

**Master Thesis Proposal**

**Topic: „Lattice Boltzmann simulation of drying of a microfluidic pore network with liquid films“**

Pore network models (PNMs) are powerful mathematical tools that are often used to study mass transfer in porous media. However, we have experimentally observed situations in which the existing PNMs show their limits. These are namely referred to the invasion of the pore space in presence of liquid films with complex structure. As a consequence, to get a better understanding of phenomena and develop corresponding models, we aim to study these situations more deeply with direct numerical simulations (DNS). Given efficiency of the lattice Boltzmann method (LBM) on modern computer architectures and large-scale clusters, it will be used to perform these simulations. Within the framework of the LBM, multi-phase interactions will be accounted for using an approach known as pseudo-potentials. While the PNMs are usually formulated on the scale of the REV of a porous medium, LBM simulation is usually on the scale of single pores.

It is the task of this Master thesis to further extend the pseudo-potential module of the in-house solver ALBORZ, developed at the Institute of Fluid Mechanics so that it can be applied to study gas invasion in a liquid filled pore network in presence of liquid films. The model shall then be used to investigate different situations in order to identify the limits of individual invasion regimes as well as to determine effective parameters that can be used for the PNM.

Relevant literature:

* Xie, C., Raeini, A.Q., Wang, Y., Blunt, M.J. Wang, M.: doi.org/10.1016/j.advwatres.2016.11.017
* Qin, F., Del Carro, L., Moqaddam, A.M., Kang, Q., Brunschwiler, T., Derome, D., Carmelie, J.: doi.org/10.1017/jfm.2019.69
* Zachariah, G.T., Panda, D., V.K. Surasani: doi.org/10.4995/ids2018.2018.7464
* Chen, L., Kang, Q., Mu, Y., He, Y.L., Tao, W.Q: doi.org/10.1016/j.ijheatmasstransfer.2014.04.032
* Krüger, T., Kusumaatmaja, H., Kuzmin, A., Shardt, O., Silva, G., Viggen, E.M.: doi.ord/10.1007/978-3-319-44649-3

Work packages:

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| **Month:** | **1** | **2** | **3** | **4** | **5** |
| **Test of LB model** |  |  |  |  |  |
| **Implementation of pore network** |  |  |  |  |  |
| **Simulation** |  |  |  |  |  |
| **Determination of effective parameters** |  |  |  |  |  |
| **Writing thesis** |  |  |  |  |  |

Start of work: December 1st, 2019

Duration: 20 weeks

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Dr.-Ing. Nicole Vorhauer