工学系WINGS産学協創教育推進基金

第423回GMSI公開セミナー／第168回WINGSセミナー

Molecular Physics of Carbon Storage and Utilization in Tight Reservoirs

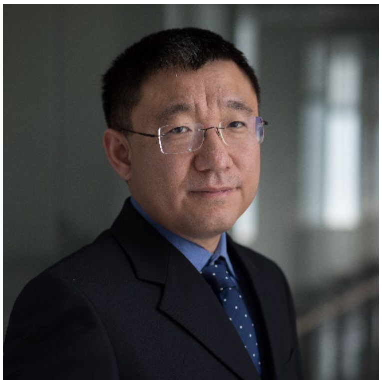
Professor Rui Qiao

Department of Mechanical Engineering, Virginia Tech

Date： Tuesday, June 11, 2024 14:00-15:00

Venue：Faculty of Engineering Bldg. 2, Room 31A

Abstract: Oil from tight reservoirs has grown to dominate liquid petroleum production in the U.S., which greatly benefits the petroleum industry. The industry, however, faces challenges in improving oil recovery from these reservoirs and reducing its carbon footprint. CO_2 injection for enhanced oil recovery (EOR) and CO_2 sequestration helps address these challenges. However, its practice is hindered by a lack of predictive tools for the storage and transport of oil and CO_2 in these reservoirs. Fundamentally, since tight reservoirs' porosity is dominated by pores smaller than 10-100nm, confinement and chemistry of pore walls can affect the storage and transport of oil-CO_2 in these reservoirs, and physical processes underpin their effects occur at the molecular scale. Here, I will introduce our work on the molecular thermodynamics and hydrodynamics of CO_2 EOR and sequestration in tight reservoirs. I will first examine CO_2-mediated oil transport in nanopores, focusing on the dual role of interfacial CO_2 in modulating oil flow. Next, I will examine critical steps in the Huff-n-Puff scheme of EOR and CO_2 sequestration at the single nanopore scale, focusing on the transport and storage of CO_2 in nanopores, the recovery of oil from pores, and their coupling. These works highlight the critical role of adsorption in oil recovery and CO_2 storage in tight reservoirs. Dimensionless parameters governing the importance of adsorption are identified, and the scaling law of oil recovery in the presence of adsorption is revealed. Finally, I will present the diffusioosmosis of oil-CO_2 mixture driven by CO_2 gradient and discuss its importance relative to the pressure-driven flow in tight oil reservoirs.



Professor Rui Qiao

Department of Mechanical Engineering, Virginia Tech

Biography: Dr. Rui Qiao received his B.S. degree from Huazhong University of Science and Technology and an M.S. degree from Tsinghua University. He obtained his Ph.D. and postdoctoral training at the University of Illinois at Urbana-Champaign. He was a faculty at Clemson University before joining Virginia Tech in 2014 and has been an ASME Fellow since 2023. His research centers on clarifying the essential physics of interfacial and transport phenomena underlying engineering technologies to shape and accelerate their development.

主催：
東京大学大学院工学系研究科専攻間横断型教育プログラム 機械システム・イノベーション（GMSI）
未来社会協創国際卓越大学院（WINGS CFS）
量子科学技術国際卓越大学院（WINGS-QSTEP）
統合物質・科学国際卓越大学院（MERIT-WINGS）
高齢社会総合研究国際卓越大学院（WINGS-GLAFS）
工学系WINGS産学協創教育推進基金

本件連絡先：
東京大学大学院工学系研究科機械工学専攻　准教授　徐偉倫
GMSI事務局　E-mail: office@gmsi.t.u-tokyo.ac.jp　Phone:　03-5841-0696