

WEN SONG

University of Texas at Austin
Hildebrand Department of Petroleum and Geosystems Engineering
200 E. Dean Keeton Street
Austin, TX 78712
Phone: (512) 471-5789
e-mail: wensong@utexas.edu

NATIONALITY: CANADIAN

EXPERIENCE

2019 – Present **Assistant Professor**
Hildebrand Department of Petroleum and Geosystems Engineering
University of Texas at Austin, Austin, TX

EDUCATION

- 2014 – 2019 **Stanford University, Department of Energy Resources Engineering**
Ph.D. in Energy Resources Engineering
Advisor: Professor Anthony R. Kavscek
Dissertation Topic: *"Fluid-Fluid, Fluid-Mineral Interactions and Reactive Transport in Porous Media"*.
Ph.D. Minor in Mechanical Engineering
Advisor: Professor John O. Dabiri
- 2012 – 2014 **University of Toronto, Department of Mechanical Engineering**
M.S. in Mechanical Engineering
Advisor: Professor David A. Sinton
Thesis: *"Microfluidic Visualization of Phase and Flow Phenomena Related to Carbon Dioxide Transport and Usage"*.
- 2008 – 2012 **University of Toronto, Department of Mechanical Engineering**
B.S. in Engineering Science
Advisor: Professor Brent E. Sleep
Honors Thesis: *"Two Phase Dynamics in Porous Media with Applications to Carbon Sequestration"*.

INTERESTS

ACADEMIC I am ultimately interested in understanding the formation and development of energy resources through experimental and theoretical micro and nanofluidic approaches in reactive transport. Specifically, my research interests aim to understand multiphase reactive transport and fluid-fluid/ fluid-rock interactions in porous media in the context of low environmental impacts energy resources recovery. My current research develops and uses microfluidic visualization platforms to study the mechanisms underlying multiphase fluid transport and surface interactions that dictate energy materials recovery.

TEACHING My primary teaching goal is to educate students with the fundamental knowledge that is required to meet our society's rising demands to develop low environmental impacts energy resources. I also aim to help develop their ability and passion towards advancing fundamental engineering knowledge. I am interested in teaching both basic and applied courses on thermodynamics and phase equilibria, fluid mechanics, micro and nanoscale transport phenomena, and general courses in energy resources to develop the next generation of leaders in the field of energy science and engineering.

SERVICE

- 2019 Convener, Session H136 Understanding Pore-Scale Mechanisms of Fluid Flow in Porous Media: Modeling and Experimental Approaches, AGU Fall Meeting
- 2019 Petroleum Science and Technology Institute for Texas High School Teachers, Department of Petroleum and Geosystems Engineering, UT Austin
- 2019 Student Paper Contest Judge, Society of Petroleum Engineers UT Austin Chapter, UT Austin
- 2019 Careers Opportunities On Location Week Lecture, UT Austin
- 2019 Graduate and Industry Networking Poster Judge, Graduate Engineering Council, UT Austin
- 2019 UT Energy Week Poster Judge, UT Energy Club, UT Austin
- 2017 – 2018 Clean Energy, Education, and Empowerment (C3E) Symposium Organizing Committee, Clean Energy Ministerial, US Department of Energy
- 2017 – 2018 Global Energy Forum Organizing Committee, Precourt Institute for Energy, Stanford University
- 2017 – 2018 Student Energy Competitions Task Force, Precourt Institute for Energy, Stanford University
- 2017 – 2018 President, Stanford Energy Club, Stanford University
- 2017 – 2018 Department Seminar Committee, Energy Resources Engineering, Stanford University
- 2017 – 2018 Undergraduate Mentor Program Chair, Energy Resources Engineering, Stanford University
- 2016 – 2017 Faculty Search Committee, Energy Resources Engineering, Stanford University
- 2016 – 2017 Oil and Gas Group Leader, Stanford Energy Club, Stanford University
- 2015 – 2018 Undergraduate and Graduate student mentor, Stanford University
- 2015 – 2017 President, Officer, Society of Petroleum Engineers, Stanford University Chapter
- 2013 – 2014 Founder and President, Society of Petroleum Engineers, University of Toronto Chapter

- 2010 – 2013 Director of Seminars, Sustainable Engineers Association
- 2009 – 2012 Chair, Mentor, Engineering Science Freshman Mentorship Program
- 2009 – 2012 President, Project Director Tetra Society, University of Toronto Chapter

PROFESSIONAL ACTIVITIES

- 2017 – Present Advisor, Interface Fluidics
- 2016 – Present Reviewer, SPE Journal; Fuel; Journal of Petroleum Science and Engineering; Natural Resources Research; Greenhouse Gases: Science and Technology; IEEE Transactions on Geoscience and Remote Sensing
- 2013 – Present Member, Society of Petroleum Engineers (SPE); American Chemical Society (ACS); American Association of Petroleum Geologists (AAPG); Geochemical Society; Academy of Association for the Advancement of Science (AAAS)

HONORS AND AWARDS

- 2018 – 2019 Gerald J. Lieberman Fellowship
- 2017 Gordon Research Conference (Microfluidics, Physics and Chemistry of) Best Poster Award
- 2016 Gordon Research Seminar (Flow and Transport in Permeable Media) Discussion Leader
- 2016 Petroleum Research School of Norway STEP Scholarship
- 2015 – 2018 Hormoz and Fariba Ameri Graduate Education Fellowship in Earth Sciences
- 2014 Society of Petroleum Engineers Calgary Section Scholarship
- 2013 4th World Petroleum Council Youth Forum Student Invitation Fellowship
- 2013 – 2014 Queen Elizabeth II Graduate Scholarship in Science and Technology
- 2013 MIE Research Symposium Best Poster Presentation Award
- 2013 Carbon Management Canada International Research Exchange Fellowship
- 2012 Gordon Cressy Award for Student Leadership
- 2009 Engineering Science Research Opportunities Program Fellowship

GRANTS AND FUNDING

Engineered Water for Improved Oil Recovery from Fractured Reservoirs (PI: Kishore K. Mohanty).

Source of Support: DOE Fossil Energy

Award Number:

Total Award Period: 09/01/2019 - 08/31/2023

Total Award Amount: \$ 7,919,227

Song Share Amount: \$ 165,000

Targeted Enhanced Oil Recovery using Nanoparticle-Stabilized Solvent Capsules

Source of Support: Chemical Enhanced Oil Recovery Consortium

Total Award Period: 06/01/2019 - 05/31/2020

Total Award Amount: \$ 25,000

Song Share Amount: \$ 25,000

CO₂ foams stabilized only with surface-modified silica nanoparticles for enhanced oil recovery

Source of Support: ConTex

Total Award Period: 09/01/2019 - 08/31/2020

Total Award Amount: \$ 100,000

Song Share Amount: \$ 70,000

INVITED TALKS

- [21] Mechanistic Delineation on the Storage of CO₂ as Stable Hydrates. Department of Geophysics. Stanford, CA, January 2020.
- [20] Pore-Scale Controls of Reactive Transport in Carbonate Porous Media. AGU Fall Meeting. San Francisco, CA, December 2019.
- [19] Mechanistic Delineation of Reactive Transport in Carbonate Porous Media and its Impact on CO₂ Storage Security. Society of Engineering Science Annual Technical Meeting. St. Louis, MO, October 2019.
- [18] Mineral Resources: Powering Sustainability. UT Austin Energy Institute Annual Showcase. Austin, TX, October 2019.
- [17] Mechanisms of Subsurface Resources Management. Physics of Microfluidics. Austin, TX, June 2019.
- [16] Pore-Scale Observations into CO₂ Storage Security. Gordon Research Seminar: Carbon Capture, Utilization and Storage. Les Diablerets, Switzerland, May 2019.
- [15] Control of Fluid-Rock Interactions at the Micro/Nano-Scales. Chemical Enhanced Oil Recovery Meeting, Department of Petroleum and Geosystems Engineering, University of Texas at Austin, Austin, TX, April 2019.
- [14] In Search of Global Energy Solutions: What the Small-Scale can Offer. External Advisory Committee Meeting, Department of Petroleum and Geosystems Engineering, University of Texas at Austin, Austin, TX, April 2019.
- [13] Functionalized Micromodels for Mechanistic Understanding of Petroleum Resources. Digital Rocks Petrophysics Inaugural Meeting, Department of Petroleum and Geosystems Engineering, University of Texas at Austin, Austin, TX, March 2019.
- [12] Fluid-Fluid, Fluid-Mineral Interactions and Reactive Transport in Porous Media. Bureau of Economic Geology, University of Texas at Austin, Austin, TX, February 2019.
- [11] Microscale Transport for Improving Petroleum Recovery. Upstream Research Company, ExxonMobil, Spring, TX, April 2018.

- [10] Pore-Scale Transport for Hydrocarbon Recovery. Hildebrand Department of Petroleum and Geosystems Engineering, University of Texas at Austin, Austin, TX, April 2018.
- [9] Microfluidics for Subsurface Energy and Environmental Resources. Department of Mechanical and Industrial Engineering, University of Toronto, Toronto, Canada, March 2018.
- [8] Micro/Nanoengineering for Subsurface Energy and Environmental Resources. Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA, February 2018.
- [7] Pore-Scale Fluid-Mineral Interactions related to Multiphase Reactive Transport. Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, Cambridge, MA, November 2017.
- [6] Wettability in Reactive Transport through Carbonates and Implications for CO₂ Storage Security. Global Climate and Energy Project Student Energy Lectures, Stanford University, Stanford, CA, July 2017.
- [5] Wettability in Transport through Carbonates. Stanford Center for Carbon Storage Annual Meeting, Stanford University, Stanford, CA, May 2017.
- [4] Micro- and Nano-Fabricated Visualization Platforms for studying Hydrocarbon Recovery and CO₂ storage. IEEE SFBA Nanotechnology Council's 13th Annual Symposium, Milpitas, CA, May 2017.
- [3] Direct Visualization of Pore-Scale Phenomena related to Multiphase Reaction and Transport through Porous Media. Department of Mechanical and Industrial Engineering, University of Toronto, Toronto, Canada, September 2016.
- [2] Wettability in Reactive Transport through Carbonates. Gordon Research Seminar: Flow and Transport in Permeable Media. Girona, Spain, July 2016.
- [1] Direct Visualization of Pore-Scale Fines Migration and Formation Damage during Low-Salinity Waterflooding. Center for Integrated Petroleum Research, University of Bergen, Bergen, Norway, June 2016.
- [0] Pore-Scale Visualization of Clay Particle Release in response to Changes in Brine Composition. Pore Scale Seminar, Department of Energy Resources Engineering, Stanford University, Stanford, CA, April 2015.

STUDENTS ADVISED

CURRENT STUDENTS

- 2019 - Present Artur Davletshin, Ph.D. Student, University of Texas at Austin
Thermochemical Improved Oil Recovery from Unconventional Resources.
- 2019 - Present Sheila Gerardo, M.S./Ph.D. Student, University of Texas at Austin
Wettability of Surfaces due to Aging and its Modification.
- 2019 - Present Chizoba Obasi, M.S./Ph.D. Student, University of Texas at Austin
Nanoparticle-Stabilized Solvent Delivery for Enhanced Oil Recovery.
- 2019 - Present David Fukuyama, Ph.D. Student, University of Texas at Austin (with Hugh Daigle)
Hydrates Gas Exchange for Deepwater CO₂ Storage.
- 2019 - Present Jaehun (Eric) Yoon, B.S. Student, University of Texas at Austin
Direct Microvisual Chemical Analysis of Reactive Transport Dynamics.

FORMER STUDENTS

- 2019 Xuefei (Sophie) Zhao, B.S. Student, University of Texas at Austin
Self-Folding Origami Structures for Compression-Resistance.
- 2018 Emma Li (High School research student), Stanford University
Fractal dimensions of fluid fingering in Hele-Shaw cells.
- 2017 Raja Ramesh (Undergraduate research student), Stanford University
Nanofabrication of micromodels for fluid-mineral interactions visualization.
- 2015 Donnique Sherman (SURGE Diversity Program Undergraduate research student), School of Earth, Energy, and Environmental Sciences, Stanford University
Low salinity brine-clay interactions in kaolinite-functionalized micromodels.

PH.D. COMMITTEES SERVED

2019 Lucas Mejia, Advised by M. Balhoff, University of Texas at Austin

AWARDS WON BY STUDENTS

2019 Sheila Gerado: DOE Research Experience in Carbon Sequestration Travel Grant

COURSES TAUGHT

INSTRUCTOR

Fall 2019 PGE 323K: Reservoir Engineering I, University of Texas at Austin

Undergraduate course on the fundamentals of reservoir engineering. Classification of subsurface reservoirs by type and recovery mechanism is discussed. Reserve estimates based on material balance are derived. We develop equations for steady-state and transient fluid flow in permeable reservoir rocks in application to solving subsurface engineering problems.

Winter 2019 PGE 383: Small-Scale Fluid Flow, University of Texas at Austin

Graduate course on the physics of fluid flow at the microscale in the context of pore-scale transport in subsurface systems and microfluidic models of subsurface systems. A basic review of geological sediment deposition motivates the appropriate microscopic length-scales. Equations of mass and momentum conservation for incompressible fluids are derived. Simplifications towards the small-scale, slow-flow limit are developed to describe transport through pores along with topics in diffusion, dispersion, Brownian Motion, and electrostatic relations to flow. Techniques in micromodels development are covered.

Fall 2017 ENERGY 251: Thermodynamics of Equilibria, Stanford University

Develop and deliver 11 lectures on the thermodynamics of phase equilibria and fundamental thermodynamics. Develop weekly problem sets. Lectures are 110 minutes each and delivered 2 times a week. Taken by graduate students.

TEACHING ASSISTANT

Winter 2018 ENERGY 301/ CEE 301/ MS&E 494: The Energy Seminar, Stanford University

Assist with inviting speakers and grade final papers. Taken by graduate and undergraduate students.

Winter 2017 ENERGY/EE 293B: Fundamentals of Energy Processes, Stanford University

Develop and lead weekly 1-hour lecture-style Section to review material covered in lecture. Topics include thermodynamics of heat

cycles, biomass, geothermal, and solar thermal energy resources.
Taken by graduate and undergraduate students.

Winter 2016 ENERGY/EE 293B: Fundamentals of Energy Processes, Stanford University
Led weekly office hours that cover thermodynamics of heat cycles, biomass, geothermal, and solar thermal energy resources and graded problem sets. Taken by graduate and undergraduate students.

Fall 2013 CHE 260: Thermodynamics and Heat Transfer, University of Toronto
Developed and delivered tutorials on fundamental thermodynamics.
Taken by undergraduate students.

PUBLICATIONS

JOURNAL PUBLICATIONS

- [7] Song, W. and Kavscek, A.R. Spontaneous Clay Pickering Emulsification. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 577, 158-166, 2019. doi:10.1016/j.colsurfa.2019.05.030.
- [6] Song, W., Ogunbanwo, F., Steinsbo, M., Ferno, M., and Kavscek, A.R. Mechanisms of Multiphase Reactive Flow using Biogenically Calcite-Functionalized Micromodels. *Lab on a Chip*, 18, 3881-3891, 2018. doi:10.1039/C8LC00793D.

Invited by editor to be featured as the issue cover.

- [5] Harrison, A.L., Dipple, G.M., Song, W., Mayer, K.U., Power, I.M., and Sinton, D. Pore scale visualization of mineral dissolution-precipitation reactions in the vadose zone. *Chemical Geology*, 463, 1-11, 2017. doi:10.1016/j.chemgeo.2017.05.003.
- [4] Song, W. and Kavscek, A.R. Direct visualization of pore-scale fines migration and formation damage during low-salinity waterflooding. *Journal of Natural Gas Science and Engineering*, 34, 1276-1283, 2016. doi:/10.1016/j.jngse.2016.07.055.
- [3] Song, W. and Kavscek, A.R. Functionalization of micromodels with kaolinite for investigation of low salinity oil-recovery processes. *Lab on a Chip*, 15 (16), 3314-3325, 2015. doi:10.1039/C5LC00544B.

Invited by editor to be featured as the issue cover.

- [2] Song, W., de Haas, T.W., Fadaei, H., and Sinton, D. Chip-off-the-old-rock: the study of reservoir-relevant geological processes with real-rock micromodels. *Lab on a Chip*, 14 (22), 4382-4390, 2014. doi:10.1039/C4LC00608A.

This article was highlighted in a Chemistry World article.

- [1] Song, W., Fadaei, H., and Sinton, D. Determination of dew point conditions for CO₂ with impurities using microfluidics. *Environmental Science and Technology*, 48 (6), 3567-3574, 2014. doi:10.1021/es404618y.

SUBMITTED JOURNAL PUBLICATIONS AND ARTICLES IN PREPARATION

- [3] Song, W. and Kovscek, A.R. Spontaneous Fingering between Miscible Fluids. *In Review.*
- [2] Song, W., Sinton, D., and Kovscek, A.R. Geological microfluidics: state-of-the-art and opportunities. *In preparation.*
- [1] Song, W., Ramesh, R., and Kovscek, A.R. Pore-scale study of carbonate dissolution under low salinity conditions. *In preparation.*

CONFERENCE PRESENTATIONS

- [18] Pore-Scale Observations into CO₂ Storage Security. Gordon Research Conference: Carbon Capture, Utilization and Storage. Les Diablerets, Switzerland, May 2019. [Poster]
- [17] Song, W. and Kovscek, A.R. Spontaneous Fractal Fingering between Miscible Fluids. *Gordon Research Conference: Flow and Transport in Permeable Media.* Newry, ME, July 2018. [Poster]
- [16] Song, W. and Kovscek, A.R. Spontaneous Fractal Fingering between Miscible Fluids. *2018 SUPRI-A Industrial Advisory Committee Meeting.* Stanford, CA, April 2018. [Talk]
- [15] Song, W. and Kovscek, A.R. Reactive Transport through Carbonates and Implications for CO₂ Storage Security. *Global Climate and Energy Project Research Symposium.* Stanford, CA, October 2017. [Talk]
- [14] Song, W., Ferno, M.A., and Kovscek, A.R. Pore-scale mechanics of reactive transport and phase change through calcite porous media. *Gordon Research Conference: Physics and Chemistry of Microfluidics.* Lucca, Italy, June 2017. [Poster]
- [13] Song, W., Ogunbanwo, F., Steinsbo, M., Ferno, M.A., Tchelepi, H., and Kovscek, A.R. Reactive Transport through Carbonates. *2017 SUPRI-A Industrial Advisory Committee Meeting.* Stanford, CA, April 2017. [Talk]
- [12] Song, W., Ferno, M.A., and Kovscek, A.R. Wettability in reactive transport through carbonates. *Gordon Research Conference: Flow and Transport in Permeable Media.* Girona, Spain, August 2016. [Poster]

- [11] Song, W. and Kavscek, A.R. Pore-scale visualization of carbonate dissolution mechanisms. *2016 SUPRI-A Industrial Advisory Committee Meeting*. Stanford, CA, April 2015. [Talk]
- [10] Song, W. and Kavscek, A.R. Direct visualization of pore-scale wettability alteration due to clays and impact on low salinity waterflooding. *2016 SUPRI-A Industrial Advisory Committee Meeting*. Stanford, CA, April 2016. [Talk]
- [9] Song, W. and Kavscek, A.R. Direct visualization of pore-scale wettability alteration due to clays. *12th International Symposium on Reservoir Wettability and its Effects on Oil Recovery*. Lawrence, KS, October 2015. [Talk]
- [8] Harrison, A.L., Dipple, G.M., Song, W., Power, I.M., Mayer, K.U., Beinlich, A., and Sinton, D. Pore Scale Visualization of Multiphase Reactions in the Unsaturated Zone. *Goldschmidt Abstracts*. Prague, Czech Republic, August 2015.
- [7] Song, W. and Kavscek, A.R. Pore-scale visualization of clay particle release in response to changes in brine composition. *2015 SUPRI-A Industrial Advisory Committee Meeting*. Stanford, CA. [Talk]
- Also presented at the *12th SEEES Annual Research Review* in Stanford, CA, April 2015.
- [6] Harrison, A.L., Dipple, G.M., Song, W., Power, I.M., Mayer, K.U., Beinlich, A., and Sinton, D. Pore scale visualization of multiphase reactions in the vadose zone. *The Geological Society of America Annual Meeting*. Vancouver, Canada, October 2014.
- [5] Harrison, A.L., Power, I.M., Dipple, G.M., Mayer, K.U., Wilson, S., Song, W., Sinton, D., and Su, D. Controls on carbon mineralization in mine wastes. *4th Annual Carbon Management Canada Conference*. Banff, Canada, June 2014.
- [4] Song, W., Fadaei, H., and Sinton, D. Reservoir engineering on a chip: enhanced oil recovery (EOR) studies using microfluidics. *4th World Petroleum Council Youth Forum*. Calgary, Canada, October 2013. [Talk]
- [3] Song, W., Fadaei, H., and Sinton, D. Micro/nanofluidics for hydraulic fracturing of shale gas. *Institute of Sustainable Energy Industrial Advisory*

Board Meeting. Toronto, Canada, October 2013. [Poster]

- [2] Song, W., Fadaei, H., and Sinton, D. Dew point determination for impure CO₂ mixtures at high pressures and high temperatures using microfluidics. *3rd Annual Carbon Management Canada Conference*. Calgary, Canada. [Poster]

Also presented at the *8th Annual Ontario-on-a-Chip conference* in Toronto, Canada, and the *4th MIE Research Symposium*. Toronto, Canada, June 2013.

- [1] Song, W. and Xia, K. Effect of notch thickness on the determination of fracture toughness using dynamic semi-circular bend technique. *University of Toronto Undergraduate Engineering Research Day*. Toronto, Canada, August 2009. [Talk]