H. Publications

1. A. Rydh, R. Xie, M. Zach, U. Welp, W. K. Kwok, G. W. Crabtree, S. Bending, M. V. Milosevic, F. M. Peeters, Magnetization of a few-fluxoid lead crystal, *Physica C*, submitted.
2. M. Zach, K. Brown, J. Corsolini, Argonne's Ultrafast, Ultrasensitive Hydrogen Sensors, Video and R&D 100 Award Application Package, Submitted March 2006.
3. T. Xu*, M. P. Zach, Z.L.Xiao, D.Rosenmann, U.Welp, W.K.Kwok, G.W.Crabtree, Self-Assembled Monolayer-Enhanced Hydrogen Sensing with Ultrathin Palladium Films, **Appl. Phys. Lett.** 86, 203104 (2005)

4. M.P.Zach, J.Newberg, L.Sierra, J.Hemminger, R.M.Penner*, Chemical Vapor Deposition of Silica Micro- and Nanoribbons Using Step-Edge Localized Water, **J. Phys. Chem., B**, 107 (23) 5393-5397.
5. E.C. Walter, M.P. Zach, F. Favier, B.J. Murray, K. Inazu, J.C. Hemminger, and R.M. Penner*, Metal Nanowire Arrays by Electrodeposition, **ChemPhysChem** (2003) 4 (2) 131-138.
6. M.P.Zach, K.Inazu, K.H. Ng, J.Hemminger, R.M.Penner*, Synthesis of Molybdenum Nanowires with Millimeter-Scale Lengths Using Electrochemical StepEdge Decoration, **Chem. Mater.** 14 (2002) 3206-3216.
7. E.C. Walter, M.P. Zach, F. Favier, B.J. Murray, K. Inazu, J.C. Hemminger, and R.M. Penner* " Electrodeposition of Portable Metal Nanowire Arrays ", in: **Physical Chemistry of Interfaces and Nanomaterials, Proc.**, Eds. Jin Z. Zhang, Zhong L. Wang, SPIE 2002 (2002) ISBN 0-8194-4575-4.
8. E.C. Walter, R.M. Penner, H. Liu, K.H. Ng, M.P. Zach, F. Favier*, Sensors From Electrodeposited Metal Nanowires, **Surface and Interface Analysis**, 34 (1) 409-412.
9. E.C. Walter, K. Ng, M.P. Zach, R.M. Penner, F. Favier, Electronic devices from electrodeposited metal nanowires, **Microelectronic Engineering**, 61-2: 555-561(2002).
10. F. Favier, E.Walter, M.P.Zach, T.Benter, R.M.Penner, Hydrogen Sensors and Switches from Electrodeposited Palladium Nanowires, **Science**, V293, 2227-2231 (2001).
11. H.Liu, F.Favier, K.Ng, M.P.Zach, and R.M. Penner*, A General Method for the Electrodeposition of Dimensionally Uniform Meso-Scale Metal Particles, **Electrochimica Acta**, 47 (2001) 671.
12. P.D. Markowitz, M.P. Zach, P.D. Gibbons, R.M. Penner, and W. E. Buhro*, Phase Separation in $\text{Al}_x\text{Ga}_{1-x}\text{As}$ Nanowhiskers Grown by the Solution-Liquid-Solid Mechanism, **J. Am. Chem. Soc.**, 123 (2001) 4502.
13. S. Gorer, H. Liu, R.M. Stiger, M.P. Zach, James V. Zoval, and R.M. Penner*, "**The Handbook of Metal Nanoparticles: Synthesis, Characterization, and Applications.**" C.Foss and D. Feldheim, Eds., Marcel-Dekker Inc., (2001).
14. M.P. Zach, K.H. Ng and R.M. Penner*, Molybdenum Nanowires by Electrodeposition, **Science**, V290, 2120-2123 (2000) (*Selected as cover story*).
15. M.P. Zach and R.M. Penner, Size-Monodisperse and Nanocrystalline Nickel Nanoparticles, **Adv. Mat.**, 12 (2000) 878.

I. U.S. Patents

1. Method for Deployment of Ultrafast Hydrogen Sensors for Safety, M.P.Zach, Patent Application in Argonne's internal review.
2. Combinatorial Electrodeposition System, M.P.Zach, US Patent Application # 60/704,558 filed August 2, 2005.
3. Ultrafast And Ultrasensitive Hydrogen Sensors Based on Self-Assembly Monolayer Promoted 2-Dimensional Palladium Nanoclusters, T.Xu, M.P.Zach, Z.L.Xiao, US Patent Application #11/001,193 filed December 1, 2004. Licensed.
4. Methods for Fabricating Metal Nanowires, R.M.Penner, M.P.Zach, F.Favier, filed December 2000, issued January 18, 2005, US Patent # 6,843,902. Licensed.

J. Conferences, Oral, and Poster Presentations

1. Featured speaker at Argonne National Laboratory's Open House 2006, 3 presentations, October 2006.
2. Nanotechnology Teacher's Workshop. Presentation and laboratory exercise teaching high school teachers how hydrogen sensors are made. Dept. of Educational Programs, Argonne National Laboratory, July 2006.
3. State Microscopical Society of Illinois, Invited Speaker, Chicago, IL, May 2006.
4. Illinois Valley Community College, Seminar Speaker, Chemistry Department, Oglesby, IL, April 2006.
5. Argonne Department of Educational Program's Science Careers in Search of Women Conference, High school age women, April 2006
6. Monroe Public Schools, ten separate demonstration/presentations to all elementary 4th&5th graders, middle school students and high school science students, March 2006, Monroe, WI.
7. Badger Lapidary and Geological Society, Seminar speaker, "Learning Nature's Secrets – Growing Crystals in the Laboratory," March 2006, Monroe, WI
8. Argonne Department of Educational Programs Video Outreach to Chicago's Agricultural School, February 2006.
9. Milwaukee School of Engineering, Seminar speaker, Chemistry Department, December 2005.
10. Morgan Park Academy, Demonstration of hydrogen safety & sensors, Chicago, IL, January 2006. Milwaukee School of Engineering, Seminar Speaker, Milwaukee, WI, December 2005.
11. University of Jyväskylä, Chemistry Department, Seminar Speaker, Jyväskylä, Finland, September 2005.
12. University of Wisconsin – Stevens Point, Seminar Speaker, Chemistry Department, September 2005.
13. Gordon Research Conference on Electrochemistry, Poster Presentation, January 2005, Ventura, CA.
14. University of Wisconsin – Platteville, Seminar Speaker, Chemistry Department, November 2004.
15. Conference on Fundamentals of Self-Assembly in Complex Materials: Self-organization and Continuum Models, Invited Oral Presentation, Argonne National Laboratory, August 2004.
16. Gordon Research Conference on Electrodeposition, Poster Presentation, August 2004, New Lisbon, NH.
17. National Institute of Standards and Technology, Invited Oral Presentation, October 2003, Gaithersburg, MD.
18. Milwaukee School of Engineering, Oral Presentation, July 2003, Milwaukee, WI.
19. University of Wisconsin, Chemical Engineering Department, Oral Presentation, July 2003, Madison, WI.
20. Lawrence Livermore National Lab, Invited Oral Presentation, July 2003, Livermore, CA.
21. IBM Almaden Research Labs, Invited Oral Presentation, July 2003, San Jose, CA.
22. Pacific Division of the AAAS, Session Organizer and Speaker, Title: New Methods for Controlled Patterning of Materials. June 2003, San Francisco, CA.

23. University of Wisconsin's Inaugural Technical Conference and Public Expo on Nanotechnology, Poster Presentation, May 2003, Madison, WI.
24. SRI International, Invited Oral Presentation, May 2003, Menlo Park, CA.
25. NanoSIG: NanoMaterials & Manufacturing Forum, Poster Presentation, April 2003, Menlo Park, CA.
26. San Francisco Microscopical Society, Invited Oral Presentation, April 2003, San Francisco, CA.
27. American Chemical Society, National Meeting, Contributed Oral Presentation, March 2003, New Orleans, LA.
28. Gordon Research Conference on Electrochemistry, Poster Presentation, January 2003, Ventura, CA.
29. Gordon Research Conference on Biomineralization, Poster Presentation, August 2002, New London, NH.
30. Southern California Society of Microscopy and Microanalysis Annual Meeting, Invited Oral Presentation, June 2002, Long Beach, CA.
31. Departmental Seminar, Chemistry Department, Invited Oral Presentation, UC, Irvine, April 2002.
32. Wilson Ho Group, Physics Department, UC, Irvine, Invited Oral Presentation, April 2002.
33. UC, Irvine's Institute for Surface and Interface Science, Interdepartmental Meeting, Poster Presentation, April 2002.
34. Ph.D. Dissertation Defense, UC, Irvine, March 2002.
35. American Association for the Advancement of Science, National Meeting, Poster Presentation, February 2002, Boston, MA.
36. Gordon Research Conference on Electrochemistry, Poster Presentation and Contributed Oral Presentation, January 2002, Ventura, CA.
37. American Vacuum Society, Contributed Oral Presentation, October 2001, San Francisco, CA.
38. Southern California Chapter of the American Vacuum Society, Poster Presentation, October 2001, Anaheim, CA.
39. Microscopy and Microanalysis, Microscopy Society of America, Poster Presentation, August 2001.
40. Banfield Research Group, University of Wisconsin-Madison, Oral Presentation, July 2001.
41. American Association for the Advancement of Science, Pacific Division, Poster Presentation, June 2001, Irvine, CA.
42. ACS National Conference, Division of Colloid and Surface Science, Poster Presentation, April 2001. San Diego, CA.
43. Gordon Research Conference on Electrochemistry, Poster Presentation and Contributed Oral Presentation, January 2000, Ventura, CA.
44. Invited seminar speaker to University of Wisconsin – Stevens Point, Chemistry Department, December 2000.
45. Southern California Chapter of the American Vacuum Society, Oral Presentation October 1998, Anaheim, CA.
46. Gordon Research Conference on Electrodeposition, Poster Presentation and Contributed Oral Presentation, August 2000, New Lisbon, NH.
47. Gordon Research Conference on Electrochemistry, Poster Presentation, January 2000, Ventura, CA.

48. Southern California Chapter of the American Vacuum Society, Poster Presentation
October 1999, Anaheim, CA.
49. ACS National Conference, Division of Colloid and Surface Science, Poster Presentation,
April 1999. Anaheim, CA.
50. Great Lakes College Chemistry Conference, Poster Presentation, April 1997, Lansing, MI.

K. Funding Applications

1. "Conversion of Solid Carbon Feedstocks into Liquid Hydrocarbons for Transportation Fuels through Gasification," C. Marshall, et.al., \$2.45 million over 3 years, ANL LDRD Proposal, partially funded for \$200k for the first year.
2. "Cross-Cutting Solar Energy Science and Technology" J. Elam, et.al., \$1.8 million over 3 years, funded \$70K with 6 month review.
3. "Electrochemically deposited fuel cell catalysts and catalyst supports using combinatorial electrodeposition," M. Zach, Z.Xiao, W.Kwok, C.Marshall, 3 years, \$130K/year, ANL LDRD Proposal, not funded.
4. "Combined Electrochemical Deposition and Atomic Layer Deposition for Synthesis of Novel Fuel Cell Catalysts," J. W. Elam, M. P. Zach, M. J. Pellin, J. N. Hryn, U. Welp, W. Kwok, 3years, \$120K/year, ANL LDRD Proposal, not funded.
5. "Biological Nanocasting: From Brute Force to Elegance," M. Zach, Z. Xiao, W. Kwok; 2 years, \$75K/year, ANL LDRD Proposal, not funded.
6. "Uniform-Sized Biodegradable Nanospheres for Drug Delivery - Novel Synthesis Platform Can Revolutionize Targeted Drug Delivery," M. Zach, C. Mertz, W. Kwok, M. Kaminski; 2 years, \$85K/year, ANL LDRD Proposal, Funded & Renewed.
7. "Combinatorial Electrochemistry on a Chip," M. Zach, Z. Xiao, W. Kwok; 2 years, \$75K/year, ANL LDRD Proposal, not funded.
8. Research Proposal for Argonne Named Postdoctoral Fellowship; M. Zach; 2 years, \$70K/year +\$20K/year supplies, Funded.
9. Research Proposal for Miller Institute for Basic Research in Sciences; M. Zach, 3 years, \$50K/year + \$10K/year supplies, Funded.
10. Research Proposal for American Chemical Society – Division of Analytical Chemistry, Graduate Student Fellowship, \$15,000, Funded.

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Office: 715/346-3179
Home: 715/544-0286
<http://chemdept-nmr.uwsp.edu/~mzach/>

References

Ph.D. advisor:

Reginald M. Penner, Professor
Department of Chemistry
516 Rowland Hall
University of California, Irvine
Irvine, CA 92697

Phone: 949 824-8572
Fax: 949 824-3168
email: RMPenner@uci.edu

Teaching Mentor:

George Miller, Emeritus Professor
Department of Chemistry
516 Rowland Hall
University of California, Irvine
Irvine, CA 92697

Phone: 949 824-6649
Fax: 949 824-3168
email: GEMiller@uci.edu

Argonne Supervisor:

Wai-Kwong Kwok
Group Leader: Superconductivity and Magnetism
Office c-129, Building 223
Argonne National Laboratory
Argonne, IL 60439-4845

Phone: 630 252-5539
Fax: 630 252-4748
email: WKwok@anl.gov