The coating of a plate: Transitions from precursor films to Landau-Levich films

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ABSTRACT

In several types of coating processes a solid substrate is removed at a controlled velocity U from a bath of non-volatile pure liquid. The shape of the liquid meniscus and the thickness of the coating layer depend on U. These dependencies have to be understood in detail to control the deposition of a layer of non-volatile liquid and to lay the basis for the control of more complex situations (volatile pure liquid, solution or suspension with volatile solvent).

We study the case of non-volatile liquids employing a precursor film model that describes partial wettability with a Derjaguin (or disjoining) pressure. In particular, we focus on the relation of the deposition of (i) an ultrathin precursor film at small velocities and (ii) a macroscopic film of thickness $h \sim U^{3/2}$ (corresponding to the classical Landau-Levich film).

Depending on the plate inclination, four regimes are found for the change from case (i) to (ii). The different regimes and the transitions between them are analysed employing numerical continuation of steady states and saddle-node bifurcations and simulations in time. We also discuss the relation of our results to results obtained with a slip model [1].

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References

[1] J. Ziegler, J. H. Snoeijer and J. Eggers, *J. Eur. Phys. J. Special Topics* **166**, 177 (2009).