Contribution ID: **546** Type: **Poster (+) Presentation**

Pore-scale physics in imposed thermal gradient drying in porous media using Lattice Boltzmann Method

Tuesday, 1 June 2021 20:00 (1 hour)

Drying of porous media sounds simple yet it is complicated to understand the physics behind it. As drying is an energy-intensive process, it is necessary to understand the trade-off between energy costs and efficient drying process using recently developed mathematical models. In our previous presentations [1]–[3], we addressed a novel isothermal diffusion dominated drying model using the mesoscopic model: Lattice Boltzmann Method (LBM). It has emerged as a powerful modeling tool for multiphase flows in complex pore structures because of its easiness of implementing the no-slip boundary conditions with intricate solid surfaces. The complex pore-scale physics involving Haines Jumps and its implications to drying kinetics was presented. In this work, we are extending our previous works to include thermal drying model using imposed thermal gradients. A linearly varied stationary temperature profile is imposed along the depth of the porous medium. The preferential heating is of two types: positive thermal gradient where temperature varies from top to bottom in increments (e.g., Convective drying) and negative thermal gradient where the temperature varies in decrements (e.g., Contact heating mode of drying). According to the competition between capillary, viscous and gravitational forces, different kinds of invasion patterns are observed. The invasion-percolation (IP) of stabilizing and destabilizing drying fronts are discussed, where in the two sided (primary and secondary) drying regimes is observed. Thanks to the automatic interface capturing method which is inherently present in the multiphase Shan Chen LBM, it is exciting to observe capillary condensation in negatively imposed thermal gradient. In the past, condensation is implemented for partially filled throats[4]. However, for the first time, evaporation-condensation phenomena in drying of capillary porous media is completely addressed through LBM simulations[5]. Finally, the micro-macro interactions and the future of forming a freely evolving thermal drying model in LBM are elucidated.

Time Block Preference

Time Block C (18:00-21:00 CET)

References

[1] G. T. Zachariah, D. Panda, and V. K. Surasani, "Lattice Boltzmann simulations for invasion patterns during drying of capillary porous media,"Chem. Eng. Sci., vol. 196, pp. 310–323, 2019.

[2] D. Panda, B. Supriya, A. Kharaghani, E. Tsotsas, and V. K. Surasani, "Lattice Boltzmann simulations for micro-macro interactions during isothermal drying of bundle of capillaries,"Chem. Eng. Sci., vol. 220, 2020.

[3] D. Panda, S. B, S. Paliwal, A. Kharaghani, E. Tsotsas, and V. Surasani, "Pore-scale physics of drying porous media revealed by Lattice Boltzmann simulations,"Dry. Technol. 2020

[4] V. K. Surasani, T. Metzger, and E. Tsotsas, "Influence of heating mode on drying behavior of capillary porous media: Pore scale modeling,"Chem. Eng. Sci., vol. 63, no. 21, 2008.

[5] D. Panda, S. Paliwal, D. P. Sourya, A. Kharaghani, E. Tsotsas, and V. K. Surasani, "Influence of thermal gradients on the invasion patterns during drying of porous media: A lattice Boltzmann method,"Phys. Fluids, vol. 32, no. 12, p. 122116, Dec. 2020.

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