MODELING ELECTROWETTING-INDUCED DROPLET DETACHMENT FROM SOLID SURFACES

N. T. Theodorou[1], A. G. Sourais[1], A. G. Papathanasiou[1,*]

[1] School of Chemical Engineering, NTUA, 15780, Athens
* pathan@chemeng.ntua.gr

ABSTRACT

The need to detach liquid droplets from solid surfaces arises in numerous processes and devices, like DNA microarrays [1] and can be accomplished with various methods, with those based on electrowetting being very efficient. Electrowetting involves spreading of a droplet on a solid substrate using electrostatic forces caused by an applied voltage. Detachment of the droplet can be achieved by removing the applied voltage while the droplet is stretched, leading to its shrinkage and acceleration. For an efficient design, the ability to simulate the behavior of droplets is important.

In this work we simulated the electrowetting-induced detachment of droplets from solid surfaces. In these simulations we incorporated a previously developed model [2], in which the interaction forces between a droplet and a solid surface are accounted by augmenting the Young – Laplace equation with a disjoining pressure term.

Our results are compared with experimental measurements reported by Lee et al. [3]. It is shown that our model can efficiently capture the detachement dynamics of the droplets (see figure 1). Moreover we found that the application of double applied voltage pulses allows detachment of the droplets at lower voltage in comparison to the application of single voltage pulses.

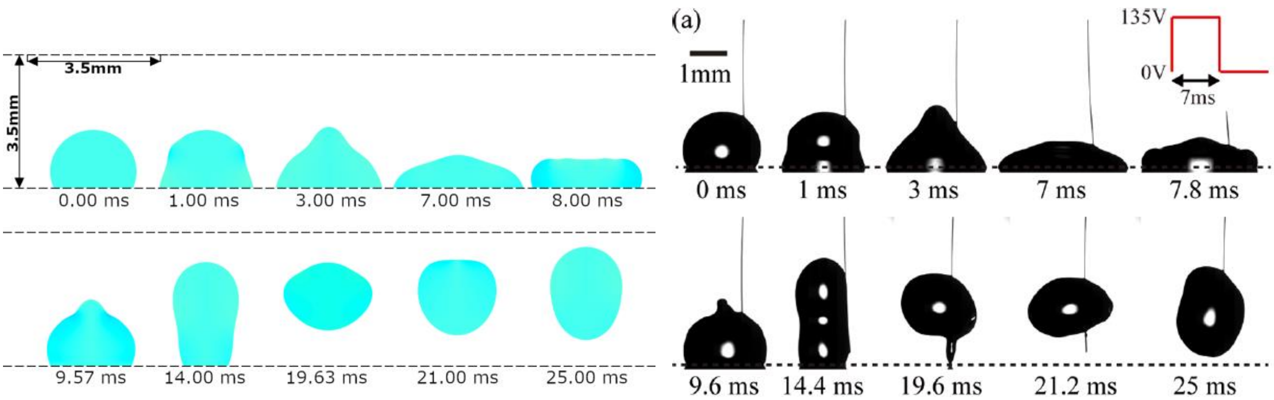

Figure 1. Shapes of a 5μL droplet that detaches from a substrate with the assistance of an electric square pulse with a voltage of 135V and a duration of 7ms, as a function of time. Left: Simulation, Right: Experiments [3].

KEYWORDS: Droplet Detachment, Electrowetting, Contact Angle, Disjoining Pressure, Computational Fluid Dynamics

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