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Numerical Simulation of Multi-phase Flow in Porous Media with a Phase-field Method

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Multiphase flows in porous media are central to many applications in the chemical industry, such as coating, infiltration of resin in composites, and reactive gas-liquid flows in gas diffusion electrodes. To improve these processes, a deep understanding of flow phenomena is crucial. Therefore, detailed simulation of multiphase flows is of great importance.

In this contribution, we present a Cahn-Hilliard phase field model coupled with the Navier-Stokes equation to simulate two-phase flow. This relatively new approach is characterized by a diffusive representation of the interface [1]. Because of the diffusive interface, it is possible to use continuum mechanics methods with Eulerian formulation to simulate the interfacial flow without explicitly tracking the interface, making the model suitable for a wide range of software.

The focus of this contribution is on the validation and application of the phase field model in context of multi phase flow in porous media. Comparisons with experiments are rare and usually involve steady-state or very simple interfacial phenomena. In addition to some basic wetting phenomena, such as capillary rise in a thin channel and the spreading of a droplet on a flat surface, we compare our simulation with an experimental dynamic drainage process in a micromodel [2]. The capillary finger formation observed in the experiment is very well reproduced by our simulation. This shows the great potential of the method for modeling multiphase flows in porous media.

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References

[1] Jacqmin, D. (1999). Calculation of Two-Phase Navier–Stokes Flows Using Phase-Field Modeling. Journal of Computational Physics, 155(1), 96–127. https://doi.org/10.1006/JCPH.1999.6332
[2] Karadimitriou, N. K., Joekar-Niasar, V., Hassanizadeh, S. M., Kleingeld, P. J., & Pyrak-Nolte, L. J. (2012). A novel deep reactive ion etched (DRIE) glass micro-model for two-phase flow experiments. Lab on a Chip, 12(18), 3413–3418. https://doi.org/10.1039/C2LC40530J

Time Block Preference

Participation

In person

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