
Contribution ID: **560** Type: **Poster (+) Presentation**

# Numerical studies of capillary flow in paper-based microfluidic devices

*Wednesday, 2 June 2021 16:00 (1 hour)*

Paper-based microfluidic devices are rapidly becoming popular as a platform for developing point-of-care medical diagnostic tests[1]. Capillary force is the main driving force for the transportation of test liquids in paper-based devices. Therefore, a deep understanding of its internal capillary flow are indispensable for designing sensitive and accurate paper-based point-of-care medical diagnostic device. Spontaneous absorption in papers is an unsaturated flow process, which was often modelled by the Richards equation[1-5]. It is well known that two constitutive relationships including relative permeability and capillary pressure are crucial to the model prediction. In this work, we use μCT scanning to obtain the three-dimensional porous structure of a filter paper. The PoreSpy based on the watershed algorithm is used to extract the pore network[6]. A quasi-static pore-network model (QPNM) is used to obtain the capillary pressure and relative permeability relationships. Moreover, we verify the numerical results against lab experiments. Combining imaging technique and pore-network simulations could help us understand material properties of capillary flow in paper-based microfluidic devices, which will guide us to design high-performance paper-based devices.

## Time Block Preference

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

## References

[1] Rath, D.; Sathishkumar, N.; Toley, B. J. Experimental measurement of parameters governing flow rates and partial saturation in paper-based microfluidic devices. Langmuir. 2018, 34, 8758–8766.
[2] Hertaeg, M. J.; Tabor, R. F.; Berry, J. D.; Garnier, G. Radial Wicking of Biological Fluids in Paper. Langmuir. 2020, 36, 8209-82217.
[3] Patari, S.; Mahapatra, P. S. Liquid Wicking in a Paper Strip: An Experimental and Numerical Study. ACS Omega. 2020, 5, 22931-22939.
[4] Perez-Cruz, A.; Stiharu, I.; Dominguez-Gonzalez, A. Two dimensional model of imbibition into paper-based networks using Richards'equation. Microfluid. Nanofluid. 2017, 21, No. 98.
[5] Liu, Z.; He, X.; Han, J.; Zhang, X.; Li, F.; Li, A.; Qu, Z.; Xu, F. Liquid wicking behavior in paper-like materials: mathematical models and their emerging biomedical applications. Microfluid. Nanofluid. 2018, 22, No. 132.
[6] Gostick, J. T. Versatile and efficient pore network extraction method using marker-based watershed segmentation. PHYSICAL REVIEW E. 2017. 023307.

## Acceptance of Terms and Conditions

Click here to agree

## Newsletter

I do not want to receive the InterPore newsletter

## Student Poster Award

**Primary author:** Dr WANG, Yang

**Co-authors:** Prof. YE, Dingding; Prof. ZHU, Xun; Prof. YANG, Yang; Prof. QIN, Chaozhong; Prof. CHEN, Rong; Prof. LIAO, Qiang

**Presenter:** Dr WANG, Yang

**Session Classification:** Poster +

**Track Classification:** (MS16) Fluid Interactions with Thin Porous Media