● Numerical 3D wetting on textured surfaces through Lattice-Boltzmann method and comparison with experimental data

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Abstract content

Wetting is communally used for surfaces characterization and numerical approach could lead to design substrates with precise wetting behavior. In this work, we applied pseudopotential multiphase Lattice-Boltzmann Method (LBM) to wetting. The purpose is to evaluate our code's capability to simulate wetting on 3D realistic surfaces, by comparing numerical simulation with experimental data. The experimental study was made using a PDMS negative replica derived from a cast grooved by femtosecond laser texturation, which we characterize through sessile drop experiment (fig.1.a). On the other hand, our simulation are initiate with different droplets shape sinked into the discretized substrates (fig.1.b). Various initial states are tested to modelize effects of the deposit method during experiment. Numerically, different wetting behavior has been observed depending on the initial position of the droplets (fig.2) such as impregnation or suspension. Macroscopic contact angle can be post-processed to compare numerical and experimental results. Numerical study has been extend to different materials (through variation of reference contact angle measured on plane surfaces) to observe other phenomena as gas imprisonment below liquid's phase.

References

[1] V.Neyrand, et al. Numerical simulation of wetting on a chemically textured surface with a large intrinsic contact angle ratio by the Lattice Boltzmann Method. Experimental and Computational Multiphase Flow, 2021. [2] E.Bormashenko. Progress in understanding wetting transitions on rough surfaces. Advances in Colloid and Interface Science, 2014. [3] L.Chen, et al. A critical review of the pseudopotential multiphase lattice Boltzmann model: Methods and application. International Journal of Heat and Mass Transfer, 2014.

fig1: a)Experimental deposit b)Initial shape

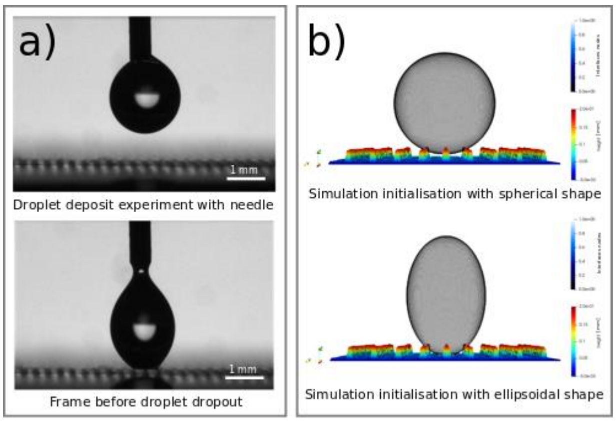

fig2: Equilibrium depending on initial position