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Liquid Bridges in a Complex Geometry: Microfluidic Drop Manipulation Inside a Wedge

Authors : D. Baratian, A. Cavalli, D. van den Ende, F. Mugele

Abstract : The morphology of liquid bridges inside complex geometries is the subject of interest for many years. These efforts try to find stable liquid configuration considering the boundary condition and the physical properties of the system. On the other hand precise manipulation of droplets is highly significant in many microfluidic applications. The liquid configuration in a complex geometry can be switched by means of external stimuli. We show manipulation of droplets in a wedge structure. The profile and position of a drop in a wedge geometry has been calculated analytically assuming negligible contact angle hysteresis. The characteristic length of liquid bridge and its interfacial tension inside the surrounding medium along with the geometrical parameters of the system determine the morphology and equilibrium position of drop in the system. We use electrowetting to modify one the governing parameters to manipulate the droplet. Electrowetting provides the capability to have precise control on the drop position through tuning the voltage and consequently changing the contact angle. This technique is employed to tune drop displacement and control its position inside the wedge. Experiments demonstrate precise drop movement to its predefined position inside the wedge geometry. Experimental results show promising consistency as it is compared to our geometrical model predictions. For such a drop manipulation, appealing applications in microfluidics have been considered.

Keywords : liquid bridges, microfluidics, drop manipulation, wetting, electrowetting, capillarity
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