



Contribution ID: 180

Type: Oral Presentation

## Study on Convective Drying of Porous Media – Comparison of Phase Field Simulations with Micro-model Experiments

*Monday, 22 May 2023 14:00 (15 minutes)*

Convective drying of porous media is central to many engineering applications, ranging from spray drying over water management in fuel cells to food drying. To improve these processes, a deep understanding of drying phenomena in porous media is crucial. Therefore, detailed simulation of multiphase flows with phase change is of great importance to investigate the complex processes involved in drying porous media.

In this contribution, we propose a Navier-Stokes Cahn-Hilliard model coupled with balance equations for heat and moisture to simulate the two-phase flow with phase change. The phase distribution of the two fluids air-water is modelled by the Phase Field equation [1].

The focus of this contribution is on the validation and application of the numerical model. While many studies aim to access the phenomena by simulations, here we succeed to compare comprehensively simulations with an experimental methodology based on microfluidic multiphase flow studies in engineered porous media [2]. Comparisons with experiments are rare in literature and usually involve very simple cases. We compare our simulation with convective drying experiments of porous media [3]. Experimentally, the interface propagation was visualized in detail in a structured microfluidic cell made from PDMS. The drying pattern and the drying time in the experiment is very well reproduced by our simulation.

### Participation

In-Person

### References

- [1] Jacqmin, D. Calculation of Two-Phase Navier–Stokes Flows Using Phase-Field Modeling. *Journal of Computational Physics*, 155(1), 96–127 –2014 <https://doi.org/10.1006/JCPH.1999.6332>
- [2] Hesameddin Safari, Mohammad Hassan Rahimian, and Manfred Krafczyk, Calculation of Two-Phase Navier–Stokes Flows Using Phase-Field Modeling. *Journal of Computational Phys. Rev. E* 90, 033305 –2014 <https://doi.org/10.1103/physreve.90.033305>
- [3] Linlin Fei, Feifei Qin\*, Jianlin Zhao, Dominique Derome, and Jan Carmeliet, Pore-Scale Study on Convective Drying of Porous Media. *Langmuir* 38, 19, 6023–6035 –2022 <https://doi.org/10.1021/acs.langmuir.2c00267>

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