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Modeling transport of methane under nanoconfinement and in complex geometries using LBM

Thursday, 3 June 2021 10:30 (15 minutes)

Transport of shale gas is in general a multiscale process: gas flows through the matrix, which is mainly composed of nano-size (microscale) pores, followed by a fracture network, and eventually into a wellbore. Accurate prediction of flow behavior in the shale matrix is critical for efficient development of shale gas reservoirs. Current continuum-based approaches may not be appropriate to simulate transport in microscale pores. On the other hand, molecular dynamics (MD) simulations are capable of capturing the relevant microscale physics with high fidelity, albeit at a substantial computational cost, which restricts MD simulation to rather small systems and computational domains. This limitation creates a gap between the continuum-based models and MD simulations. The lattice Boltzmann method (LBM) is a suitable candidate to bridge this gap. In this work, the multiple-relaxation-time (MRT)-LBM is used to study methane transport in nano-size pores. Adsorption effects near solid boundaries, as well as non-ideal behavior of fluids, are accounted for via incorporating appropriate force terms in LBM. Parameters associated with the force terms in the equation of state (EOS) are studied in detail and their optimum values are proposed. Simulation results obtained using LBM are validated against those from MD predictions. Results show that LBM captures slip velocity and nonuniform distribution of density predicted by MD simulations. This motivates the use of LBM in scale translation of the physics of mass transport in complex permeable media.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

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