Tianhao Wu

Associate Professor

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Research Interests

We study the fundamental physics of fluid flow in porous media. Our research aims to gain insight into the multi-physical processes in porous media and address the practical engineering problems for energy and environmental systems, including unconventional resources development and geological carbon sequestration. Our research involves various experimental techniques and simulation methods, including micro/nanomechanical tests, fluid flow experiments for porous media, molecular simulations, and pore-scale and laboratory-scale simulations. Specifically, we are interested in the following topics:

- Nanomechanical tests for rocks under complex conditions
- Advanced experimental methods for microflow and nanoflow
- Molecular scale, pore-scale, and laboratory-scale simulations for multi-physical processes in porous media

Education

07/2016 **Ph.D. in Mechanics (Energy and Resources Engineering)**
College of Engineering, Peking University, Beijing, China.
Dissertation: Investigation of gas transport mechanisms in the matrix of shale gas reservoir with numerical simulations and experiments

07/2010 **B.E. in Energy and Resources Engineering**
College of Engineering, Peking University, Beijing, China.

07/2010 **B.A. in Economics (double major)**
National School of Development, Peking University, Beijing, China.

Work Experience

2023 – present **Associate Professor,** College of Engineering
Eastern Institute for Advanced Study (EIAS), Ningbo, China.

2022 – 2023 **Assistant Professor,** College of Engineering
Eastern Institute for Advanced Study (EIAS), Ningbo, China.

2021 – 2022 **Research Associate Professor,** School of Environmental Science and Engineering
Southern University of Science and Technology, Shenzhen, China.

2020 – 2021 **Postdoctoral Research Associate,** Department of Chemical and Biomolecular Engineering
Rice University, Houston, USA.

2017 – 2020 **Postdoctoral Researcher**, Reservoir Engineering Research Institute (RERI), Palo Alto, USA.

2016 – 2017 **Research Associate**, College of Engineering, Peking University, Beijing, China.

Publications

(1) **Wu, T.**, & Firoozabadi, A. (2022). Effect of fluids on the critical energy release rate of typical components in shale and andesite by molecular simulations, *The Journal of Chemical Physics*, 157(4), 044701.

(2) **Wu, T.**, & Firoozabadi, A. (2021). Calculation of solid–fluid interfacial free energy with consideration of solid deformation by molecular dynamics simulations, *The Journal of Physical Chemistry A*, 125(26), 5841–5848.

(3) **Wu, T.**, & Firoozabadi, A. (2021). Surfactant-enhanced spontaneous emulsification near the crude oil-water interface, *Langmuir*, 37(15), 4736–4743.

(4) **Wu, T.**, Zhao J., Zhang W., & Zhang, D. (2020). Nanopore structure and nanomechanical properties of organic-rich terrestrial shale: An insight into technical issues for hydrocarbon production, *Nano Energy*, 69, 104426. (**Front Cover Article**)

(5) **Wu, T.**, & Firoozabadi, A. (2020). Mechanical properties and failure envelope of kerogen matrix by molecular dynamics simulations, *The Journal of Physical Chemistry C*, 124(4), 2289–2294.

(6) **Wu, T.**, & Firoozabadi, A. (2020). Fracture toughness and surface energy density of kerogen by molecular dynamics simulations in tensile failure, *The Journal of Physical Chemistry C*, 124(29), 15895–15901.

(7) **Wu, T.**, Zhang D., & Li, X. (2020). A radial differential pressure decay method with micro-plug samples for determining the apparent permeability of shale matrix, *Journal of Natural Gas Science and Engineering*, 74, 103126.

(8) Yang, Y., Liu, J., Yao, J., Kou, J., Li, Z., **Wu, T.**, Zhang, K., Zhang, L., & Sun, H., (2020). Adsorption behaviors of shale oil in kerogen slit by molecular simulation, *Chemical Engineering Journal*, 387, 124054.

(9) **Wu, T.**, & Firoozabadi, A. (2019). Effect of microstructural flexibility on methane flow in kerogen matrix by molecular dynamics simulations, *The Journal of Physical Chemistry C*, 123(17), 10874–10880.

(10) **Wu, T.**[#], Zhao H.[#], Tesson S., & Firoozabadi, A. (2019). Absolute adsorption of light hydrocarbons and carbon dioxide in shale rock and isolated kerogen, *Fuel*, 235, 855–867. ([#]Equal contribution)

(11) Zhao, J., Zhang, D., **Wu, T.**, Tang, H., Xuan Q., Jiang, Z., & Dai, C. (2019). Multiscale approach for mechanical characterization of organic-rich shale and its application, *International Journal of Geomechanics*, 19(1), 04018180.

(12) **Wu, T.**, & Firoozabadi, A. (2018). Molecular simulation of binary gas mixture transport in slit nanopores, *The Journal of Physical Chemistry C*, 122(36), 20727–20735.

(13) Zhao, H., **Wu, T.** & Firoozabadi, A. (2018). High pressure sorption of various hydrocarbons and carbon dioxide in Kimmeridge Blackstone and isolated kerogen, *Fuel*, 224, 412–423.

(14) **Wu, T.**, Li, X., Zhao, J., & Zhang, D. (2017). Multiscale pore structure and its effect on gas transport in organic-rich shale. *Water Resources Research*, 53(7), 5438–5450. (**Editor's Highlights**)

(15) **Wu, T.**, & Zhang, D. (2016). Impact of adsorption on gas transport in nanopores. *Scientific Reports*, *6*, 23629.

(16) Zhang, D., Yang, T., **Wu, T.**, Li, X., & Zhao, J. (2016). Recovery mechanisms and key issues in shale gas development. *Chinese Science Bulletin (in Chinese)*, 61(1), 62–71.

Conference Proceedings

(1) **Wu, T.**, & Firoozabadi, A. Methane flow in shale nanopores with kerogen microstructure by molecular simulations, *SPE Annual Technical Conference & Exhibition*, SPE-191686-MS, Dallas, USA, September 24–26, 2018.

(2) Zhang D., Zhao J., **Wu, T.**, Tang, H., Xuan, Q., & Jiang, Z. Multiscale approach to mechanical characterization of shale, *Sixth Biot Conference on Poromechanics*, Paris, France, July 9–13, 2017.

(3) **Wu, T.**, Jiang, Z., & Zhang, D. A case study of fluid transport in shale crushed samples: Experiment and interpretation, *International Symposium of the Society of Core Analysts*, Avignon, France, September 8–12, 2014.