SCOTT C. WARREN, PH.D.

ASSISTANT PROFESSOR, UNC CHAPEL HILL

Department of Chemistry
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EDUCATION

Ph.D., Cornell University, Department of Chemistry 2007
Dissertation: Nanoparticle-block copolymer self-assembly

B.A. with honors, Whitman College, Department of Chemistry 2002

PROFESSIONAL EXPERIENCE

UNC Chapel Hill 2013-Present
Assistant Professor
Department of Chemistry
Department of Applied Physical Sciences

Northwestern University 2011-2013
Post-doctoral researcher with Bartosz Grzybowski
Metal nanoparticle electronics and solvated electrons

Technion-Israel Institute of Technology 2011
Visiting scholar with Avner Rothschild
Solar-powered water splitting

École Polytechnique Fédérale de Lausanne 2007-2010
Post-doctoral researcher with Michael Grätzel
Solar-powered water splitting

HONORS

Research highlighted in magazines and journals 2006-2012
MRS Bulletin, 2011, 2012; C&E News, 2008; Nature Materials, 2007, 2008; Science, 2006.

Prix Speciale du Doyen, École Polytechnique Fédérale de Lausanne (EPFL) 2008-2011
A prize from EPFL's dean for successfully establishing a research network on solar water splitting by winning a highly competitive European FP-7 grant worth U.S. $6 million.

Prize for Young Chemists, International Union of Pure and Applied Chemistry 2008
In recognition of outstanding Ph.D. research by the IUPAC.

Marilyn Emmons Williams Award, Cornell University Research Board 2007
Presented to the person at Cornell who has most promoted undergraduate research.

The Tunis Wentink Prize, Cornell University 2007
In recognition of outstanding Ph.D. research by the Department of Chemistry.

Graduate STAR fellowship, Environmental Protection Agency 2004-2007
Fellowship to fund graduate research; $180,000 over three years.

Graduate student Silver Award, Materials Research Society 2006
In recognition of outstanding Ph.D. research by the MRS.

U.S. National Science Foundation Fellowship 2006
Award to study transmission electron microscopy at the Pan-American Studies Institute.

PEER-REVIEWED PUBLICATIONS

1. S. Han, X. Hou, S. C. Warren, Y. Wei, C. D. Malliakas, B. Kowalczyk, M. G. Kanatzidis, B. A. Grzybowski. Rendering metal-organic frameworks photoconductive by occlusion of metal nanoclusters. In preparation.
2. S. C. Warren, K. Voïtchovsky, C. Leroy, M. Cornuz, F. Stellacci, C. Hebert, A. Rothschild, M. Grätzel. Identifying champion nanostructures for solar water splitting. In review at Nat. Mater.
3. A. C. Fahrenbach,* S. C. Warren,* J. T. Incorvati, A.-J. Avestro, J. C. Barnes, J. Fraser Stoddart, B. A. Grzybowski. Organic switches for surfaces and devices. Published online, Adv. Mater. *Equal contributions.
4. S. C. Warren, M. R. Perkins, A. M. Adams, M. Kamperman, A. Burns, H. Arora, E. Herz, T. Suteewong, H. Sai, Z. Li, J. Werner, J. Song, U. Werner-Zwanziger, J. Zwanziger, M. Grätzel, F. J. DiSalvo, U. Wiesner. A silica sol-gel design strategy for nanostructured metallic materials. Nat. Mater. **11**, 460-467 (2012).

   **This was highlighted by the MRS Bulletin, the Cornell Chronicle, and nanotechweb.org.
5. S.C. Warren, O. Guney-Altay, B. A. Grzybowski. Responsive and nonequilibrium nanomaterials. J. Phys. Chem. Lett., **3**, 2103-2111 (2012).
6. S. C. Warren, D. A. Walker, B. A. Grzybowski. Plasmoelectronics: coupling plasmonic excitation with electron flow. Langmuir **28**, 9093-9102 (2012).
7. S. C. Warren, E. Thimsen. Plasmonic solar water splitting. Energy Environ. Sci. **5**, 5133-5146 (2012).

   **Featured on the journal's cover.
8. S. C. Warren. Emerging trends in water photoelectrolysis. Editors: R. van de Krol, M. Grätzel. In: Photoelectrochemical hydrogen production. Springer (2012).
9. S. C. Warren, M. R. Perkins, U. Werner-Zwanziger, J. W. Zwanziger, F. J. DiSalvo, U. Wiesner. Generalized routes to mesostructured silicates with high metal content. Zeitschrift für Physikalische Chemie. **226**, 1219-1227 (2012).
10. Y. Wei, S. Han, D. A. Walker, S. C. Warren, B. A. Grzybowski. Enhanced photocatalytic activity of hybrid Fe_2O_3-Pd nanoparticulate catalysts. Chem. Sci. **3**, 1090-1094 (2012).
11. H. Dotan, K. Sivula, M. Graetzel, A. Rothschild, S. C. Warren. Probing the photoelectrochemical properties of hematite (α-Fe_2O_3) electrodes using hydrogen peroxide as a hole scavenger. Energy Environ. Sci. **4**, 958-964 (2011).

    This was highlighted in the MRS Bulletin **36, 166 (2011).
12. E. Thimsen, F. Le Formal, M. Graetzel, S. C. Warren. Influence of plasmonic Au nanoparticles on the photoactivity of Fe_2O_3 electrodes for water splitting. Nano Lett. **11**, 35-43 (2011).
13. J. Lee, Y. S. Jung, S. C. Warren, M. Kamperman, S. M. Oh, F. J. DiSalvo, U. Wiesner. Direct access to mesoporous crystalline TiO_2/carbon composites with large and uniform pores for use as anode materials in lithium ion batteries. Macromol. Chem. Phys. **212**, 383-390 (2011).
14. H. Arora, Z. Li, H. Sai, M. Kamperman, S. C. Warren, U. Wiesner. Block copolymer directed nanoporous metal thin films. Macromol. Rapid Commun. **31**, 1960-1964 (2010).
15. M. Nedelcu, S. Guldin, M. C. Orilall, J. Lee, S. Huettner, E. J. W. Crossland, S. C. Warren, C. Ducati, P. R. Laity, D. Eder, U. Wiesner, U. Steiner, H. J. Snaith. Monolithic route to efficient dye-sensitized

solar cells employing diblock copolymers for mesoporous TiO_2. J. Mater. Chem. **20**, 1261-1268 (2010).

16. Z. Li, H. Sai, S. C. Warren, M. Kamperman, H. Arora, S. Gruner, U. Wiesner. Metal nanoparticle-block copolymer composite assembly and disassembly. Chem. Mater. **21**, 5578-5584 (2009).
17. M. Kamperman, A. Burns, R. Weissgraeber, N. van Vegten, S. C. Warren, S. M. Gruner, A. Baiker, U. Wiesner. Integrating structure control over multiple length scales in porous high temperature ceramics with functional platinum nanoparticles. Nano Lett. **9**, 2756-2762 (2009).
18. S. C. Warren, U. Wiesner. Self-assembled ordered mesoporous metals. Pure & Appl. Chem. **81**, 72-84 (2009).
19. R. Oren, Z. Liang, J. S. Barnard, S. C. Warren, U. Wiesner, W. T. S. Huck. Organization of nanoparticles in polymer brushes. J. Am. Chem. Soc. **131**, 1670-1671 (2009).
20. M. Nedelcu, J. Lee, E. J. W. Crossland, S. C. Warren, M. C. Orilall, S. Guldin, S. Huttner, C. Ducati, D. Eder, U. Wiesner, U. Steiner, H. J. Snaith. Block copolymer directed synthesis of mesoporous TiO_2 for dye-sensitized solar cells. Soft Matter **5**,134-139 (2009).
21. S. C. Warren, L. C. Messina, L. S. Slaughter, M. Kamperman, Q. Zhou, S. M. Gruner, F. J. DiSalvo, U. Wiesner. Ordered mesoporous materials from metal nanoparticle-block copolymer self-assembly. Science **320**, 1748-1752 (2008).
This was highlighted in C&E News **8, *26*, 10 (2008) and Nat. Mater. **7**, 608 (2008).
22. H. Abe, F. Matsumoto, L. R. Alden, S. C. Warren, H. D. Abruña, F. J. DiSalvo. Electrocatalytic performance of fuel oxidation by Pt_3Ti nanoparticles. J. Am. Chem. Soc. **130**, 5452-5458 (2008).
23. J. Lee, M. C. Orilall, S. C. Warren, M. Kamperman, F. J. DiSalvo, U. Wiesner. Direct access to thermally stable and highly crystalline mesoporous transition-metal oxides with uniform pores. Nat. Mater. **7**, 222-228 (2008).
24. S. C. Warren, A. C. Jackson, Z. D. Cater-Cyker, F. J. DiSalvo, U. Wiesner. Nanoparticle synthesis via the photochemical polythiol process. J. Am. Chem. Soc. **129**, 10072-10073 (2007).
25. S. C. Warren, F. J. DiSalvo, U. Wiesner. Nanoparticle-tuned assembly and disassembly of mesostructured silica hybrids. Nat. Mater. **6**, 156-161 (2007).
This was highlighted by A. Balazs in Nat. Mater., News and Views, "Nanocomposites: economy at the nanoscale," **6, 94-95 (2007).
26. S. C. Warren, M. J. Banholzer, L. S. Slaughter, E. P. Giannelis, F. J. DiSalvo, U. Wiesner. Generalized route to metal nanocrystals with liquid behavior. J. Am. Chem. Soc. **128**, 12074-12075 (2006).
This was highlighted in Science, Editor's Choice, "Flowing precious metals," **313, 1542 (2006).
27. C. Roychowdhury, F. Matsumoto, V. B. Zeldovich, S. C. Warren, P. F. Mutolo, M. Ballesteros, U. Wiesner, H. D. Abruña, F. J. DiSalvo. Synthesis, characterization, and electrocatalytic activity of PtBi and PtPb nanoparticles prepared by borohydride reduction in methanol. Chem. Mater. **18**, 3365-3372 (2006).

PATENTS

1. S. C. Warren, Y. Yan, B. A. Grzybowski. Nanoparticle electrides. Patent pending, 2013.
2. S. C. Warren, F. J. DiSalvo, U. Wiesner. Ordered metal-rich mesostructures from nanoparticle-block copolymer self-assembly. Patent pending, 2009.
3. S. C. Warren, F. J. DiSalvo, U. Wiesner. Sol-gel precursors and synthesis of functionalized nanostructures. Patent pending, 2008.

LECTURES

1. S. C. Warren, M. R. Perkins, A. M. Adams, M. Kamperman, A. Burns, H. Arora, E. Herz, T. Suteewong, H. Sai, Z. Li, J. Werner, J. Song, U. Werner-Zwanziger, J. Zwanziger, M. Grätzel, F. J. DiSalvo, U. Wiesner. A silica sol-gel design strategy for nanostructured metallic materials. Spring MRS meeting in San Francisco, CA, 2013.
2. S. C. Warren, Y. Yan, B. Grzybowski. Nanoparticle electrides. Spring MRS meeting in San Francisco, CA, 2013.
3. S. C. Warren, Y. Yan, B. Grzybowski. All-metal nanoparticle electronics. Spring MRS meeting in San Francisco, CA, 2013.
4. S. C. Warren, K. Voïtchovsky, C. Leroy, M. Cornuz, F. Stellacci, C. Hebert, A. Rothschild, M. Grätzel. Identifying champion nanostructures for solar water splitting. Spring MRS meeting in San Francisco, CA, 2013.
5. S. C. Warren, K. Voïtchovsky, C. Leroy, M. Cornuz, F. Stellacci, C. Hebert, A. Rothschild, M. Grätzel. The impact of nanoscopic grain boundaries on charge transfer at the semiconductor/electrolyte interface. Spring MRS meeting in San Francisco, CA, 2013.
6. S. C. Warren, M. R. Perkins, A. M. Adams, M. Kamperman, A. Burns, H. Arora, E. Herz, T. Suteewong, H. Sai, Z. Li, J. Werner, J. Song, U. Werner-Zwanziger, J. Zwanziger, M. Grätzel, F. J. DiSalvo, U. Wiesner. A silica sol-gel design strategy for nanostructured metallic materials. Fall MRS meeting in Boston, MA, 2012.
7. All-metal nanoparticle electronics. S. C. Warren, Y. Yan, B. Grzybowski. Fall MRS meeting in Boston, MA, 2012.
8. S. C. Warren. Nanoparticle electrides. Invited presentation at the University of Oxford, United Kingdom, 2012.
9. S. C. Warren. Nanoparticle-based materials for sustainable energy. Invited presentation at the University of Cambridge, United Kingdom, 2012.
10. S. C. Warren, K. Voïtchovsky, H. Dotan, F. Stellacci, C. Hebert, A. Rothschild, M. Grätzel. The role of grain boundaries in champion hematite photoanodes. Fall MRS meeting in Boston, MA, 2011.
11. S. C. Warren, E. Thimsen, M. Grätzel. Impact of plasmonic nanoparticles on hematite photoanodes for solar-powered water splitting. Fall MRS meeting in Boston, MA, 2011.
12. S. C. Warren, M. Perkins, A. Adams, M. Kamperman, A. Burns, H. Arora, E. Herz, T. Suteewong, H. Sai, Z. Li, J. Werner, J. Song, U. Werner-Zwanziger, J. W. Zwanziger, M. Grätzel, F. J. DiSalvo, U. Wiesner. Generalized silica sol-gel route to porous metallic percolation networks. Fall MRS meeting in Boston, MA, 2011.
13. S. C. Warren, E. Thimsen, M. Grätzel. Plasmonic near-field and scattering effects in Au/Fe_2O_3 nanocomposite electrodes. Challenges in Renewable Energy conference at MIT in Cambridge, MA, 2011.
14. S. C. Warren. Nanoparticle-based electrodes for sustainable energy. Invited presentation at the Technion-Israel Institute of Technology in Haifa, Israel, 2011.
15. S. C. Warren, E. Thimsen, F. Le Formal, M. Grätzel. Plasmon-based energy transfer in Au/Fe_2O_3 photoelectrodes for water splitting. Fall MRS meeting in Boston, MA, 2010.
16. S. C. Warren, M. Grätzel. Mesoscopic α-iron oxide for water photoelectrolysis. Spring MRS meeting in San Francisco, CA, 2010.
17. S. C. Warren, F. J. DiSalvo, U. Wiesner. An ordered mesoporous metal from nanoparticle-block copolymer self-assembly. APS March meeting in Portland, OR, 2010.
18. S. C. Warren. Writing a FP-7 proposal: maximizing your chances for success. EPFL, 2009.

19. S. C. Warren, H. Sai, U. Wiesner. An ordered mesoporous metal from nanoparticle-block copolymer self-assembly. First International Conference on Multifunctional, Hybrid, and Nanomaterials. Tours, France, 2009.
20. S. C. Warren, K. Sivula, M. Grätzel. Hematite photoanodes for water photoelectrolysis. Invited presentation at the fall MRS meeting in Boston, MA, 2008.
21. S. C. Warren, K. Sivula, M. Grätzel. IEA-HIA update: hematite photoanodes. Invited presentation at the DOE hydrogen working group meeting in Honolulu, HI, 2008.
22. S. C. Warren, F. J. DiSalvo, U. Wiesner. Fuel cell electrodes from nanoparticle-block copolymer self-assembly. European Science Foundation Conference on Nanotechnology for Sustainable Energy. Obergurgl, Austria, 2008.
23. U. Wiesner, S. C. Warren, F. J. DiSalvo. Assembly and disassembly of polymer nanoparticle composites. Spring ACS meeting in New Orleans, LA, 2008.
24. S. C. Warren, F. J. DiSalvo, U. Wiesner. Synthesis, properties, and self-assembly of metal nanoparticle-based ionic materials. Invited presentation at the Polymer Outreach Program, Cornell University, 2007.
25. S. C. Warren, F. J. DiSalvo, U. Wiesner. Self-assembly of mesostructured electrode architectures. Invited presentation at the Fuel Cell Symposium, Cornell University, 2007.
26. S. C. Warren. Self-assembly approaches to fuel cell electrodes. Invited presentation at the Wentink Award symposium, Cornell University, 2007.
27. S. C. Warren. The assembly and disassembly of catalytic nanoparticle architectures. Invited presentation at EPFL, 2006.
28. S. C. Warren, F. J. DiSalvo, U. Wiesner. The influence of nanoparticle characteristics on the assembly and disassembly of nanoparticle-block copolymer mesostructured hybrids. Fall meeting of the MRS in Boston, MA, 2006.
29. S. C. Warren, M. J. Banholzer, L. S. Slaughter, F. J. DiSalvo, U. Wiesner. Inducing flow in solventless metal nanoparticles via ligation of a thiol-containing ionic liquid. Fall meeting of the ACS in San Francisco, CA, 2006.
30. S. C. Warren, F. J. DiSalvo, U. Wiesner. Morphology control and anisotropic structure formation in mesostructured silica-block copolymer hybrids. Fall meeting of the ACS in San Francisco, CA, 2006.
31. S. C. Warren, M. R. Perkins, F. J. DiSalvo, U. Wiesner. General route to metal-silica-block copolymer mesostructured hybrids with high metal loadings. Fall meeting of the ACS in San Francisco, CA, 2006.
32. S. C. Warren, F. J. DiSalvo, U. Wiesner. Nanoparticle-tuned assembly and disassembly of mesostructured silica hybrids. Cornell Center for Materials Research Postdoc/Grad Symposium, 2006.
33. S. C. Warren, F. J. DiSalvo, U. Wiesner. Assembly and disassembly of catalytic nanoparticle architectures. Cornell Chemistry Graduate Summer Symposium, 2006.
34. S. C. Warren, F. J. DiSalvo, U. Wiesner. Disassembly of block copolymer-silica nanoparticle hybrids. U.S.-Japan Nanohybrids Workshop in Monterey, CA, 2006.
35. S. C. Warren, F. J. DiSalvo, U. Wiesner. Block copolymer-nanoparticle hybrids: size-dependent assembly. New York Complex Matter Workshop, Syracuse University, 2005.
36. S. C. Warren, F. J. DiSalvo, U. Wiesner. Development of a generalized ligand chemistry for the synthesis of nanoparticle-based catalysts. Cornell Chemistry Graduate Summer Symposium, 2005.
37. S. C. Warren, M. J. Banholzer, A. C. Jackson, F. J. DiSalvo, U. Wiesner. Size-induced demixing of nanoparticles from block copolymers. Fall meeting of the ACS in Washington, DC, 2005.
38. S. C. Warren, F. J. DiSalvo, U. Wiesner. Towards a nanostructured fuel cell electrode. Cornell Center for Materials Research Postdoc/Grad Symposium, 2005.

39. S. C. Warren, F. J. DiSalvo, U. Wiesner. One-pot synthesis approaches to reformer catalysts and fuel cell electrode materials. Fall meeting of the MRS in Boston, MA, 2004.

FUNDED RESEARCH PROJECTS

1. "Nanostructured Photoelectrodes for Energy Conversion"; S.C. Warren (author, work package leader), €4,000,000, EPFL, 2009-2011.