

Trevor A. Makal, Ph.D.

Department of Natural Sciences
The University of Virginia's College at Wise
One College Avenue
Wise, VA 24293

Phone: 512-639-4019 (m)
276-376-3442 (o)
Email: tam9k@uvawise.edu

EDUCATION

- 2013 **Ph.D.**, Chemistry (Inorganic), Department of Chemistry, Texas A&M University, College Station, TX 77840. Ph.D. Advisor: Dr. Hongcai Joe Zhou. Dissertation Title: "Pendant Functional Groups in Metal-Organic Frameworks – Effects on Crystal Structure, Stability, and Gas Sorption Properties"
- 2008 **B.S.**, Chemistry, Department of Chemistry, Texas A&M University, College Station, TX 77840.

Professional Experience

- 2013 – Present **Assistant Professor of Chemistry**, Department of Natural Sciences, The University of Virginia's College at Wise, Wise, VA
- 2013 – Present **Independent Consultant/Analyst**
- 2013 **Postdoctoral Research Assistant**, Department of Chemistry, Texas A&M University, College Station, TX. Zhou Research Lab. Research in the synthesis and application of advanced porous materials. Responsibilities included research, mentoring, overseeing organization and writing of grant proposals, overseeing preparation of grant quarterly reports, and overseeing daily function of Zhou research laboratories.
- 2012 **Instructor of Chemistry**, English Language Institute, Texas A&M University, College Station, TX
- 2010 – 2011 **Resident Scientist**, Partnership for Environmental Education and Rural Health (PEER), Texas A&M University and Texas A&M Consolidated Middle School, College Station, TX. NSF Graduate STEM Fellow in K-12 Education (GK-12) – fellowship designed to enhance K-12 education in rural schools and broaden graduate students' abilities to explain cutting-edge research. Prepared and presented activities and lessons to five 7th grade science classes per week. Activities included projects related to the subject matter currently in progress (primarily biology) with efforts to tie in practical applications as well as my own research. Strengthened ability to explain current scientific research in a manner understandable to middle school-aged students.
- 2008 – 2013 **Graduate Research Assistant**, Department of Chemistry, Texas A&M University, College Station, TX. Zhou Research Lab. Research in the synthesis of functional metal-organic frameworks for applications in gas storage. Extensive organic and metal-organic framework synthesis and characterization. Assisted in initial setup of Zhou labs at Texas A&M University and acquisition of major instrumentation.

- 2008 – 2012 **Graduate Teaching Assistant**, Department of Chemistry, Texas A&M University, College Station, TX. Courses included Descriptive Inorganic Chemistry, Advanced Inorganic Chemistry Lab, Organic Chemistry Lab, General Chemistry Lab
- 2007 **Undergraduate Research Assistant**, Department of Chemistry, Texas A&M University, College Station, TX. North lab. Conducted research for Prof. Simon W. North in the study of the kinetics of tropospheric oxidation of biogenic hydrocarbons. Assisted in the design and setup of instrumentation for laser photolysis/laser induced fluorescence experiments.
- 2005 – 2008 **Tutor**, Student Learning Center, Texas A&M University, College Station, TX. Provided free tutoring to students in the subjects of: general and organic chemistry; business and finite mathematics, and calculus; and physics.

Courses Taught Independently:

Inorganic Chemistry and lab
College Chemistry I and II, and labs
Sheltered Chemistry
English for Chemistry

RESEARCH EXPERIENCE

Research Summary:

Through my studies as an undergraduate and graduate researcher I gained a wide range of research experiences in the fields of inorganic solid state and coordination chemistry, organic chemistry, and physical atmospheric chemistry. I have substantial experience in X-ray crystallography (single crystal and powder diffraction), sorption studies, NMR spectroscopy, air sensitive synthesis, and crystallization techniques. My research skills are focused, but not limited to the synthesis and characterization of new metal-organic framework materials, primarily focused on the self-assembly process and structure-property relationships.

Specialized Knowledge of Instruments and Methods:

- X-ray single crystal diffraction data collection and structure determination/refinement
- X-ray powder diffraction, including structure analysis and Rietveld refinement
- Gravimetric and volumetric gas and vapor sorption measurements
- NMR/IR/UV-Vis spectroscopy and elemental analysis
- Gas chromatography
- Standard solid-state reaction techniques and solvothermal synthesis including various crystallization techniques
- Handling of air sensitive materials using both glovebox and Schlenk techniques
- Basic knowledge of molecular simulation software (GAUSSIAN, GaussView, AMPAC, Materials Studio, Molden, Sirius)

Research Collaboration Network with Experts in their Fields:

- Dr. Greg Halder, Argonne National Lab, *in situ* synchrotron X-ray powder diffraction
- Dr. Andrey Yakovenko, Argonne National Lab, X-ray single crystal diffraction and structure determination and refinement from X-ray powder diffraction data

- Prof. Berend Smit, LBNL, UC-Berkeley, molecular simulation of adsorption and diffusion of adsorbates in microporous materials
- Prof. Perla Balbuena, TAMU, atomic-level simulations
- Prof. Zhiyong Wang, Troy State University, organic ligand synthesis
- Prof. Kim Dunbar, TAMU, magnetic measurements (SQUID)
- Prof. Hong-Cai Zhou, TAMU, adsorption and selectivity measurements

PUBLICATIONS

ResearcherID: F-6778-2012

- Wang, X.; **Makal, T. A.**; Zhou, H.-C. Protein Immobilization in Metal-Organic Frameworks by Covalent Binding *Aust. J. Chem.* **2014**, *67*, 1629-1631.
- Makal, T. A.**; Zhang, W.; Zhou, H.-C. Realization of Both High Hydrogen Selectivity and Capacity in a Guest Responsive Metal-Organic Framework *J. Mater. Chem. A* **2013**, *1*, 13502-13509.
- Makal, T. A.**; Wang, X.; Zhou, H.-C. Tuning the Moisture and Thermal Stability of Metal-Organic Frameworks through Incorporation of Pendant Hydrophobic Groups *Cryst. Growth Des.* **2013**, *13* (11), 4760-4768.
- Lu, W.; Yuan, D.; **Makal, T. A.**; Wei, Z.; Li, J.-R.; Zhou, H.-C. Highly Porous Metal-Organic Framework Sustained with 12-Connected Nanoscopic Octahedra *Dalton Trans.* **2013**, *42*, 1708-1714.
- Makal, T. A.**; Li, J.-R.; Lu, W.; Zhou, H.-C. Methane Storage in Advanced Porous Materials *Chem. Soc. Rev.* **2012**, *41* (23), 7761-7779. (Featured on Back Cover)
- Lu, W. G.; Yuan, D.; **Makal, T. A.**; Li, J.-R.; Zhou, H.-C. A Highly Porous and Robust (3,3,4)-Connected Metal-Organic Framework Assembled with a 90 degrees Bridging-Angle Embedded Octacarboxylate Ligand *Angew. Chem. Int. Ed.* **2012**, *51* (7), 1580-1584.
- Makal, T. A.**; Yakovenko, A. A.; Zhou, H.-C. Isomerism in Metal-Organic Frameworks: "Framework Isomers" *J. Phys. Chem. Lett.* **2011**, *2*, 1682-1689. (Featured on Cover)
- Li, H.-Y.; Jiang, L.; Xiang, H.; **Makal, T. A.**; Zhou, H.-C.; Lu, T.-B. Construction of Two 3D Homochiral Frameworks with 1D Chiral Pores via Chiral Recognition *Inorg. Chem.* **2011**, *50* (8), 3177-3179.
- Makal, T. A.**; Yuan, D.; Zhao, D.; Zhou, H.-C. In *The Chemistry of Nanostructured Materials, Vol. II*, Yang, P., Ed. World Scientific: Singapore **2011**: pp 37-64.
- Fang, Q.-R.; **Makal, T. A.**; Young, M. D.; Zhou, H.-C. Recent Advances in Mesoporous Metal-Organic Frameworks *Comment. Inorg. Chem.* **2010**, *31*, 165-195.
- Kuppler, R. J.; Timmons, D. J.; Fang, Q.-R.; Li, J.-R.; **Makal, T. A.**; Young, M. D.; Yuan, D.; Zhao, D.; Zhuang, W.; Zhou, H.-C. Potential Applications of Metal-Organic Frameworks *Coord. Chem. Rev.* **2009**, *253*, 3042-3066.

Submitted Manuscripts

- Liu, Y.; Zou, L.; Xizhen, L.; **Makal, T. A.**; Li, J.-R.; Zhou, H.-C. Enhancing Stability of Metal-Organic Frameworks for Applications *Acc. Chem. Res.* **submitted manuscript**

PRESENTATIONS

- "Improving Porosity and H₂-Affinity of Porous Framework Materials" 2012 Annual Merit Review & Peer Evaluation, U.S. Department of Energy Hydrogen and Fuel Cells Program **2012**, Washington, DC.
- "Structural Control of Metal-organic Frameworks Based on Linear Linkers by Co-ligand Addition" Symposium UU: Crystalline Nanoporous Framework Materials – Applications and Technological Feasibility, Materials Research Society Spring Meeting **2011**, San Francisco, CA.

“Hydrogen Storage in Metal-Organic Frameworks From the Zhou Group and Other Research” Invited seminar for the Green Path Society of Texas A&M Consolidated High School **2010**, College Station, TX.

LEADERSHIP EXPERIENCE

- 2009 – 2013 **Lab Manager**, Zhou Research Group, Department of Chemistry, Texas A&M University, College Station, TX. Responsible for safety training, duty assignment, and daily operation of the research laboratory and equipment. Head of recruiting for the research group. Conducted laboratory safety inspections. Presented overview of group research focus, laboratory tours, and provide explanations of all equipment and techniques used in lab to visiting professors and collaborators.
- 1996 – 2001 **Boy Scouts of America**, Eagle Scout (August 2001) and Brotherhood Member of the Order of the Arrow.

SERVICE

College Service:

- 2014 **Member**, Faculty Search Committee, Chemistry Lecturer position. Department of Natural Sciences, The University of Virginia’s College at Wise, Wise, VA.
- 2012 **Graduate Student Mentor**, Graduate Visitation Weekend, Department of Chemistry, Texas A&M University, College Station, TX.

Professional Service:

Peer Reviewer for the Following Journals:

Energy & Environmental Science
New Journal of Chemistry
Polymer Chemistry
Chemical Communications
Inorganic Chemistry
CrystEngComm
Dalton Transactions
Journal of Molecular Structure
Langmuir

Peer Reviewer for American Chemical Society – Petroleum Research Fund Grant Application

AWARDS/GRANTS

ARPA-E MOVE Grant, Co-led the development, writing, organization, and negotiation of a successful **\$3M** grant, “System Development for Vehicular Natural Gas Storage Using Advanced Porous Materials”, with three major collaborators (General Motors, Lawrence Berkeley National Lab, RTI International), July 2012. PI: Hongcai Joe Zhou.

Eastman Chemical Company Teaching Award, awarded for excellence in teaching from the TAMU First Year Chemistry Program, spring 2009

Submitted Grants under Evaluation

American Chemical Society – Petroleum Research Fund, Undergraduate New Investigator, Submitted grant proposal “Heavy Metal Adsorption in Metal-Organic Frameworks”, **\$55,000** over 2 years. Notification ~October 2014. PI: Trevor A. Makal. *Declined*

PROFESSIONAL AFFILIATIONS

American Chemical Society – Member	<i>2008-present</i>
Materials Research Society – Member	<i>2011-2013</i>
Phi Eta Sigma National Honor Fraternity – Member	<i>2005-2008</i>

GRADUATE COURSEWORK

Symmetry and Group Theory
Physical Methods in Inorganic Chemistry
Structural Inorganic Chemistry
Chemical Kinetics
Main Group Chemistry
Ethics in Chemical Research
Literature Seminar Presentation
Title: Stability and Dynamics of Self-Assembled Hydrogen-Bonded Capsules

OTHER INFORMATION

Languages: English (native speaker), German (basic knowledge), Spanish (basic knowledge)

Computer Literacy: Proficient with X-ray programs, such as SHELXTL, PLATON, Mercury, Jana, Diamond, TOPOS, APEXII; diverse research software, such as OriginPro, ChemBioOffice, Word, Excel, PowerPoint, EndNote; basic knowledge with molecular simulation software, such as GAUSSIAN, GaussView, AMPAC, Materials Studio, Molden, Sirius

Personal Interests:

- **Community theatre** (2011 – present): Performed in 5 productions at StageCenter Theatre, Bryan, TX, and one production with the “You’ll Never Work in Theatre, Again! Players”, Wise, VA.
- **Bowling** (2004 – present): Personal record 267 league game