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# The Interplay of Spreading, Imbibition and Evaporation of Water Droplets on Nanoporous Surfaces

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The study of fluid dynamics in nanoporous materials is nowadays a topic of great interest due to the often significantly modified thermal equilibrium and non-equilibrium properties of extremely spatially confined liquids compared to their bulk counterparts. However, fluid transport in nanoscale geometries plays also an increasing role in functional materials consisting of fluid-infused solids, such as supercapacitors and porous materials with integrated actuation, sensation [1] and adaptive lubrication [2].

Here we present a study on the spreading of water droplets on nanoporous silicon as a function of time. The evolution of the droplet volume is analyzed theoretically and experimentally considering the evaporation and the radial imbibition of the liquid into the porous substrate. The scaling behavior of these quantities are qualitatively in agreement with phenomenological descriptions [3,4], however also substantial deviations compared to Molecular Dynamics simulations on this phenomenology are revealed [5]. Our experiments shall serve as a base for future studies employing electrowetting to control the competition of spreading and imbibition [6].

## Time Block Preference

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

## References

[1] P. Huber (ed.), Soft Matter under Geometrical Confinement: From Fundamentals at Planar Surfaces and Interfaces to Functionalities of Nanoporous Materials in World Scientific Series in Nanoscience and Nanotechnology, World Scientific Publishing, Singapore, August 2020
[2] P. Basnyat, et al., Surface texturing for adaptive solid lubrication in Surface and Coatings Technology, 203.1-2 (2008): 73-79.
[3] D. Seveno, et al., Spreading drop dynamics on porous surfaces in Langmuir, 18.20 (2002): 7496-7502.
[4] A. Cazabat et al., Evaporation of macroscopic sessile droplets in Soft Matter 6.12 (2010): 2591-2612.
[5] X. Frank et al., Droplet spreading on a porous surface: a lattice Boltzmann study in Physics of Fluids 24.4 (2012): 042101.
[6] Y. Xue, et al., Switchable imbibition in nanoporous gold in Nature Communications, 5.1 (2014): 1-8.

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**Primary author:** GALLARDO, Laura (TUHH)

**Co-authors:** BELLEZZA, Hugo (CNRS & Univ. Lyon 1, ILM); SANCHEZ, Juan (Tachnical University of Hamburh-Harburg (TUHH)); HUBER, Patrick (Hamburg University of Technology); VINCENT, Olivier (CNRS)

**Presenter:** GALLARDO, Laura (TUHH)

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