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Surfactant-induced Marangoni effect on aqueous film instability

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Wet film deposition is a key process in glazing industry as it is a quick and efficient way to functionalise large surfaces. Achieving thin and homogeneous waterborne coatings on glazing is a major challenge. Although attractive, the development of such coatings is still limited by the apparition of defects in the liquid film during the drying step. Yet, in extended flat films Marangoni flows, induced by surface tension gradients, can result in defects [1] or film dewetting [2].

In this talk, we tackle how the coupling of solvent evaporation and surfactant adsorption at the surface can induce Marangoni flows and hydrodynamic instabilities in drying flat films. The influence of the coating conditions (evaporation rate, initial thickness, viscosity) and the surfactant adsorption dynamics over the film stability are questioned.

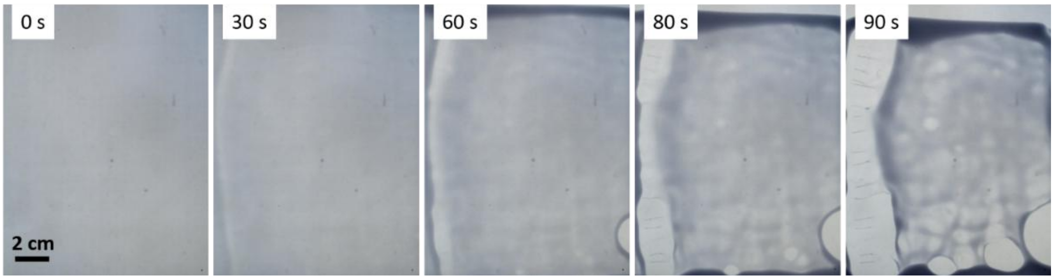

Figure 1. Snapshots of a liquid film of an aqueous solution of SDS (82 mM) that is drying under a relative humidity of 30%. A die is added for observation. An instability develops in the centre of film with an emergent wavelength of the order of the centimetre.

Aqueous solutions of surfactants are blade coated on a horizontal glass plate under controlled atmosphere into thin films of thickness in the range [10 µm,100 µm]. As shown in Figure 1, under strong evaporation rate, a thin film of an aqueous solution of SDS is strongly unstable. A consistent mechanism relaying on an evaporation-induced Marangoni instability is suggested. For a broader comprehension, this phenomenon is rationalised through a lubrication model and with numerical simulations using the Navier-Stokes solver Basilisk [3] with a multilayer description [4].

References

[1] H. S. Kheshgi and L. Scriven, Ch. Eng. Sci., 46, 519-526 (1991)
[2] S. Karpitschka, F. Liebig and H. Riegler, Langmuir, 33, 4682-4687 (2017)
[3] http://basilisk.fr/
[4] S. Popinet, J. Comput. Phys, 418, 109609 (2020)