Curriculum Vitae

Dr. Li-Qiong Wang

Department of Chemistry
Brown University,
Providence, RI 02912
(401) 863-2844
Li_Qiong_Wang@brown.edu

Education

B.S. in Chemistry, Wuhan University, China, August 1982
Ph.D. in Chemistry, University of California, Berkeley, CA, June 1991

Professional appointments

July 2021 – Present	Teaching Professor, Department of Chemistry, Brown University
July 2015 – July 2021	Senior Lecturer, Department of Chemistry, Brown University
Jan. 2010 – June 2015	Lecturer, Department of Chemistry, Brown University
Jan. 2005 – Dec. 2009	Chief Scientist, Division of Fundamental Science, Pacific Northwest National Laboratory
Jan. 2003 – Dec. 2009	Adjunct Associate Professor, Materials Science Program, Washington State University
Mar. 1993 – Dec. 2004	Senior Research Scientist, Material Science Department, Pacific Northwest National Laboratory
Oct. 1991 – Jan. 1993	Research Chemist, Chevron Chemical Company

Awards and Recognitions

- R&D 100 Awards (1998).
- Discover Magazine Awards Finalist (1998).
- DOE Materials Science Award (1998).
- Pacific Northwest National Laboratory Environmental Health Science Division Outstanding Performance Award (2000).
- Pacific Northwest National Laboratory Outstanding Team Performance Award (2000), "Low K Mesoporous Dielectrics."
- Pacific Northwest National Laboratory Outstanding Team Performance Award (2001), "Development of a Commercially Viable NTP-Catalyst NO_x Reduction Technology."
- Pacific Northwest National Laboratory Energy Science and Technology Directorate Outstanding Performance Award for Outstanding Research Progress Funded by the Office of Basic Energy Sciences (2002).
- Pacific Northwest National Laboratory Energy Science and Technology Directorate Outstanding Performance Award for "Design, Synthesis, and Characterization of Solution Templated Nanoarchitectured Materials" (2003).
- Exceptional Contribution Award (2003).
- Pacific Northwest National Laboratory Energy Science and Technology and Fundamental Science Directorate Outstanding Performance Award for Outstanding Project Research-DOE Basic Energy Sciences (2004).
- Pacific Northwest National Laboratory Energy Science and Technology and Fundamental Science Directorate Outstanding Performance Award for "developing and implementing ^{129}Xe NMR spectroscopy at PNNL (2008).

- Sheridan Teaching Fellow AY 2012-2013
- Program Co-Program Chairs for the American Chemical Society National Meeting in Chemical Education Division (Fall 2019 and 2021).
- Nominated for the Philip J. Bray Award for Excellence in Teaching in the Physical Sciences
- Nominated for Excellence in Research Mentoring Award (for mentor on UTRA students)

Teaching and Advising

Courses Taught

Chem. 2870 Graduate Colloquium Course
(This is the course to prepare 1st year graduate students to successfully complete their doctoral degrees in chemistry and have great careers in science)
Spring 2020, Spring 2021, Spring 2022, Spring 2023, Fall 2023, Spring 2024
Enrollment: 11-29

Chem. 0999 Chemistry and Art
(This is a newly created inquiry and case-study based course where class discussions, lectures, hands-on activities, writing assignments, research projects, and final paper/presentation are integrated into this one course that intersects chemistry and art)
Fall 2019, Fall 202, Fall2023, Fall 2024
Enrollment: 12-16

Chem. 0330 Introductory Chemistry Course, Instructor
(2 lectures per week)
Spring 2023
Enrollment: 180

Chem. 0330 Introductory Chemistry Laboratory Courses-Fall, Laboratory Instructor
(2-3 hr Prelab lecture, 4 hr Lab and 23-30 lab sections per week)
Fall 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2024
Enrollment: 330-490, Teaching Assistants: 20-30

Chem. 0330 Introductory Chemistry Laboratory Courses-Spring, Laboratory Instructor
(2-3 hr Prelab lecture, 4 hr Lab and 13-16 lab sections per week)
Spring 2010, 2011, 2012, 2013, 2014, 2015, 2017, 2018, 2019, 2020, 2021, 2022, 2024
Enrollment: 160-260, Teaching Assistants: 11-20

Chem. 0400 Bioinorganic Laboratory Course, Laboratory Instructor
Spring 2012, Spring 2013, Spring 2014, Spring 2015, Spring 2017
Enrollment: 50, Teaching Assistants: 3

Chem. 0500 Inorganic Laboratory Course, Laboratory Instructor
Spring 2018, Spring 2019
Enrollment: 45-56, Teaching Assistants: 1-3

Chem 0100 Introductory Chemistry Conferences
Fall 2018

Enrollment: 33

Chem. 0970 Independent Study, Undergraduate Research Supervisor
Spring 2013, Fall 2013, Spring 2018, Fall 2018, Spring 2019, Fall 2019, Spring 2020, Fall2020, Spring 2021, Spring 2022, Spring2024

Chem. 0330 Introductory Chemistry, Guest Lecturer in Electrochemistry/Fuel Cell
Since Spring 2010
Enrollment: 420 (Fall semesters), 200 (Spring semesters)

Chem 0100 Introductory Chemistry, Guest Lecturer
Fall 2018
Enrollment: 120

CLPS0050W Color in World, Guest Lecturer
Spring 2019, Spring 2020

THAD-H654-01 The Use and Sustainability Of Artist Materials
Guest Lecturer on "Chemistry, Plastics and Art"
Spring 2022, RISD

Undergraduate Academic Advisor at Brown University

Spring 2010 (6 freshmen, 1 sophomore), Fall 2010 (6 freshmen, 1 sophomore)
Spring 2011 (6 freshmen, 6 sophomores), Fall 2011 (6 freshmen, 5 sophomores)
Spring 2012 (6 freshmen, 5 sophomores), Fall 2012 (6 freshmen, 6 sophomores)
Spring 2013 (6 freshmen, 6 sophomores), Fall 2013 (6 freshmen, 5 sophomores)
Spring 2014 (5 freshmen, 6 sophomores), Fall 2014 (6 freshmen, 5 sophomores)
Spring 2015 (6 freshmen, 6 sophomores), Fall 2015 (6 freshmen, 5 sophomores)
Spring 2016 (6 freshmen, 6 sophomores), Fall 2016 (6 sophomores)
Fall 2017 (6 freshmen)
Spring 2018 (6 freshmen, 6 sophomores), Fall 2018 (6 freshmen, 6 sophomores)
Spring 2019 (6 freshmen, 6 sophomores), Fall 2019 (6 freshmen, 6 sophomores)
Spring 2020 (6 freshmen, 6 sophomores), Fall 2020 (5 freshmen, 6 sophomores)
Spring 2021 (5 freshmen, 5 sophomores), Fall 2021 (5 freshmen, 5 sophomores)
Spring 2022 (4 freshmen, 5 sophomores), Fall 2022 (5 freshmen, 4 sophomores
Spring 2023 (5 freshmen, 5 sophomores), Fall 2023 (6 freshmen, 2 sophomores)
Spring 2024 (6 freshmen, 3 sophomores), Fall 2023 (6 freshmen, 3 sophomores)

Undergraduate Research and Teaching Advisor at Brown University

Summer 2010/Fall 2010 (UTRA, Kristina Klara, sophomore)
Summer 2011/Fall 2011 (UTRA, Ning Hou, Sophomore)
Summer 2012/Fall 2012 (UTRA, Allison Lawman, Sophomore)
Spring 2013 (Research, Allison Lawman, Sophomore)
Spring 2013 (Research, Samuel Moore, Freshman)
Fall 2013 (Research, Marjorie Palmeri, Senior)
Fall 2013 (Research, Patrick Lynch, Sophomore)
Spring 2014 (Patrick Lynch, Sophomore, Gregory Lowry, freshman)
Summer 2014/Fall 2014 (UTRA, Patrick Lynch, Gregory Lowry)

Summer/Fall 2015 (Research, Natalie Tarr, a master student in education)
Summer/Fall 2015 (UTRA: Ileana Pirozzi)
Spring 2017 (UTRA: Dana Rubenstein)
Summer 2017 (UTRA: Will Patterson)
Fall 2017 (UTRA: Dana Rubenstein, Will Patterson, Sophomore)
Fall 2017 (Zern Endowed Teaching grant, Iris Peng, Sophomore)
Fall 2017 (Research Volunteered for Art and Chemistry, Jolie Ren, Natasha Richmond, Thaouyen Pham, Freshmen, Isabella Lovelace, Sophomore)
Spring 2018 (UTRA, Iris Peng, Isabella Lovelace, Sophomore)
Spring 2018 (Independent Research: Rio Matthew (RISD), Sophomore, Jolie Ren, Freshmen)
Summer 2018 (UTRA: Iris Peng, Isabella Lovelace, Sophomore)
Fall 2018 (UTRA: Iris Peng, Junior; Isabella Lovelace, Junior; Tiffany Lin, Sophomore)
Spring 2019 (UTRA: Jolie Ren, Sophomore)
Spring 2019 (Independent Research: Rio Matthew (RISD), Junior; Tiffany Lin, Sophomore; Volunteer: Iris Peng, Junior; Isabella Lovelace, Junior)
Summer 2019 (UTRA: Jolie Ren, Sophomore, Carlos Perez-Ruiz)
Fall 2019 (Independent Research: Isabella Lovelace; Volunteer Research: Rio Matthew, Senior; Iris Peng, Senior)
Spring 2020 (Independent Research: Laura Perlmutter, Sophomore; Iris Peng, Senior; Volunteer Research: Rio Matthew, Senior; Noah Bronowich, Sophomore, Tiffany Lin, Junior)
Summer 2020 (UTRA: Laura Perlmutter, Noah Bronowich; SPRINT Award: Matthew Vigilante; Jake Ruggiero; Volunteer Research**:** Habesha Petros)
Fall 2020 (UTRA: Laura Perlmutter, Junior; Noah Bronowich, Junior; Independent Research: Habesha Petros, Junior, Jolie Ren, Senior)
Spring 2021 (Jolie Ren, Independent Research)
Fall 2021 (Research Volunteers: Laura Perlmutter, Noah Bronowich, Selena Kiu, Emma Bradley)
Spring 2022 (Research Volunteers: Ethan Epstein, Sophomore; Chelyn Park, Sophomore; Independent Research: Ariyaporn Haripottawekul, Sophomore)
Spring 2023 (Independent Research: Ariyaporn Haripottawekul and Kiley Haberkorn)
Summer 2023 (UTRA: Ariyaporn Haripottawekul, Sydney Chon, Jenny Shan)
Fall 2023 (Independent Research: Sam Klemen, Lyric Johnson, Volunteer: Alexandra Coia, Jackson Ruddick)
Spring 2024 (Independent Research: Ethan Epstein, Jackson Ruddick, Sam Kelemen, Lyric Johnson; Volunteer: Ishan Khurana)
Fall 2024 (UTRA: Jackson Ruddick, Sam Kelemen, Volunteer: Ishan Khurana, Huyen Nguyen)

<u>Undergraduate Independent Concentration Principal Advisor</u>
Sydney Chon (from Fall 2023 -)

<u>Undergraduate Thesis Advisor</u>
Senior Thesis Advisor for Jolie Ren (Graduated on Dec. 2021)

<u>Undergraduate Brown RISD Dual Degree (BRDD) Capstone Advisor</u>
Jake Ruggiero (Fall 2021-Spring 2022)

Graduate Student Advisor for Curriculum Development at Brown University

Fall 2011 (Chao Gong, Chem. 0330)
Spring 2012 (Liheng Wu, Chem 0330; Qi Wang, Chem. 400)
Fall 2012 (Xinxin Cheng, Chem 0330)
Fall 2013 (Danielle Rand, Chem 0330; Sally Ho, Chem. 400)
Spring 2014 (Danielle Rand, Chem 0330)
Fall 2014 (James Budarz, Chem 0330)
Spring 2015 (Frank Schunk, Chem 0330; Kevin Sterling, Chem 400)
Fall 2015 (Frank Schunk, Chem 0330)
Spring 2018 (Hanjun Yang, Chem. 500)
Spring 2019 (Len Leonard W. Sprague, Chem 0330)
Fall 2019 (Junyu Wang, Katie Hills-Kimball, Chem 0999)

Graduate Teaching Assistant Training

Spring semesters: 7-10 for Chem 0330 (2010-present), 2-4 for Chem 500 (2018-2019)
Fall semesters: 11-14 for Chem 0330 (2010-present), 1 for Chem 0999 (2019)

Director of Graduate Study

Fall 2016 (9 first-year graduate students); Spring 2017 (9 first-year graduate students), Fall 2017 (17 first-year graduate students)

Services /Outreach/Activities

- Committee Member on Computing in Chemical Education of American Chemical Society (CCCE) (Jan. 2024 – present)
- Academic Member of the Athens Institute for Education and Research (Spring 2024 - present)
- Program Co-Program Chair for the Fall 2019 ACS National Meeting in Chemical Education Division
- Program Co-Program Chair for the Fall 2021 ACS National Meeting in Chemical Education Division
- Symposium Presider for the Fall 2019 and Fall 2021 ACS National Meetings in Chemical Education
- Mentor for National Chemistry Women Mentorship Network involving women faculties across the country (Chem WMN) (Fall 2017 – present).
- Presenters for two workshops, "Science and Art" at the Conference for Undergraduate Women in Physics (CUWIP 2023) at Brown University, Jan 21, 2023.
- Program committee member for the Division of Chemical Education of American Chemical Society (Jan. 2015 – Dec.2023)
- College Curriculum Council (CCC) Member (Spring 2014-Spring 2017, Fall 2019-Fall 2023).
- Junior Faculty Mentor (Fall 2021 -
- Independent Concentration Adviser (Fall 2023-)
- Independent Study Committee Member (reviewing 30-40 course proposals per academic year), Fall 2019-present
- Chairs for opening and planetary Sessions at the 26th Assembly of Advanced Materials Congress, Stockholm, Sweden, June 10-13, 2019.
- Symposium organizer/chair for Biennial Conference on Chemical Education, July 2018

- Symposium organizer/chair for Biennial Conference on Chemical Education, July 2020 (Cancelled due to Covid-19)
- Director of Graduate Study for Chemistry (Fall 2016 – Spring2018).
- Mentor for a Junior faculty organized by FOC (Faculty of Color), 2018-present
- Women of Color, faculty representative, April 16, faculty club, 2018.
- Member of Independent Concentration (reviewing 30-40 proposals per academic year) Spring 2014-Spring 2017.
- Symposium Presider for the Fall 2019 and Fall 2021 ACS National Meetings in Chemical Education Division.
- Brown University STEM day for high school. Held two sessions of "Chemistry and Color" workshop. March 26, 2024.
- Judge for Rhode Island Science and Engineering Fair, March 13, 2021.
- Led one breakout session for the 2020 Brown STEM day, Jan 21, 2020
- Advisor for DUG (departmental undergraduate group) (Fall 2014-Spring 2016)
- Panelists and speakers for the DUG events (Aug. 24, Oct. 17, 2020)
- Ad-Hog committee member for curriculum development (Fall 2011-present)
- Departmental Committee member for curriculum development (Fall2012-present)
- Volunteer for helping Brown students tutoring local high school students (2012)
- Volunteer for the minority prospective student's recruitment (10/22/2011, 4/15/2012)
- Seminar leader for the freshman first-book discussions (Fall 2010-present)
- Invited to be in the panel discussion for "Women in STEM at Brown University." (11/16/2012)
- Invited speaker for the undergraduate research organized by WISE (women in science and Engineering) at Brown (Nov. 20, 2013).
- Presented seminars for recruiting undergraduate students into the Brown Ph.D. program (10/17/2014, Clark University, Worcester, MA)
- Invited speaker for WISE (women in science and Engineering) at Brown on the importance of finding a faculty mentor (Oct. 8, 2014, Feb. 23, 2017, Nov. 29, 2017).
- Faculty moderator for prospective students, Chemistry Department, Brown University, April 19, 2017, April 27, 2018.
- Faculty facilitator for faculty-student mixer organized by Brown/RISD AAPI (Asian American Pacific Islander), Oct. 25, 2017.
- Invited speaker for Research Immersion Day organized by Brown Science Prep to Expose the local high school students to "real life" scientists doing interesting work in STEM fields, at Brown University (Dec. 5, 2015)
- Chemistry department representative for language evaluations of incoming graduate students (Spring 2010-present)
- Invited to attend the Brown International Student Organization events
- Participating in "Science Friday" for improving undergraduate teaching
- Participating in Sheridan Teaching Certificate I and Teaching fellow programs (Fall 2012, Spring 2013)
- Section Chair, 2012 DOE EPSCoR Symposium, Brown University, June 1, 2012.
- Invited to attend the U.S. Department of Energy's Vehicle Technologies Program 2013 Annual Merit Review and Peer Evaluation Meeting, May 13-17, 2013.
- Invited to speak as one of two brown faculty representatives at the meeting for

"Welcoming New Chinese Students to Brown," organized by Brown CSSA, Beijing, China, July 26, 2013.

Curriculum Development and Practice

Created and implemented many new course materials and lab modules consisting of lab manuals, prelab questions/answers, lab report and report keys, and quizzes and quiz keys.

- Introduced a lab module "How Can Eleven Colorless Solutions be Chemically Identified?" to over 600 Chem. 0330 students per academic year starting fall 2010. To encourage critical thinking skills, I created inquiry-based prelab/lab report questions and asked students to design their own procedures.
- Produced a new instructional video for the lab technique demonstration for the experiment on "How Can Eleven Colorless Solutions be Chemically Identified?" and introduced the video to over 600 Chem. 0330 students per academic year starting spring 2010.
- Developed a new lab module, "Chemical Reaction and Stoichiometry: Which Method of Recovering Product from a Precipitation Reaction gives a More Accurate Result?" and introduced to over 600 Chem. 0330 students per academic year starting spring 2011.
- Redesigned the lab module "How Can Thermodynamic Values be Determined from the Solubility of a Salt" by adding a new ice pack activity and more efficient lab procedure in fall 2011 and introduced to more than 600 Chem. 0330 students per academic year starting spring 2012.
- Developed a new lab module, "What are the Factors Controlling the Equilibrium of Cobalt Complex Ions?" (Cl^- based, green chemistry procedures) in fall 2011 and introduced to over 600 Chem. 0330 students.
- Developed a new lab module, "How Can We Use a Hydrogen Fuel Cell to Generate Clean Energy and Connect Chemistry to the Real World?" in Sept, 2011 and introduced to over 600 Chem. 0330 students starting spring 2012. This work was published in Journal of Chemical Education.
- Produced a new instructional video demonstrating the fuel cell car technology for the fuel cell lab and introduced to over 600 students per academic year starting fall 2011.
- Developed and implemented a new computational lab activity module, "3D Modeling of Molecular Structures," to over 400 Chem. 0330 students since fall 2013. This activity not only makes a close connection with the lecture materials on Lewis structure and VSEPR theory, but also allows students to verify their predictions with a free 3D visualization software, exposing students to the computational chemistry.
- Developed new "green" and efficient lab procedure for the alcohol based cobalt complex ion experiment: "Exploring Le Chatelier's Principle: What Factors Control the Equilibrium of Cobalt Complex Ions?" in summer 2012 and implemented successfully in spring 2013.
- Redesigned the "Iron Loading into Transferrin" lab and introduced to the Chem. 40 class in spring 2014. We made this lab affordable by significantly cutting down the amount and cost of the materials used per student by replacing human serum transferrin with bovine serum transferrin and using a much smaller cuvette for the measurements.
- Developed a new lab module," How is Acid Rain Neutralized in Nature? This new lab module not only correlates well with the lecture materials, but also introduces environmental science into the introductory chemistry. This was introduced to a group of 22 students in spring 2014 and has been successfully implemented to over 350 students since fall 2014. The experiment was well received. This work was published in Journal of

Chemical Education.

- Created a new video combining the animation with the student's demonstration for the acid rain lab in summer 2014. This type of video for the undergraduate teaching is novel and was published along with the manuscript on the acid-rain lab in Journal of Chemical Education.
- Created a video that helps students to get familiar with the lab techniques and introduces them the sources of errors associated with the lab devices and measurements. This video has been posted online and students can watch it anytime before the laboratory.
- Developed and implementing a new lab module, "Experimental Error Analysis: Heat Capacity of Unknown Metal and Recovering Reaction Products" in fall 2015. It is important for students to understand that all measurements are subject to uncertainties and nothing can be measured exactly. Two engaging lab activities helped students to increase the awareness of errors associated with experimental measurements and to build the basic lab skills in the beginning of the semester. This lab has been successfully implemented to the Chem. 330 courses of over 600 students per academic year since fall 2015. It has been proven effective and well received.
- Developed and successfully implemented a new lab module, "Explore Wave Mechanics Principles at Mesoscopic and Macroscopic Levels Through Hands-on Chemistry Laboratory Activities" in fall 2015 for a makeup lab. We have created new lab manual, prelab question/answers and lab report/keys and built a home-made frequency generator. The goal of this lab was to explore wave mechanics, and therein quantum mechanics, principles at the macroscopic and mesoscopic levels through hands-on activities involving bubble membranes and nanoparticles respectively. The observation of wave mechanics at the macroscopic level provides students with an intuition that aids in the understanding of wave mechanical principles governing phenomenon at mesoscopic level.
- Developed and successfully implemented a novel engaging laboratory "Origin of Color", relating the chemistry concepts (i.e. quantum mechanics, molecular structure, bonding, and orbital theory) to color and art, stimulating students' interest in learning. Three major categories of color materials that exhibit color by absorbing light—are explored. These materials include nanoparticles, organic dyes, and metal complexes (metal salts in aqueous solution). Though the selected materials can produce visually similar colors, this occurs through different microscopic processes that are responsible for the colors observed in medieval stained glass, dye fabric, and gemstones, respectively. In this laboratory, students synthesize silver nanoparticles of different shapes and sizes in addition to identifying unknown colorful solutions made of metal complexes and organic dyes. This lab is highly desirable since there are no prior "wet" labs available that correlate with these rather difficult concepts covered in the lecture in an early semesters of the introductory chemistry sequence. This laboratory excites students with basic chemistry backgrounds about complex chemistry concepts such as nanoparticles and molecular orbitals by highlighting the connections to the origin of colors in art and everyday life. Student's feedbacks are very positive. This work was published in Journal of Chemical education.
- Developed and successfully implemented a new undergraduate lab, "Manganese-doped Lead-Halide Perovskite Quantum Dots – A Simple Synthesis Illustrating Optoelectronic Properties of Semiconductors" for Chem. 500 of 45, and 56 students in Spring 2018 and 2019. In this lab, uniform Mn-doped lead-halide perovskite QDs with bright dual-color photoluminescence are synthesized by students using a simple preparation setup. In addition to a vivid presentation of the state-of-the-art perovskite technology, the results from the laboratory provide students with tangible understanding of several important concepts in inorganic chemistry, including ligand field theory, energy band theory, electron

magnetic resonance, transition metal complexes, and quantum confinement. This experiment combines cutting-edge technology with lab-scale practice to offer students thorough understanding of nanochemistry and quantum phenomena. Student's feedbacks on this lab were very positive. This work was published in Journal of Chemical education.

- Developed and successfully implemented a novel and engaging experiment "Exploring Chemical Equilibrium for Alcohol-Based Cobalt Complexation Through Visualization of Color Change and UV-Vis Spectroscopy" since spring 2018. The octahedral to tetrahedral (pink to blue) cobalt complex transition generates vivid visualizations, increasing students' interest in learning. The equilibrium constants can be measured using UV-vis absorption spectroscopy and the Beer-Lambert law. Vast differences in molar absorptivity coefficients between octahedral and tetrahedral geometries of cobalt complexes prompt discussions on absorptivity, orbital splitting, and color change under the purview of learning Le Châtelier's principle. Additionally, the experimental results regarding the equilibrium constant allowed students to examine possible mechanistic pathways. Student responses to conducting the experiment were positive, most notably because this experiment encouraged them to analyze their experimental results critically and propose possible reaction mechanisms and equilibrium expressions while appreciating the sharp color transition that the complexation equilibrium undergoes. This work was published in Journal of Chemical Education.
- Created several case studies for Chemistry and Art course. For example, under the art conservation chapter, we focus on the case study of the Statue of Liberty. After arriving in the US as a copper statue, the Statue of Liberty turned into the iconic patina that is famously known for, due to the chemical reaction of copper with the atmosphere and saline air. However, the same forces that gave it a beautiful verdigris also threatened to corrode its structure. The preservation efforts that were enacted to save the statue are of both chemical and artistic consequences, and are accessible to students of beginning chemical knowledge. We used this case study as a branching point to talk in depth about acid base chemistry, electrochemistry, organometallic reactions, and other conservation methods.
- Implemented case-study and inquiry-based approaches in teaching of chemistry and art course. Prior to the class, students are required to read several journal articles and other references on the case study topics. They are asked to submit short responses to the questions posted by the instructor and come up with a few new questions related to their readings prior to each class. In class, students are encouraged to use their critical thinking to inquire about their literature reading through group discussions. In addition, through the lab activities and classroom teaching, students need to write two case studies of their own at the end of the semester.
- Created and successfully taught a new Chemistry and Art course where inquiry and case study-based class discussions, lectures, hands-on activities, writing assignments, research projects, and final papers/presentations are integrated into the one course. Chemistry and Art is an interdisciplinary course that explores different chemical concepts and techniques through the lenses of art and art history. The topics covered include paint and painting (pigments, dyes, and binders); stained glass; pottery and porcelains; gemstones and jewelry; color and art conservation. The class consisted of students from different academic backgrounds ranging from art, history, literature to science. Students were able to synthesize the paint pigments, painting them on canvas, and making patina and ceramic art objects. They were also exposed to many analytical techniques enabling them to research on surprising results from their hands-on activities. At the end of semester, students were able to come up two new case studies exploring the chemical principles behind the art.

Students feedback are very positive. This course helps them built critical thinking, writing, communication and analytical skills.

- Created and implemented a novel lab activity, "exploring the colors and their origins of copper-containing ceramic glazes for the Chemistry and Art course. Students were able to make their own glazes using their synthesized pigment and create small ceramic art objects. Some of them put their ceramic objects into the necklaces and key chains. They also wrote essays exploring the role of pigment in controlling the color in ceramic glazes and relate to the history of art in ceramics. A suite of XRD, EPR and FIIR techniques were introduced through the facility visit and case study readings. Students feedback are very positive. Students found that ceramic activity was interesting because they got to create art objects with their own hands and use different glazes. It was really fascinating for students to see how the glazes went from being indistinguishable to being very different once they were fired. This work will result in one publication.
- Created and implemented a novel lab activity on paint and painting for the Chemistry and Art course. Students were able to synthesize their own paint and make artistic paining of their favorite scenes using their synthesized blue paint along several other commercial paint. A week later, students were led to observe their painting and shocked by noticing that their painted blue sky or water turned into sage green. They realized that the blue pigment mixed with the oil binder changed color while the paint made with the water based binder did not change. This surprising finding led a semester long research and writing projects. Students were guided to use different analytical tools including XRF, EPF, SEM and XRD to explore the mechanism of the color change. At the end of semester, based on the research data and class discussion, students were able to write a final case study paper describing 1) how the color change influences the aesthetics of their paintings, 2) how the observed phenomenon relates to the color fading/change in history of art and the artist's practice, and 3) what are the chemical principles behind the color change. Students feedbacks on this activity are very positive. They thought this was a perfect activity combining art and chemistry in practice. They liked how they were not told what happened with this blue paint activity, which strengthened their critical thinking skill. They felt it was a very effective way to learn how to analyze and interpret the results of experiments and solve a problem one step at a time throughout the semester. This work will result in two publications.
- Created several full length prelab lecture videos to better prepare general chemistry students for their laboratory experiments and to help them to understand the principles behind the experiment. Due to the different lecture sections, the lab and lecture are often not synchronized. The online prelab lecture videos helped students to learn the materials that are not covered by the in-class lecture and to see close-up experimental setups. We also make sure that the video is engaging by asking questions to the pretended "student audience" (our camera crew member) and by injecting some humors into the lecture to grab student's attention. Students' feedbacks are very positive. Students commented that the online prelab lectures were informative and engaging. Students were able to pause and rewind to make sure they understand concepts correctly before moving on. In addition, they felt that they were well prepared for the contents that are not covered in the lecture. Based on the end of semester survey, overwhelming number of students (> 80%) prefer all online prelab lectures.
- Created novel interactive videos in summer 2019 to help our general chemistry students to visualize the experimental setups and procedures. These short laboratory videos have built-in interactive components that supplement the lab manuals by allowing student to "play" with the experimental setup through multiple choice games, along with images of

appropriate tools. The videos were filmed in first person-perspective using several different cameras such as GoPro to put students in the experimenter's shoes, as well as bird's-eye view and side view, allowing students to engage with the virtual experiments. Interactive questions emphasize lab procedure and safety. There have been some short lab videos used in other undergraduate labs. However, none has built in interactive components like ours. Our novel approach was made possible through numerous hours of our hard work and the collaboration with the media production staff. Based on the student's feed backs, these videos have been proven very effective in helping them to visualize the experimental setup and procedures, enhancing their learning and enjoyment. They asked for more such videos to be produced in the future. This work will result in one publication.

- Created and implemented a lab module "Conjugated Systems and Colors" in Fall 2019 for the Chem 0330 course. This is a novel lab combining the theoretical calculations with the experimental measurement of "wet" chemical solutions. The free online cross-platform modeling software, Avogadro3 was used to visualize the theoretical molecular orbitals in conjugated systems and obtain the energies between HOMO and LUMO molecular orbitals for a series of long chain molecules. In addition, students took the UV-vis absorption spectra for different colored solutions made of bromothymol blue at different pH conditions and β-carotene. In their lab reports, students were asked to estimate the HOMO and LUMO energy gap using a particle in a box model and compare with the theoretical calculated values. Students were able to understand the relationship between the HOMO-LUMO gap and the degree of conjugation. The PH effect on the color and the degree of the conjugation were also explored.
- Created several animated and novel interactive lab videos to help our general chemistry students to visualize how the experiments are conducted in a real Brown university laboratory setting for our virtual Chem 0330 lab course during the pandemic in summer 2020. These videos were produced in summer 2020 by our summer research group of five undergraduate students working together. In addition to the integrative lab videos, a short animation was incorporated into the video to engage students to learn the chemical concepts and principles behind the experiment and the analytical techniques. Regarding the impact of COVID-19, creating the videos in the lab setting itself allowed students a feeling of performing the experiments on campus, miles away from campus. Based on the student's feed backs, these videos have been proven very effective in helping them to visualize the experimental setup and procedures. With the help of these videos, the synchronized virtual lab section and interactive report, students felt they have learned a lot from our virtual lab course. Our innovative approach for making such videos will result in a publication.
- Created a new modeling activity (Fall 2020) on 3D atomic orbital visualization using a free software. This activity paired up with our 3D modeling of molecular structures helped students to visualize the atomic orbitals and to find the quantum numbers, and the number of radial and angular nodes. This activity correlates well with the lecture part of the course on quantum mechanics and is especially helpful for the virtual lab course.

- Develop new materials and activities for the course *From Molecules to Masterpieces: Chemistry's Influence on Culture and Art.* This interdisciplinary course explores the deep connections between chemistry and art within historical contexts, emphasizing cultural perspectives and chemistry's role in artistic expression. Topics include the use of color in art, chemical analysis of pigments, art conservation, ceramics, pottery, stained glass, and more. Through case studies, hands-on activities, and reflective writing assignments, students will gain a profound understanding of how chemistry has shaped creativity,

cultural identity, and artistic innovation.

- Create a training lab module at the beginning of the semester to help students to get familiar with the basic lab skills.

Grants (Past/Recent)

Curriculum Development Grants (UTRA): Total 30 UTRA Awards
Summer 2010//Fall 2010
Spring 2011/Summer 2011/Fall 2011
Spring 2012/Fall 2012
Summer 2014/Fall 2014
Summer 2015/Fall 2015
Spring 2017/Summer 2017/Fall 2017
Spring2018/Summer2018/Fall 2018
Spring 2019/Summer 2019
Spring2020/Summer 2020/Fall2020

Zern Endowed Teaching Grant
For creating a new "Art and Chemistry" course, $4000, June 2018
For creating a new "*From Molecules to Masterpieces: Chemistry Influence on Culture and Art,*" course, $3750, June 2024

DOE EPSCOR
Co-PI (renewed, Oct. 2014- Oct. 2017), 200 K/per year/per person

DOE EPSCOR
Co-PI (Oct.1 2011-2014), 200 K/per year/per person, 100 K/capital equipment

STAC (Rhode Island Science and Technology Advisory Council)
Co-PI (June 2014-June 2015), 50 K/per year

Faculty Development Grant
(June 2013, June 2018, June 2019)

DOE BES programs
Co-PI (Oct. 1-1993- Oct. 1, 2009), 300 K/per year/per person

Synergistic Activities

Dr. Li-Qiong Wang joined Brown chemistry department in Jan. 2010. Recently she has incorporated the PEM fuel cell technology into a freshmen chemistry laboratory course. She is a co-PI in the DOE EPSCoR grant for Li-ion Battery studies using solid-state NMR techniques. Her group has been constructing a state of art HP ^{129}Xe NMR polarizer that will be used to probe porosity and interconnectivity in porous electrode materials. During last 17 years working with Pacific Northwest National Laboratory (PNNL), she was a co-principal investigator in DOE Basic Energy Science Programs and has mentored several graduate

students over the course of her research career. Her expertise is in the areas of surface science (UHV, STM, AFM, TPD, XPS, EXAFS), nanostructural materials (synthesis of novel nanostructured materials) and nuclear magnetic resonances (both liquid and solid state NMR techniques). She has pioneered the use of ^{129}Xe NMR on mesoporous materials. She was also a principal investigator in the PNNL Laboratory's Directed Research and Development program in exploring novel NMR/MRI techniques for in situ diagnostics of gas and water transport in operating PEM fuel cells. She was the first to use ^{3}He MRI technique for in-situ monitoring of gas flow in an operating PEM fuel cell and quantitative mapping of H_2 fuel utilization. She and her co-workers have been developing an in-situ portable device for rapid monitoring biomass degradation processes.

Collaborators Other Affiliations

Collaborators: Pradeep Guduru (Brown University), Donghai Wang (Pen. State University), Xiaodong Zhou (South Carolina University), T. Baumann (LLNL), Mark Engelhard (PNNL), Greg Exarhos (PNNL), Kim Ferris (PNNL), Glen Fryxell (PNNL), Alex D. Li (Washington State University), Burt Lee (Clemson University), Jun Liu (PNNL), Paul Major (PNNL), Shas Mattigod (PNNL), Peter McGrail (PNNL), David McCready PNNL), Kevin Minard (PNNL), Igor Moudrakovski (NRC, Canada), Bruce Palmer (PNNL), Chuck Peden (PNNL), Peter Rieke (PNNL), John Ripmeester (NRC, Canada), William Samuels (PNNL), Yongsoon Shin (PNNL), Vish Vishwanathan (PNNL), Omar M. Yaghi (UCLA, CA).

Service to the Scientific and Engineering Committee

Member of the American Chemical Society

Materials Research Society, and American Vacuum Society

Graduate and Postdoctoral Advisors

Graduate: David A. Shirley (UC Berkeley)

Publications

122. A. Haripottawekul, E. Epstein, J. Ren, N. Bronowich, L. Perlmutter, M. Spaur, K. Sloane, G. R. Gastaldi, L-Q. Wang, "Innovative Approaches for Student-Led Creation of Animated and Interactive Videos in an Undergraduate Introductory Chemistry Course", *J. Chem. Educ.* (2025). In Press.

121. M. Rios, I. Peng, I. M. Lovelace, W. Patterson, L-Q. Wang, "Developing an Interdisciplinary Art and Chemistry Course from the Perspective of an Undergraduate Art Student", To be submitted to J. Chem. Educ.

120. I. Peng, I. M. Lovelace, M. Rios, K. Hills-Kimball, J. Wang, L-Q. Wang*," Creating and Implementing a Novel, Interdisciplinary, and Engaging Hands-On Activity on Ceramic Glaze Chemistry: An Undergraduate Student's Perspective," To be Submitted to J. Chem. Educ.

119. A. Haripottawekul, L-Q. Wang*," Collaborative, Interdisciplinary and Student-Led Approaches in Undergraduate Research, Teaching, and Learning," Athens Journal of Education 2025, 12 (3), 727(2025). https://doi.org/10.30958/aje.12-4-9

118. C. Alexandra Coia 1, R. Jackson, K. Olivia Kuang, L-Q. Wang*," Exploring the Role and Variability of 3d Transition Metal Complexes in Artistic Coloration through a Bottom-Up Scientific Approach," Colorants 3, 152 (2024). https://doi.org/10.3390/colorants3020012

117. Y. Mao, N. K. Karan, R. Kumar, R. Hopson, P. R. Guduru, B.W. Sheldon, L-Q. Wang* "Effect of Electrochemical Cycling on Microstructures of Nanocomposite Silicon Electrodes Using Hyperpolarized ^{129}Xe and ^{7}Li NMR Spectroscopy," (Invited Submission) Journal of Vacuum Science and Technology A **40**, 043203 (2022); https://doi.org/10.1116/6.0001768.

116. K. Hills-Kimball, I. M. Lovelace, I. Peng, J. Wang, Hector Garces, M. Rios, O. Chen, L-Q. Wang, "New insights to the interactions between amorphous georgite pigment and linseed oil binder that lead to a drastic color change", Inorganica Chimica Acta. 529, 120661 (2022).

115. I. Peng, K. Hills-Kimball, I. M. Lovelace, J. Wang, M. Rios, O. Chen, L-Q. Wang*," Exploring the colors of copper-containing pigment and their origins in ceramic glazes," Colorants 1, 376 (2022). https://doi.org/10.3390/colorants1040023

114. D. Rubenstein, W. Patterson, I. Peng, F. Schunk, A. Mendoza-Garcia, M. Lyu, L-Q. Wang*," Introductory Chemistry Laboratory: Quantum Mechanics and Color," J. Chem. Educ. 97, 4430 (2020).

113. L-Q. Wang*, J. Ren, "Strategies, Practice and Lessons Learned from Remote Teaching of the General Chemistry Laboratory Course at Brown University," J. Chem. Educ. 97, 3002(2020).

112. J. Ren, T. Lin, L. W. Sprague, I. Peng, and L-Q. Wang*, "Exploring Chemical Equilibrium for Alcohol-Based Cobalt Complexation through Visualization of Color Change and UV-Vis Spectroscopy," J. Chem. Educ. 97, 509 (2019).

111. H. Yang, W. Fan, K. H.-Kimball, O. Chen*, L-Q. Wang*, "Manganese-doped Lead-Halide Perovskite Quantum Dots – A Simple Synthesis Illustrating Optoelectronic Properties of Semiconductors," *J. Chem. Educ.* 96 (10), 2300 (2019).

110. Y. Mao, D. Kim, R. Hopson, M.J. Sailor, and L-Q. Wang*, " Investigation of Carbon Grafted Mesoporous Silicon Sponge Using Hyper-Polarized ^{129}Xe NMR Spectroscopy," J. Mater. Res. 33 (17), 1 (2018).

109. Y. Mao, N.K. Karan, M. Song, R. Hopson, P. R. Guduru, and L-Q. Wang*," Investigation of Solid Electrolyte Interphase (SEI) Formed on Si Nanoparticle Composite Electrodes Using Hyperpolarized ^{129}Xe NMR Spectroscopy", *Energy Fuels*, *31* (5), 5622 (2017)

108. Y. Mao, D. Kim, J. Joo, M.J. Sailor, and L-Q. Wang*, "Hyper-polarized ^{129}Xe Nuclear Magnetic Resonance Study of Mesoporous Silicon Sponge Materials," Journal of Materials Research. 32 (16), 3038 (2017).

107. Y. Mao, M. Song, R. Hopson, N.K. Karan, P. R. Guduru, and L-Q. Wang*, " Hyperpolarized ^{129}Xe Nuclear Magnetic Resonance Studies of Si Nanocomposite Electrode Materials**,"** Energy Fuels, 30 (2), 1470 (2016).

106. D. Rand, P. Lynch, W. Zhu, G. Lowery, and L. -Q. Wang*, "Development and Implementation of a Simple, Engaging Acid Rain Neutralization Experiment and Corresponding Animated Instructional Video for Introductory Chemistry Students," J. Chem. Educ. *93* (4), 722 (2016).

105. L. -Q. Wang*, " Hyperpolarized ^{129}Xe NMR in Materials Sciences: Pore Structure, Interconnectivity and Functionality," Invited review article, book chapter: Hyperpolarized Xenon-129 Magnetic Resonance : Concepts, Production, Techniques and Applications, Publisher, RSC publishing (2015).

104. K. Klara, N. Hou, A. Lawman, L. Wu, D. Morrill, A. Tente and Li-Qiong Wang*, "Developing and Implementing a Simple Affordable Hydrogen Fuel Cell Laboratory in Introductory Chemistry," J. Chem. Educ. 91, 1924 (2014).

103. M. Song, S. P. V. Nadimpalli, V. A. Sethuraman, M. J. Chon, P. R. Guduru, and L-Q. Wang,* " Investigation of Initial Lithiation of Silicon (100) Using Solid-State ^{7}Li NMR**,"** J. Electrochem. Soc. 161 (6), A915 (2014).

102. K. Klara, N. Hou, A. Lawman, L. -Q. Wang*, " Developing and Implementing a Collaborative Teaching Innovation in Introductory Chemistry," J. Chem. Educ. 90, 401 (2013).

101. L. -Q. Wang*, D. Wang, J. Liu, G. J. Exarhos, " Probing Porosity and Pore Interconnectivity in Self-Assembled TiO_2–Graphene Hybrid Nanostructures Using Hyperpolarized ^{129}Xe NMR," J. Phys. Chem. C 116, 22 (2012)

100. Y. Wang, C. Zhang, S. Kang, B. Li, P. Zhu, Y. Wang, X. Li, Li.-Q. Wang, "Simple Synthesis of Graphitic Ordered Mesoporous Carbon Supports Using Natural Seed Fat," J. Mater. Chem. 21,14420 (2011).

99. K. Zhu, JM. Sun, J. Liu, L.-Q. Wang; HY. Wan, JZ Hu, Y. Wang, CHF. Peden, ZM. Nie, "Solvent Evaporation Assisted Preparation of Oriented Nanocrystalline Mesoporous MFI Zeolites, ACS Catalysis 1, 682 (2011).

98. W. Liu , T. Rao , H. Wan , A. Karkamkar, J. Liu , and L.-Q. Wang," Bubbling Reactor Technology for Rapid Synthesis of Uniform, Small MFI-Type Zeolite Crystals Synthesis of Nano-Sized MFI-type Zeolite Crystals of Controllable Al/Si Ratio," *Ind. Eng. Chem. Res.* 50 7241 (2011).

97. L. -Q. Wang,* A. Karkamkar, T. Autrey, G. J. Exarhos," Hyperpolarized 129Xe NMR Investigation of Ammonia Borane in Mesoporous Silica," *J. Phys. Chem. C* 113, 6485 (2009).

96. L. -Q. Wang,* D. Wang, J. Liu, G. J. Exarhos, S. Pawsey, I. Moudrakovski: " Probing Porosity and Pore Interconnectivity in Crystalline Mesoporous TiO_2 Using Hyperpolarized ^{129}Xe NMR," *J. Phys. Chem. C* 113, 6577 (2009).

95. S. Kaewgun, C. A. Nolph, B. I. Lee, L. -Q. Wang, "Influence of hydroxyl contents on photocatalytic activities of polymorphic titania nanoparticles", Materials Chemistry and Physics 114, 439 (2009)

94. Y. Shin, L. -Q. Wang, I-T. Bae, B. Arey, G. J. Exarhos, : "Hydrothermal Syntheses of Colloidal Carbon Spheres from Cyclodextrins," *J. Phys. Chem. C 112,* 14236 (2008)

93. Y. Shin, G. A. Baker, L. -Q. Wang, G. J. Exarhos, "Investigation of the Hygroscopic Growth of Self-Assembled Layers of N-alkyl-N-methylpyrrolidinium Bromides at the Interface between Air and Organic salt," *Colloids and Surfaces A: 318, 254 (2008).*

92. W. Wang, A. D. Bain, L.-Q. Wang, G. J. Exarhos, and A. D. Q. Li, "Molecular Self-Assembly Inhibition Leads to Basket-Shaped Cyclophane Formation with Chiral Dynamics," J. Phys. Chem. A.; 112, 3094 (2008).

91. C. Yao, Y. Shin, L.-Q. Wang, C. F. Windisch Jr, W. D. Samuels, B. W. Arey, C. Wang, W.M. Risen Jr., G. J. Exarhos, "Hydrothermal Dehydration of Aqueous Fructose Solutions in a Closed System," J. of Physical Chemistry C, 111, 15141 (2007).

90. C. F. Windisch Jr, G. J. Exarhos, C. Yao, L.-Q. Wang, "Raman Study of the Influence of Hydrogen on Defects in ZnO," Journal of Applied Physics, 101(12),123711 (2007).

89. Y. Wang, K-Y. Lee, S. Choi, J. Liu, L.-Q. Wang, and C.H.F. Peden," Grafting Sulfated Zirconia on Mesoporous Silica," Green Chemistry (invited publication), *Green Chem.*, 2007, 9, 540

88. L. –Q. Wang,* S. Pawsey, I. Moudrakovski, G. J. Exarhos, J. Ripmeester, J. L. C. Rowsell and O. M. Yaghi "Hyperpolarized ^{129}Xe Nuclear Magnetic Resonance Studies of Isoreticular Metal-Organic Frameworks,"*J. of Phys. Chem. C. 111, 6060, 2007.*

87. L.-Q. Wang,* G. J. Exarhos, C. F. Windisch Jr, C. Yao, L. R. Pederson X. –D. Zhou, "Probing hydrogen in ZnO nanorods using solid-state ^{1}H Nuclear Magnetic Resonance" Applied Physics Letters, 90(17):173115(2007).

86. K. R. Minard, V. Vishwanathan, P. Majors, L.-Q. Wang,* P. C. Rieke, "Magnetic Resonance Imaging (MRI) of PEM Dehydration and Gas Manifold Flooding During Continuous Fuel Cell Operation," Journal of Power Source, 161 (2), 856 (2006).

85. W. Wang, L.-Q. Wang, B. J. Palmer, G. J. Exarhos, and A. D. Q. Li, "Cyclization and Catenation Directed by Molecular Self-Assembly," Wang, W; Wang, LQ; Palmer, BJ; Exarhos, GJ; Li, ADQ, *J. Am. Chem. Soc.* 128, 11150 (2006).

84. H. Qishegn, J. Liu, L.-Q. Wang, Y. Jiang, T. N. Lambert, E. Fang "A New Class of Silica Crosslinked Micellar Core-Shell Nanoparticles," *J. Am. Chem. Soc.*, 128, 6447-6453, 2006.

83. S. V. Mattigod, B. P. McGrail, D. E. McCread, L. -Q. Wang, "Synthesis and Structure of Perrhenate Sodalite," *Microporous Mesoporous Mater*. 91, 139 (2006).

82. B.I. Lee, M. Wang, D. Yoon, P. Badheka, L. Qi, L.-Q. Wang,"Synthesis of Nanoparticle Barium Titanate," Chapter 7 in Chemical Processing of Ceramics, 2nd edition, CRC Press, Tayler Francis Books, Inc, Boca Raton, FL, 2005, p.173.

81. D.M. Dabbs, U. Ramachandran, S. Lu, J. Liu, L.-Q. Wang, I.A. Aksay, "Inhibition of Aluminum Oxyhydroxide Precipitation with Citric Acid," *Langmuir* 21, 11690 (2005).

80. I. L. Moudrakovski, L. -Q. Wang,* G. J. Exarhos, V. V. Terskikh, C. I. Ratcliffe, J. A.

Ripmeester, "Nuclear Magnetic Resonance Studies of Resorcinol-Formaldehyde Aerogels," *J. of Phys. Chem. B. 109, 11215 (2005).*

79. L. -Q. Wang,* S. Azad, M. H. Engelhard, "Adsorption and Reaction of CO and CO_2 on Oxidized and Reduced $SrTiO_3$(100) Surfaces," *J. of Phys. Chem. B*. 109, 10327(2005).

78. L. -Q. Wang,* K. F. Ferris, S. Azad, M. H. Engelhard, "Adsorption and Reaction of Methanol on Stoichiometric and Defective $SrTiO_3$(100) Surfaces," *J. Phys. Chem. B.* 109, 4507 (2005).

77. L. -Q. Wang,* S. V. Mattigod, K.E. Parker, D.T. Hobbs, D. E. McCready," Nuclear Magnetic Resonance Studies of Aluminosilicate Gels prepared in High-Alkaline and Salt-Concentrated Solutions," J. of Non-Crystalline Solids, 351/43-45, 3435 (2005).

76. L. Qi, B.I. Lee, P. Badheka, L. Q. Wang, P.Gilmour, W.D. Samuel, G. J. Exarhos, "Low-temperature Paraelectric-ferroelectric Phase Transformation in Hydrothermal $BaTiO_3$ Particles," Mater. Lett. 59, 2794 (2005).

75. B.I. Lee, M. Wang, D. Yoon, P. Badheka, L. Qi. and L. Q. Wang, "Synthesis of Nanoparticle barium titanate," Chapter 7 in *Chemical processing of Ceramics, 2nd edition,* CRC Press, Taylor Francis Books, Inc, Boca Raton, FL, 2005, p.173.

74. Y. Shin, L. -Q. Wang,* G.E. Fryxell, G. J. Exarhos, "Hygroscopic Growth of Self-Assembled Layered Surfactant Molecules at the Interface between Air and Organic Salts," *Journal of Colloidal and Interface,284, 278 (2005).*

73. I. L. Moudrakovski , L. -Q. Wang,* G. J. Exarhos, V. V. Terskikh, C. I. Ratcliffe, J. A. Ripmeester, "Nuclear Magnetic Resonance Investigation of Organic Aerogels," *J. Am. Chem. Soc. Commun.126, 5052 (2004).*

72. L. -Q. Wang,* K. F. Ferris, S. Azad, M. H. Engelhard, C. H. F. Peden, "Adsorption and Reaction of Acetaldehyde on Stoichiometric and Defective $SrTiO_3$(100) Surfaces," *J. Phys. Chem. B.* **108**, 1646 (2004).

71. M.-Q. Zhu, L. -Q. Wang, G. J. Exarhos, A. D. Q. Li, "Thermosensitive Gold Nanoparticles," J. Am. Chem. Soc. Commun.*126, 2656 (2004).*

70. Y. Shin, L. -Q. Wang, G.E. Fryxell, G. J. Exarhos, "Hygroscopic Growth of Self-Assembled Layered Surfactant Molecules at the Interface between Air and Organic Salts," *Mater. Res. Soc. Symp. Proc*. **775**, 141 (2003).

69. J. Liu, Y. Shin, L. -Q. Wang, G.J. Exarhos, J.H. Chang, G.E. Fryxell, Z. Nie, T. Zemanian, and W.D. Samuels, "Strategies for the Design and Synthesis of Hybrid Multifunctional Nanoporous Materials", Nanostructured Catalysts, 19(2). 297(2003).

68. S.V. Mattigod, D.T. Hobbs, K.E. Parker, D.E. McCready, L.Q. Wang, " Precipitation of Aluminum Containing Species in Tank Wastes," Symposium Papers of the American Chemical Society 226 (Pt 2). Sep. 2003. p.U90.

67. A. D. Q. Li, W. Wang, L. -Q. Wang, "Folding versus Self-Assembling," *Chemistry-A European Journal*, **9 (19)**, 4594 (2003).

66. S. Azad, J. Szanyi, C. H. F. Peden, L. -Q. Wang,* "Adsorption and Reaction of NO on Oxidized and Reduced $SrTiO_3$(100) Surfaces," *J. Vac. Sci. Technol. A* **21**, 1307 (2003).

65. L. Q. Wang,* Y. Shin, G. J. Exarhos, I. L. Moudrakovski, V. V. Terskikh, C. I. Ratcliffe, J. A. Ripmeester, "Nuclear Magnetic Resonance Investigation of Hierarchically Ordered Positive and Negative Replica of Wood Cellular Structures Prepared by Sol-Gel Mineralization," *Journal of Physical Chemistry B*. 107, 13793 (2003).

64. L. Q. Wang,* G. J. Exarhos, "Investigation of Local Molecular Ordering in Layered Surfactant-Silicate Mesophase Composites," *J. Phys. Chem. B* **107**, 443 (2003).

63. J. A. Rodriguez, S. Azad, L. Q. Wang,* J. Carcia, A. Etxeberria , L. Gonzalez, "Electronic and Chemical Properties of Mixed-Metal Oxides: Adsorption and Reaction of NO on $SrTiO_3$(100)," *J. Chem. Phys.* **118**, 6562 (2003).

62. Y. Shin, L. Q. Wang, G. J. Exarhos, "pH-Controlled Synthesis of Hierarchically Ordered Ceramics with Wood Cellular Structures by Surfactant-Directed Sol-Gel Procedure," *J. Ind. Eng. Chem.* **9**, 76 (2003).

61. W. Wang, J. J. Han, L. Q. Wang, L. S. Li, W. J. Shaw, A. D. Q. Li, "Dynamic π-π Stacked Molecular Assemblies Emit from Green to Red colors," *Nano Lett*. **3**, 455 (2003).

60. L. Q. Wang,* Y. Shin, G. J. Exarhos, I. L. Moudrakovski, V. V. Terskikh, C. I. Ratcliffe, J. A. Ripmeester, "A ^{129}Xe NMR Study of Functionalized Ordered Mesoporous Silica," *J. Phys. Chem. B* **106**, 5938 (2002).

58. Y. Shin, J. Liu, L. Q. Wang, G. J. Exarhos, "Control of Hierarchically Ordered Positive and Negative Replicas of Wood Cellular Structures by Surfactant-Directed Sol-Gel Mineralization," *Mater. Res. Soc. Symp. Proc*. **85**, 726 (2002).

57. J. H. Chang, L. Q. Wang, Y. Shin, B. Jeong, J. C. Birnbaum, G. J. Exarhos, "The Core-Shell Approach to Formation of Ordered Nanoporous Materials," *Adv. Mater.* **14**, 378 (2002).

56. L. Q. Wang,* C. F. Habeger, "^{27}Al Solid-State NMR Investigation of Catalysts in NO_X Reduction Prepared by Incorporating Aluminum in Mesoporous Silica via Post synthesis Procedures," *J. Mater. Res*. **17**, 1843 (2002).

55. L. Q. Wang,* K. F. Ferris, G. S. Herman, "Interaction of H_2O with $SrTiO_3$(100) Surfaces" *J. Vac. Sci. Technol. A* **20**, 239 (2002).

54. B. Jeong, L. Q. Wang, A. Gutowska, "One-step Synthesis of Biodegradable Thermoreversible Gelling Polymer with a Maximum Modulus at Body Temperature," *Chem. Commun*. 1516 (2001).

53. K. Domansky , J. Liu, L. Q. Wang, M.H. Engelhard, S. Baskaran, "Chemical Sensors Based on Dielectric Response of Functionalized Mesoporous Silica Films," *J. Mater*. **16**, 2810 (2001).

52. L. Q. Wang,* J. Liu, G. J. Exarhos , K. Flanigan, R. Bordia , "Conformation Heterogeneity and Mobility of Surfactant Molecules in intercalated Clay Minerals Studied by Solid-State NMR," *J. Phys. Chem. B* **104**, 2810 (2000).

51. L. Q. Wang,* K.F. Ferris, G.S. Herman, "Interaction of HCOOH with SrTiO3(100) Surfaces," *J. Vac. Sci. Technol*. A **18**, 1893 (2000).

50. J. Liu, Y. Shin, G. E. Fryxell, L. Q. Wang, Z. Nie, J. H. Chang, G. E. Fryxell, W. D. Samuels, G. J. Exarhos, "Molecular Assembly in Ordered Mesoporosity: A New Class of Highly Functional Nanoscale Materials,", *J. Phys. Chem. A* **104**, 8328 (2000). (**Invited feature article**)

49. Y. Shin, J. Liu, L. Q. Wang, Z. Nie, W.D. Samuels, G. E. Fryxell, G. J. Exarhos, "Ordered Hierarchical Porous Materials: Towards Tunable Size-and-Shape Selective Microcavities in Nanoporous in Nanoporous Channel," *Angew. Chem. Int. Ed*. **39**, 2702 (2000).

48. J. Liu, G. E Fryxell, S. Mattigod, T. S. Zemanian, Y. Shin, L. Q. Wang, "Synthesis and Applications of Functionalized Nanoporous Materials for Specific Adsorption," for *Studies in Surface Science and Catalysis*, edited by A. Sayari *et al*. Elsevier Science B.V., 729 (2000). (**Invited panel article**)

47. Y. Wang, A. Y. Kim, X. S. Li, L. Q. Wang, C. H. F. Peden, B. C. Bunker, "Shape-Selective Solid Acid Catalysts Based on Tungstophosphoric Acid Supported on Mesoporous Silica," ACS Symposium Series 738, *Shape-Selective Catalysis*, Chapter 25, 353 (2000).

46. J. Liu, G. E. Fryxell, M. Qian, L. Q. Wang, Y. Wang, "Interfacial Chemistry in Self-assembled Nanoscale Materials with Structural Ordering," *Pure Appl. Chem*. **72**, 269 (2000). (**Invited paper**)

45. Y. Shin, T. S. Zemannian, G. E. Fryxell, L. Q. Wang, J. Liu, "Supercritical Processing of Functional Size Selective Microporous Materials", *Microporous Mesoporous Mater*. **37**, 49 (2000).

44. G. E. Fryxell , J. Liu, S. V. Mattigod, L. Q. Wang, M. Gong, T. A. Hauser, Y. Lin, K. F. Ferris, X. Feng, "Environmental Applications of Interfacially Modified Mesoporous Ceramics," *Ceramics Transactions* **107**, 29 (2000).

43. L. Q. Wang,* G. J Exarhos, J. Liu, "Nuclear Magnetic Resonance — Characterization of Self-Assembled Nanostructural Materials," *Adv. Mater*. **11**, 1331 (1999). (**Invited review article**).

42. L. Q. Wang, G. J. Exarhos, J. Liu, "Self-Assembled Supramolecular Biomaterials and Functional Groups," *In Characterization of Nanophase Materials*, Chapter 8, invited, edited by Z. L. Wang (VCH, 1999).

41. L. Q. Wang,* K. F. Ferris, P. X. Skiba, A. N. Shultz, D. R. Baer, M. H. Engelhard, "Interactions of Liquid Vapor Water with Stoichiometric and Defective TiO_2(100) Surfaces," *Surf. Sci*. **440**, 60 (1999).

40. Y. Su , M. Balmer, L. Q. Wang, B. C. Bunker, "Evaluation of Thermally Converted Silicotitanate Waste Forms," *J. Mater. Res*. **556**, 77 (1999).

39. K. M. Kemner, X. Feng, J. Liu, G. E. Fryxell, L. Q. Wang, A. Y. Kim, M. Gong, S. Mattigod, "Investigation of the Local Chemical Interactions Between Hg and Self-Assembled Monolayers on Mesoporous Supports," J. *Synchrotron Rad*. **6**, 633 (1999).

38. L. Q. Wang,* K. F. Ferris, J. P. Winokur, A. N. Shultz, D. R. Baer, M. H. Engelhard, "Interactions of Methanol with Stoichiometric and Defective TiO_2 (110) and (100) Surfaces," *J. Vac. Sci. Technol. A* **16**, 3034 (1998).

37. L. Q. Wang,* G. J. Exarhos, W. D. Samuels, B. Lee, P. Cao, "^{31}P and ^{29}Si NMR Study of Sol-Gel-Synthesized Phosphate Ceramic Composites," *J. Mater. Chem*. **8**, 165 (1998).

36. K.F. Ferris, L. Q. Wang,* "Electronic Structure Calculations of Small Molecule Adsorbates on (110) and (100) TiO_2," *J. Vac. Sci. Technol. A* **16**, 956 (1998).

35. D. R. Baer, P. X. Skiba, A. N. Shultz, L. Q. Wang,* M. H. Engelhard, "Comparison of TiO_2 (110) Surfaces by XPS: Effects of UV Exposure, Electron Beam and Ion Beam Damage," *Surf. Sci. Spectra* **5**, 193 (1998).

34. J. Liu, X. Feng, G. E. Fryxell, L. Q. Wang, A. Y. Kim, M. Gong, "Hybrid Mesoporous Materials with Functionalized Monolayers," *Adv. Mater*. **10**, 161 (1998).

33. J. Liu, X. Feng, G. E. Fryxell, L. Q. Wang, A. Y. Kim, M. Gong, "Hybrid Mesoporous Materials with Functionalized Monolayers," *Chem. Eng. Technol.* **21**, 97 (1998).

32. G. J. Exarhos, A. Rose, L. Q. Wang, C. F. Windisch, "Postdeposition Reduction of Noble Metal Doped ZnO films", *J. Vac. Sci. Technol*. A **16**, 1926 (1998).

31. Z. Cao, B. I. Lee, W. D. Samuels, L. Q. Wang, G. J. Exarhos, "Sol-gel Synthesis of Phosphate Ceramic Gels-II," *J. Mater. Res*. **13**, 1553 (1998).

30. Z. Cao, B. I. Lee, W. D. Samuels, G. J. Exarhos , L. Q. Wang, "Synthesis and Photoresponse of Rare Earth Doped Phosphosilicates," *Mater. Res.Soc. Symp. Proc*. **495**, 215 (1998).

29. G. J. Exarhos, A. Rose, L. Q. Wang, C. F. Windisch, "Spectroscopic Characterization of Processing-Induced Property Changes in Doped ZnO Films," *Thin Solid Films* **308/309**, 56 (1997).

28. L. Q. Wang,* K. F. Ferris, A. N. Shultz, D. R. Baer, M. H. Engelhard, "Interactions of HCOOH with Stoichiometric and Defective TiO_2 (110) Surfaces," *Surf. Sci*. **380**, 352 (1997).

27. L. Q. Wang,* P. X. Skiba, A. N. Shultz, D. R. Baer, M. H. Engelhard, "The Interaction of Liquid and Vapor Water With Nearly Defect-Free and Defective TiO_2(100) Surfaces," *Mat. Res. Soc. Symp. Proc*. **432**, 45 (1997).

26. M. L. Balmer, B. C. Bunker, L. Q. Wang,* C. H. F. Peden, "Solid State ^{29}Si MAS NMR Study of Silicotitanates," *J. Phys. Chem. B* **101**, 9170 (1997).

25. P. C. Rieke, L. Q. Wang, S. A. Chambers, J. Liu, Y. L. Chen, Y. Liang, "Influence of Defect Structure on the Electrochemical Behavior of Single Crystal RuO_2 Electrodes Prepared by Molecular Beam Epitaxy," Electrochemical Capacitors II, F.M. Delnick, D. Ingersoll, X.Andrieu, K. Naoi, Eds. PV96-25, p35, The Electrochemical Society Proceedings series, Penning, NJ (1997).

24. J. Zhang, G. R. Golcar, P. A. Smith, L. Q. Wang,* J. G. Darab, "Hydrated $K_2SO_4.2MgSO_4$ Structure Revealed by TGA/DTA and Magic-Angle Spinning ^{1}H-NMR Spectroscopy," *J. Mater. Sci*. **32**, 5113 (1997).

23. Y. Wang, A. Kim, L. Q. Wang, S. Li, J. Liu, B. C. Bunker, *Solid Acid/Base '97 Proceedings*, 1997.

22. A. N. Schultz, W. M. Hetherington III, L. Q. Wang,* D. R. Baer, M. H. Engelhard, "Second Harmonic Generation and X-ray Photoelectron Spectroscopy Studies of N_2O Healing of Ti^{3+} Defects on TiO_2 (110) Surfaces," *Surf. Sci*. **392**, 1 (1997).

21. J. Liu, L. Q. Wang, W. D. Samuels, G. J. Exharos, "Aggregation and Dispersion of Colloidal Suspensions by Inorganic Surfactants: Effect of Chemical Speciation and Molecular Conformation," *J. Phys. Chem. B* **101**, 8264 (1997).

20. X. Feng, G. E. Fryxell, L. Q. Wang, A. Y. Kim, J. Liu, K. M. Kemner , "Functionalized Monolayers on Ordered Mesoporous Supports," *Science* **276**, 923 (1997).

19. A. Kim, P. Bruinsma, Y. Chen, L. Q. Wang, J. Liu, "Amphoteric Surfactant Templating Route for Mesoporous Zirconia," *Chem. Commun.***161** (1997).

18. L. Q. Wang,* J. Liu, G. J. Exarhos, B. C. Bunker , "Investigation of the Structure and Dynamics of Surfactant Molecules in Mesophase Silicates Using Solid-State ^{13}C NMR," *Langmuir*, **12**, 2663 (1996).

17. B. I. Lee, W. D. Samuels, L. Q. Wang, G. J. Exharos, "Synthesis Phosphate Ceramic Gels," *J. Mat. Res*. **11**, 134 (1996).

16. L. Q. Wang,* A. N. Schultz, D. R. Baer, M. H. Engelhard, "Interactions of Small Molecules with TiO_2 (110) Surfaces: The Role of Defects," *J. Vac. Sci. Technol. A* **14**, 1532 (1996).

15. J. Liu, A. Y. Kim, L. Q. Wang, B. J. Palmer, Y. L. Chen, P. Bruinsma, B. C. Bunker, G. J. Exarhos, G. L. Graff, P. C. Rieke, G. E. Fryxell, J. W. Virden, B. J. Tarasevich, L. A. Chick, "Self-Assembly in the Synthesis of Ceramic Materials and Composites," *Advances in Colloidal and Interface Science*, **69**, 131 (1996). (**Review articles**)

14. D. R. Baer, L. Q. Wang,* A. N. Schultz, J. L. Daschbach, M. H. Engelhard, "Defect Generation and Interactions with Small Molecules on the TiO_2(110) Surface in Vacuum and Solution," book chapter, New Techniques for Characterizing Corrosion and Stress Corrosion, *TMS Symp. Proc*. 74 (1996).

13. L. Q. Wang,* D. R. Baer, M. H. Engelhard, "The Adsorption of Liquid and Vapor Water on TiO_2(110) surfaces: The Role of Defects," *Surf. Sci*. **344**, 237 (1995).

12. L. Q. Wang,* D. R. Baer, M. H. Engelhard, "The Adsorption of Liquid and Vapor water on TiO_2(110) Surfaces: The Role of Defects," *Mat. Res. Soc. Symp. Proc*. **357,** 97 (1995).

11. J. Liu, L. Q. Wang, B. C. Bunker, J. W. Virden, R. H. Jones, "Effect of Hydrolysis on the Colloidal Stability of File Alumina suspensions", *Mater. Sci. Eng. A* **204**, 169 (1995).

10. D. R. Baer, L. Q. Wang,* A. N. Shultz, J. L. Daschbach, W. M. Hetherington III, M. H. Engelhard, "Defect Generation and Interactions with Small Molecules on the Rutile TiO_2 (110) Surface in Vacuum and Solution," *J. Mater. Chem*. 73 (1995).

9. A. N. Shultz, W. Jang, W. M. Hetherington III, D. R. Baer, L. Q. Wang,* M. H. Engelhard, "Comparative SHG and XPS Studies of the UV Creation and O_2 Healing of Ti^{3+} Defects on (110) Rutile TiO_2 Surfaces," *Surf. Sci*. **339**, 114 (1995).

8. L. Q. Wang,* D. R. Baer, M. H. Engelhard, "Creation of Variable Concentration of Defects on TiO_2 (110) Using Low-Density Electron Beams", *Surf. Sci*. **320**, 295 (1994).

7. D.R. Baer, M. H. Engelhard, D. W. Schulte, L. Q. Wang,* P. C. Rieke, "Electron Beam Damage of a $(CH_2)_{17}$ Self-Assembled Monolayer on Si," *J. Vac. Sci. Technol.* **A** 12, 2478 (1994).

6. G. J. Exarhos, L. Q. Wang, T. Dennis, "Spatially Resolved Densification of Solution Deposited Zirconium Dioxide Films by Laser Irradiation," *Thin Solid Films*, **253**, 41 (1994).

5. L. Q. Wang,* E. Vega, "Studies of Organometallic Cr Catalysts by X-ray Absorption Spectroscopy," Chevron Company Internal Report (1993).

4. Z. Q. Huang, L. Q. Wang, A. E. Schach von Wittenau, Z. Hussain, D. A. Shirley, "Angle-Resolved Photoemission Extended Fine Structure Study of p(2x2) K/Ni(111)," *Phys. Rev. B* **47**, 13626 (1992).

3. A.E. Schach von Wittenau, L. Q. Wang, Z. Q. Huang, Z. Hussain, D. A. Shirley, "Reevaluation of the p(2x2) S/Cu(001) Structure Using Temperature-Dependent Angle-Resolved Photoemission Extended Fine Structure," *Phys. Rev. B* **45**, 13614 (1992).

2. L. Q. Wang, A. E. Schach von Wittenau, L. S. Wang, Z. Q. Huang, D. A. Shirley, "A Detailed Study of c(2x2)Cl/Cu(001) Adsorbate Geometry and Substrate Surface Relaxation Using Temperature-Dependent Angle-Resolved Photoemission Extended Fine Structure," *Phys. Rev. B* **44**, 1292 (1991).

1. L. Q. Wang, Z. Q. Huang, A. E. Schach von Wittenau, Z. Hussain, D. A. Shirley, "The Surface Structural Determination of sq(3)xsq(3) $R30^o$ Cl/Ni(111) Using Temperature-Dependent Angle-Resolved Photoemission Extended Fine Structure," *Phys. Rev. B* **44**, 13711 (1991).

Presentations

L. -Q. Wang, ″ Collaborative, Interdisciplinary and Case Study Approaches in Undergraduate Research, Teaching and Learning," (Invited Talk) The 26th Annual International Conference on Education**,** Athens**,** Greece**.** May 20-23, 2024.

L. -Q. Wang, " Collaborative, Interdisciplinary and Case Study Approaches in Undergraduate Research, Teaching and Learning," (Invited Virtual Talk) 8th Annual International Symposium on the Future STEM, Athen, July 20-25, 2024.

L. -Q. Wang, " Translating undergraduate research to teaching," American Chemical Society Spring 2023 National Meeting Exposition, Indianapolis, IN, March 26-30, 2023.

L. -Q. Wang, " Enhancing In-Person's Learning of the General Chemistry Laboratory Course at Brown University via the Innovation Created for Remote Learning," American Chemical Society Spring 2023 National Meeting Exposition, Indianapolis, IN, March 26-30, 2023.

L. -Q. Wang, " Introductory Chemistry Laboratory: Quantum Mechanics and Color," American Chemical Society Spring 2021 National Meeting Exposition, Virtual, April 5-16, 2021.

L. -Q. Wang," From Research to Teaching," Chemistry Department Colloquium, Brown University, Providence, RI**,** Oct. 9, 2020.

L. -Q. Wang, "Creating and implementing a novel "Chemistry and Art" course through collaborative, interdisciplinary and case study approaches," Talk, 2020 Biennial Conference on Chemical Education. (Abstract was accepted, But meeting was canceled).

L. -Q. Wang*, "Teaching chemistry and art through engaging case studies and hands-on activities," American Chemical Society Fall 2019 National Meeting Exposition, San Diego, CA, August 25 - 29, 2019.

L. -Q. Wang," Investigation of structures and porosity of nanocomposite electrode materials," ***(invited Talk)****,* 26th Assembly of Advanced Materials Congress, Stockholm, Sweden, June 10-13, 2019.

L. -Q. Wang," Investigation of Nanoporosity of Carbon Grafted Mesoporous Silicon Sponge Using Hyper-Polarized ^{129}Xe NMR Spectroscopy," ***(invited Talk)****,* 2018 Collaborative Conference on Materials Research, Seoul, South Korea, June, 2018.

L. -Q. Wang, " Promoting teaching and learning through engaging case studies**,"** Talk, 2018 Biennial Conference on Chemical Education, Notre Dame University, South Bend, IN, July. 2018.

L. -Q. Wang,"Probing Nano- and Meso- Porous Electrode Materials Using Hyperpolarized ^{129}Xe NMR**,"** ***(invited Talk),*** Chemistry Department, Tsinghua University, Beijing, China, August 1, 2017.

L. -Q. Wang," Probing Nano- and Meso- Porous Electrode Materials Using Hyperpolarized ^{129}Xe NMR," ***(invited Talk),*** Chemistry Department, Shanxi University, Tayuan, China, July 21, 2017.

L. -Q. Wang," Investigation of Structures and Connectivity of Pores in Nanostructured Materials," ***(invited Talk),*** Energy Materials and Nanotechonology on Mesoporous Materials, Kaohsiung,Taiwan, March 13-17, 2017.

L. -Q. Wang*, " Investigation of Porosity and Connectivity in Mesoporous Silicon Sponge Materials using Hyper-polarized ^{129}Xe NMR Spectroscopy," ***(Invited Talk),*** American Chemical Society 252nd National Meeting Exposition, Philadelphia, PA, August 21-25, 2016.

L. -Q. Wang*, " Investigation of Solid Electrolyte Interface (SEI) formed in Nanoporous Silicon and Meso silicon Sponge Electrode Materials by using Hyperpolarized ^{129}Xe NMR spectroscopies," American Chemical Society 252nd National Meeting Exposition, Philadelphia, PA, August 21-25, 2016.

L. -Q. Wang," Solid-State and HP ^{129}Xe NMR Studies of Porous Electrode Materials Related to Li-ion Batteries,**"** ***(invited Talk),*** Chemistry Department, Shanxi University, Tayuan, China, April 26, 2016.

L. -Q. Wang*, " Probing Structures and porosity in novel nanostructured electrode materials," ***(Invited Talk),*** American Chemical Society 251st National Meeting Exposition, San Diego, California, March 13-17, 2016.

L. -Q. Wang*, "Enhancing introductory chemistry laboratory learning through collaborative teaching innovation," American Chemical Society 251st National Meeting Exposition, San Diego, California, March 13-17, 2016.

L. -Q. Wang, " Probing changes in porosity and connectivity in Si nano particle electrodes," American Chemical Society 250 th National Meeting Exposition, Boston, MA, August 16-20, 2015.

L. -Q. Wang," Investigation of Structures and Porosity of Energy Materials," Chemistry Biochemistry Department Colloquium (invited), University of Massachusetts, Dartmouth, MA, Feb 4. 2015.

L. -Q. Wang, " Developing and implementing engaging introductory chemistry laboratories through collaborative teaching innovation," American Chemical Society 250 th National Meeting Exposition, Boston, MA, August 16-20, 2015.

L. -Qiong Wang, " Investigation of Structures and Porosity of Electrode Materials in Li Ion Batteries," 2015 MRS Spring Meeting, San Francisco, CA, April 6-10, 2015.

L. -Q. Wang," Probing Structures and Porosity in Nanostructured Electrode Materials,**"** Chemistry Department Colloquium (invited), Clark University, Worcester, MA, Oct. 17, 2014.

L. -Q. Wang, " Engaging students in introductory chemistry laboratory through collaborative teaching innovation,"
Talk, 2014 Biennial Conference on Chemical Education, Grand Valley State University, Grand Rapid, MI, August 3, 2014.

L. -Q. Wang, " Investigation of Structures and Porosity of Silicon Anode Materials in Li Ion Battery," XXIII International Materials Research Congress 2014, Mexico, Cancun, August 17, 2014.

L. -Q. Wang, "Solid-State NMR Investigations of Structure Changes of Silicon Electrodes for Lithium-Ion Batteries," Invited Talk, International Conference on Chemical Bonding, Kuai, HI, July 23, 2014.

L. -Q. Wang, "HP ^{129}Xe NMR Study of Practical Electrode Materials," 55th Experimental Nuclear Magnetic Resonance Conference, Boston, MA, March 22, 2014.

L. -Q. Wang, "Structural Changes Driven by Li Flux Density in Initial Lithiation of Single Crystal Silicon,"
Poster, American Physics Society March Meeting 2014, Denver, CO, March 2, 2014.

L. -Q. Wang, "Probing Structures and Porosity in Nanostructured Electrode Materials," Invited Talk, Dalian Institute of Chemical Physics, Chinese Academy of Sciences, Dalian, China, July 29, 2013.

L. -Q. Wang, " Developing and Implementing a Collaborative Teaching Innovation in Introductory Chemistry," Talk, Gordon Research Conferences: Chemistry Education Research Practice, Salve Regina University, Newport, RI, June 9-14, 2013.

L. -Q. Wang, " Probing Structures and Porosity in Nanostructured Electrode Materials," Invited Talk, Energy Materials Nanotechnology Spring Meeting, Orlando, FL, April 8-11, 2013.

L. -Q. Wang," Probing Structures and Porosity in Nanostructured Electrode Materials," Chemistry Department Colloquium (invited), University of Rhode Island, Kingston, RI, April 1, 2013.

L. -Q. Wang," Probing Structures and Porosity in Energy Materials Using Advanced Solid-State NMR Techniques,"
Invited Talk, IMNI Brown Bag Seminars, Brown University, RI, Dec. 5, 2012.

M. Song, V. Sethuraman, S. P. V. Nadimpalli, M. J. Chon, Li-Qiong Wang, P. Guduru, " NMR study on initial lithiation of single crystal silicon," Talk, 2012 MRS Fall Meeting, Boston, MA, Nov. 25-30, 2012.

L. -Q. Wang, "Collaborative Teaching Innovation In Freshman Chemistry Laboratory," Talk, American Chemical Society 244th National Meeting Exposition, Philadelphia, PA, August 23, 2012.

L. -Q. Wang, " Probing Porosity and Pore Interconnectivity in Self-Assembled TiO_2–Graphene Hybrid Nanostructures Using Hyperpolarized ^{129}Xe NMR," American Chemical Society 244th National Meeting Exposition, Philadelphia, PA, August 21, 2012.

L. -Q. Wang, " Probing Porosity and Pore Interconnectivity in Nanostructured Electrode Materials Using Hyperpolarized ^{129}Xe NMR," Invited Seminar, Central China Normal University, Wuhan, China, June 15, 2012.

L. -Q. Wang, " Probing Porosity and Pore Interconnectivity in Nanostructured Electrode Materials Using Hyperpolarized ^{129}Xe NMR," Invited Seminar, Fudan University, Shanghai, China, June 13, 2012.

L. -Q. Wang, "Advanced Diagnostic Studies of Lithium Ion Batteries Using In-Situ and Ex-Situ NMR Spectroscopies,"
2012 DOE EPSCoR Symposium, Brown University, Providence, RI, June 1, 2012.

L. -Q. Wang,"Solid State NMR Studies of Battery Materials,**"** University of Rhode Island, Kingston, Invited Seminar, RI, May 23, 2012.

L. -Q. Wang, " Probing Porosity and Pore Interconnectivity in Nanostructured Electrode Materials Using Hyperpolarized ^{129}Xe NMR," Invited Seminar, National University of Singapore, Singapore, June 28, 2011.

L. -Q. Wang, " Probing Porosity and Pore Interconnectivity in Nanostructured Electrode Materials Using Hyperpolarized ^{129}Xe NMR," Invited Seminar, Wuhan University, Wuhan, China, July 6, 2011.

L. -Q. Wang, " Probing Porosity and Pore Interconnectivity in Nanostructured Materials Using Hyperpolarized ^{129}Xe NMR," Invited IMNI Seminar, Brown University, May 17, 2010.

L.-Q. Wang, G. J. Exarhos, A. Karkamkar, T. Autrey, "Probing Porosity and Pore Interconnectivity in Nanophase Ammonium Borane in Mesoporous Silica Using HP ^{129}Xe NMR." 50^{th} Rocky Mountain Conference On Analytical Chemistry," Breckenridge, CO. July 2008.

L.-Q. Wang, D. Wang, J. Liu, G. J. Exarhos, S Pawsey, IL Moudrakovski, " Probing Porosity and Pore Interconnectivity in Highly Crystalline Mesoporous TiO_2 Using Hyperpolarized ^{129}Xe NMR." 50^{th} Rocky Mountain Conference On Analytical Chemistry," Breckenridge, CO. July 2008.

Wang LQ, GJ Exarhos, S Pawsey, IL Moudrakovski, and JA Ripmeester. 2007. "Hyperpolarized 129Xe Nuclear Magnetic Resonance Investigation of Molecularly Organized Nanostructural Materials." Abstract submitted to American Chemical Society 234th National Meeting Exposition, Boston, MA. PNNL-SA-54387.

Wang LQ, C Yao, X Zhou, CF Windisch, Jr, LR Pederson, and GJ Exarhos. 2007. "Probing Hydrogen in ZnO Nanorods Using in situ Solid-State 1H NMR." Abstract submitted to American Chemical Society 234th National Meeting Exposition, Boston, MA. PNNL-SA-54388.

Exarhos GJ, WD Samuels, Y Shin, LQ Wang, C Yao, and WM Risen. 2007. "Carbohydrate Templates for Engineering Nanostructures." Abstract submitted to Fundamental Synthesis Research Challenges for 21st Century Materials: Mechanism and Methods, Washington, DC. PNNL-SA-55274.

Wang LQ. 2006. "Nuclear Magnetic Resonance in Materials Research." Presented by Li-Qiong Wang (Invited Speaker) at Materials Science and Engineering Seminar at UW, Seattle, WA on March 6, 2006. PNNL-SA-46534.

Wang LQ. 2006. "NMR Investigation of Molecularly Organized Nanostructural Materials." Presented by Li-Qiong Wang at International Symposium on Xenon NMR of Materials at National Research Council, Steacie Institute for Molecular Sciences, Ottawa, Ontario, Canada, June 1-3, 2006.

Wang LQ. 2006. "Temperature Dependent High Resolution ^{1}H MAS NMR Studies of ZnO Nanorods." Presented by Li-Qiong Wang at 47th Experimental Nuclear Magnetic Resoancne Conference, Asilomar Conference Center, Pacific Grove, CA, April 23-28, 2006.

Chemistry and Material Science Department Seminar, Washington State University, Pullman, WA, Sept. 9, 2005. Invited Talk: Nuclear Magnetic Resonance in Materials Research.

The 52st National Symposium American Vacuum Society, Boston, MA, Oct.30-Nov. 4, 2005. Presentation: Adsorption and Reaction of CO and CO_2 on Oxidized and Reduced $SrTiO_3$(100) Surfaces.

National Research Council, Steacie Institute for Molecular Sciences, Ottawa, Ontario, Canada, April, 19, 2005. Invited Talk: Investigation of Molecularly Organized Nanostructural Materials.

The 51st National Symposium American Vacuum Society, Anaheim, CA, Nov. 14-19,2004. Talk: Adsorption and Reaction of Acetaldehyde and Methanol on Stoichiometric and Defective Mixed-Metal Oxide Surface.

Physics Department Seminar, Portland State University, Portland, OR, Nov. 1, 2004. Invited Talk: Investigation of Molecularly Organized Nanostructural Materials.

26th Annual Symposium on Applied Surface Analysis, Richland, WA, June 15-18, 2004, Talk: Probing the Geometry and Interconnectivity of Nano-Pores in Organic Aerogels Using Hyperpolarized 129Xe NMR spectroscopy.

26th Annual Symposium on Applied Surface Analysis, Richland, WA, June 15-18, 2004, Presentation: Adsorption and Reaction of Oxygenated Hydrocarbons on Stoichiometric and Defective Mixed-Metal Oxide Surface.

45th Rocky Mountain Conference on Analytical Chemistry, Denver, CO, July 27-31, 2003. Invited Talk: Magnetic Resonance Studies of Hierarchically Ordered Replicas of Wood Cellular Structures Prepared by Surfactant-Mediated Mineralization.

Third IEEE Conference on Nanotechnology, San Francisco, CA, Aug. 12-14, 2003. Presentation: Dynamic π-π Stacked Molecular Nanostructures Emit from Green and Red Color.

DOE Nanoscience Workshop, Sante Fe, New Mexico, Sept. 29-Oct 1, 2002. Invited talk: NMR Investigation of Molecularly Organized Nanostructural Materials.

Chemistry and Material Science Department Seminar, Washington State University, Pullman, WA, Oct. 11, 2002. Invited Talk: Investigation of Molecularly Organized Nanostructural Materials.

Northwest American Chemical Society Meeting, Spokane, WA, June20-23, 2002. Talk: Investigation of Local Molecular Ordering in Layered Surfactant-Silicate Mesophases.

EMSL 2002 User Meeting, PNNL, Richland, WA, May 21-22, 2002. Invited talk: Adsorption and Reaction of Acetaldehyde and Nitric Oxide on $SrTiO_3$ Surfaces.

223rd American Chemical Society National Meeting, Orlando, FL, April 7-11, 2002. Presentations: ^{129}Xe NMR Study of Functionalized Ordered Mesoporous Silica; Investigation of Local Molecular Ordering in Layered Surfactant-Silicate Mesophases.

Nanoscale Science and Technology Workshop, University of Washington, Seattle, WA, August16-17, 2001. Invited talk: Molecular Assembly In Ordered Nanoporosities.

48th International Symposium American Vacuum Society, San Francisco, CA, Oct. 29-Nov. 2, 2001. Talk: Surface Structure Influence on Reactivity of Small Molecules on $SrTiO_3$(100) Surfaces.

221st American Chemical Society National Meeting, San Diego, CA, April 1-5, 2001.
Talk: Multi-Nuclear Magnetic Resonance Investigation of Molecular Assembly in Ordered Nanoporosities.

221st American Chemical Society National Meeting, San Diego, CA, April 1-5, 2001. Presentation: Adsorption and Dissociation of Water and Methanol on Stepped $SrTiO_3$(100) surfaces.

220th American Chemical Society National Meeting, Washington D.C, August 20-24, 2000. Presentation: Solid-state NMR Investigation of Molecular Assembly In Ordered Nanoporosities.

220th American Chemical Society National Meeting, Washington D.C, August 20-24, 2000. Presentation: A Comparative Study for Small-molecule Adsorption onto Stoichiometric and Defective TiO_2 and $SrTiO_3$ Surfaces.

Pacifichem 2000, Honolulu, Hawaii, Dec. 14 - 19, 2000. Presentation: Interaction of Small Molecules with Stoichiometric, Stepped, and Reduced $SrTiO_3$(100) Surfaces.

42nd Rocky Mountain Conference on Analytical Chemistry", Omni Interlocken Resort, Broomfield, Colorado, July 30-Aug. 3, 2000. Presentation: Investigation of Molecular Assembly In Ordered Nanoporosities Using Solid State NMR.

Materials Research Society Fall Meeting, Boston, MA, Nov.27-Dec.1, 2000. Talk: Structure-Property Relationships for Small Molecule Adsorption on TiO_2 and $SrTiO_3$ Surfaces.

The 46th National Symposium American Vacuum Society, Seattle, WA, Oct. 25-29,1999. Talk: Interactions of HCOOH on Stoichiometric and Reduced $SrTiO_3$(100) Surfaces.

54th Northwest Regional Meeting of the American Chemical Society, Portland, WA, June 17-20, 1999. Talk: Solid State NMR Studies of Chemistry of Molecularly Engineered Nano-Materials Through Templating.

Pacific Northwest American Vacuum Society Symposium, Richland, WA, June 21-24, 1999. Talk: Interactions of H_2O and HCOOH with $SrTiO_3$(100) Surfaces.

Materials Research Society Fall Meeting, Boston, MA, Nov. 27, 1999. Talk: Solid-State NMR and Molecular Modeling Investigation of the Molecular Conformations of Long-Chain Alkanoic Acid Self-Assembled on Oxide Surfaces.

40th Rocky Mountain Conference on Analytical Chemistry", Denver, CO, July 25-Aug. 1, 1998. Presentation: Solid State NMR Studies of Conformation and Dynamics of Surfactant Molecules in Molecularly Organized Nanostructured Materials.

53rd Northwest Regional Meeting of the American Chemical Society, Pasco, WA, June 17-20, 1998. Talk: Solid State NMR Studies of Conformation and Dynamics of Functional Molecules in Molecularly Tailored Composites.

Pacific Northwest American Vacuum Society Symposium, Richland, WA, June 16-19, 1998. Talk: A Comparative Study for Interactions of Small Molecules with (100) SrTiO3 and with (100) and (110) TiO_2 Surfaces.

The 44th National Symposium American Vacuum Society, San Jose, CA, Oct. 20-24, 1997. Talk: Studies of Defect Chemistry on (110) and (100) TiO_2 Surfaces.

Pacific Northwest American Vacuum Society Symposium, Troutdale, Oregon, Sept. 18-20, 1997. Talk: Interactions of Liquid and Vapor Water with Stoichiometric and Defective (100) and (110) TiO_2 Surfaces.

213th American Chemical Society National Meeting, San Francisco, CA, April 13, 1997. Talk: Applications of NMR in Characterization of Advanced Phosphate Ceramics.

213th American Chemical Society National Meeting, San Francisco, CA, April 13, 1997. Presentation: Studies of the Defect Chemistry of TiO2 Surfaces.

Materials Research Society Spring Meeting, San Francisco, CA, April 8-12, 1996. Talk: The Interaction of Liquid and Vapor Water With Nearly Defect-Free and Defective TiO_2(100) Surfaces.

Materials Research Society Spring Meeting, San Francisco, CA, April 8-12, 1996. Presentation: Structure and Dynamics of Functional Molecules in Porous Ceramics Studied Using Multinuclear Solid State Nuclear Magnetic Resonance.

38th Rocky Mountain Conference on Analytical Chemistry", Denver, Colorado, July 21-26,

1996. Presentation: Solid State NMR Studies of The Structure and Dynamics of Functional Molecules in Porous Ceramics.

Pacific Northwest American Vacuum Society Symposium, Troutdale, Oregon, Sept. 18-20, 1996. Talk: Interactions of HCOOH with Stoichiometric and Defective TiO_2(110) Surfaces.

209th American Chemical Society National Meeting, Anaheim, CA, April 2-6, 1995. Talk: The Reactivity of Defects on TiO_2 Surfaces.

42nd National Symposium American Vacuum Society, Minneapolis, MN, Oct. 16-20, 1995. Talk: Interactions of Small Molecules with TiO_2(110) Surfaces: The Role of Defects.

Pacific Northwest American Vacuum Society Symposium, Troutdale, Oregon, Sept. 19-21, 1995. Talk: AFM, LEED, and XPS of TiO_2(100) Surfaces.

37th Rocky Mountain Conference on Analytical Chemistry, Denver, Colorado, July 23-27, 1995. Presentation: Investigations of the Structure and Dynamics of Surfactant Molecules During Nucleation of Mesophase Silicates Using Solid-State NMR.

The 47th Pacific Coast Regional Meeting of the American Ceramic Society, Seattle, WA, Nov. 1-3, 1995. Invited Talk: Applications of Solid State NMR in Synthesis of Advanced Ceramic Composites.

Materials Research Society Fall Meeting, Boston, MA, November 29 to December 3, 1994. Talk: The Adsorption of Liquid and Vapor Water on TiO_2 (110) Surfaces: The Role of Defects.

Pacific Northwest AVS Symposium, Troutdale, Oregon, Sept. 15-17, 1994. Talk: The Adsorption of Liquid and Vapor Water on TiO_2 (110) Surfaces: The Stability of Defects.

Gordon Research Conference, Plymouth, NH, July 18-22, 1994. Presentation: The Reactivity of Defects in the Adsorption of Liquid and Vapor Water on TiO_2 (110) Surfaces.

Pacific Northwest AVS Symposium, Seattle, WA, Sept. 16-17, 1993. Talk: E-Beam Induced Defect States on TiO_2(110).

17th Annual SSRL Users Group Meeting, Menlo Park, CA., October 1990. Presentation: Chemisorption Geometry of sq(3)xsq(3) R30^o Cl/Ni(111).

Ninth International Conference on Vacuum Ultraviolet Radiation Physics, Honolulu, HI, July, 1989. Talk: Temperature Dependent ARPEFS Study of c(2x2) Cl/Cu(001).