Contribution ID: **174** Type: **Oral Presentation**

A Geometry-based Throat Shape Correction of Pore Network Models

Thursday, 2 June 2022 12:05 (15 minutes)

Pore network models (PNM) are a simplified but powerful tool for fluid flow simulation in porous media. In contrast to other computational methods, e.g. the lattice Boltzmann method (LBM), where complex transport equations are solved with high structural resolution, PNM uses a strongly simplified basis. The realistic pore space is often approximated as a network of spherical pores connected by cylindrical throats with constant diameters in which simple algebraic equations are solved. Thus, PNM is computationally extremely efficient. Compared to LBM simulations, the computational time is many orders of magnitude smaller. For typical porous media applications, it can be reduced from days to minutes. This, however, comes at the cost of physical insight, and is sometimes too simplistic, especially for microporous structures where the shapes of pores and throats strongly deviate from spheres and cylinders, respectively.
To reduce or overcome this issue, in the present work, we developed an improved PNM that takes the structural deviations into account. The underlying Purcell physics, which assume constricting throats, are corrected based on a physically motivated geometrical shape factor that depends on the ratio of the inscribed and equivalent throat diameter. Using the new PNM, pressure-saturation curves are determined and compared to LBM simulations. The electrolyte filling of porous battery components is utilized as a use case. The model is adjusted to data determined from the cathode side. It is shown that thereby the filling behavior of the structurally different anode side can be predicted accurately.
Electrolyte filling is just one example for a broad variety of setups involving porous media percolation. It is used here to show that PNM captures the main characteristics of two-phase fluid flow inside porous media. Due to its efficiency, the PNM is extremely useful to determine relevant parameter spaces for certain structures. It can give first indications to determine which detailed simulations with more accurate and realistic models or methods can be conducted. As next steps, further investigation for more generic porous media applications will be considered to validate the new model for a broad variety of macro- and microporous media.

Acknowledgement: This work has been funded by European Union's Horizon 2020 research and innovation program within the research project DEFACTO under grant agreement N° 875247.

Keywords: pore network models, Lattice Boltzmann method, porous media.

Acceptance of the Terms & Conditions

Click here to agree

MDPI Energies Student Poster Award

No, do not submit my presenation for the student posters award.

Country

Germany

References

Time Block Preference

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

Participation

Online

Primary author: KELLERS, Benjamin (German Aerospace Center (DLR))

Co-authors: LAUTENSCHLÄGER, Martin (German Aerospace Center, Department of Computational Electrochemistry); Mr WEINMILLER, Julius (Helmholtz Institute Ulm for Electrochemical Energy Storage (HIU) and German Aerospace Center (DLR), Institute of Engineering Thermodynamics); DANNER, Timo (German Aerospace Center (DLR)); Prof. LATZ, Arnulf (Helmholtz Institute Ulm for Electrochemical Energy Storage (HIU) and German Aerospace Center (DLR), Institute of Engineering Thermodynamics and Ulm University, Institute of Electrochemistry)

Presenter: KELLERS, Benjamin (German Aerospace Center (DLR))

Session Classification: MS09

Track Classification: (MS09) Pore-scale modelling