Local characterization of a complex fluid drying in a dip-coating-like

Charles Loussert[1], Jean-Baptiste Salmon[1], Jacques Leng[1], Bertrand Selva[1], Béatrice Guerrier[2] and Frédéric Doumenc[2]

[1] Lab LOF, CNRS UMR 5258 - Univ. Bordeaux 1 - IPB - Rhodia, 178 Av. Dr Schweitzer, F-33608 Pessac, France

[2] UPMC Université de Paris 06, Université de Paris-Sud, CNRS, Laboratoire FAST, Bâtiment 502, Campus Universitaire, Orsay F-91405, France

Corresponding author: charles.loussert-ex@solvay.com

Keywords: dip-coating, film drying, contact-line, latex coating, coating instabilities, optical characterization

In the general framework of coatings, this work focuses on "dip-coating-like" experiments, see fig.1(a), when significant evaporation takes place in the meniscus during the filmification : the so-called "evaporative regime" [1, 2]. Most of the previous works performed only *global characterizations*, i.e. thickness of the final *dry* film and its structure as a function of cross-effects such as solute concentration, evaporation rate, coating speed or temperature [1, 2].

In the present work, we developped an original system for blade-coating different complex fluids using a x-y stage mounted on an inverted microscope (Olympus IX71). Coating speeds can be tuned between 1 to 1000 µm/s and we can monitor *locally* and in real-time the filmification with a typical resolution of 200 nm in a field of view of 0.1 mm² (with an objective 10X). The originality of our setup lies in the *independant* micrometric translation of the *whole* blade-coating device in respect of the fixed microscope, which makes it possible to monitor the filmification *at any point.*

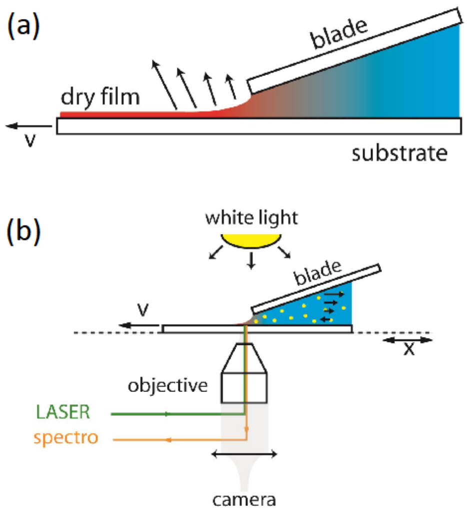

Fig. 1 : (a) Schematic geometry of evaporative coating. (b) Schematic view of the experimental setup for observation and characterization.

We also implemented, on the same optical bench, spatially-resolved tools such as Raman confocal spectroscopy (see fig. 1(a)) to measure *simultaneously* the concentration fields, and fluorescence imaging at a high frame rate (sCMOS camera) to monitor 3D velocity fields.

We illustrate the possibilities offered by these combined techniques on different model cases, namely colloidal dispersions (latex beads, 300 nm in diameter) and polymer solutions. In the first case, we reported different interesting phenomena such as periodic modulations of the film thickness associated to transverse spatial modulations of the contact line, as well as regular fracture patterns within the dry film (see fig. 2(a)), and (see fig. 2(b)).

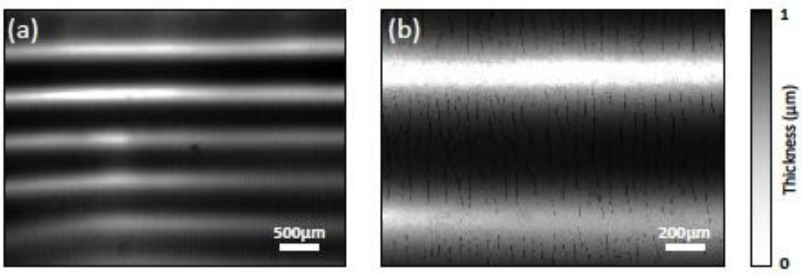

Fig. 2. (a) Latex dried film thickness oscillation.
(b) Presence of regular fractures as thickness increases within the film.

References

1. M.Le Berre, Y.Chen, D.Baigl, *Langmuir*, **25**, 2554–2557 (2009)
2. F. Doumenc, B. Guerrier, *Langmuir*, **26**, 17 (2010)