Contact angle dynamics in capillary action focusing on the predominance between the hydrodynamic and molecular kinetics

김한을, 최시영†
KAIST
(sqchoi@kaist.ac.kr†)

Starting from the Lucas-Washburn's classical theory for capillary action, previous works figured out that the contact angle at the three phase zone is important variable to understand the capillary action accurately regardless of presence of gravity. The physical understanding for contact angle change became the dynamic wetting theory or moving wetting line. The representative models are hydrodynamic and molecular kinetic model. The former solved shear viscous stress under assumed velocity profile at the molecular length scale. On the other hand, the molecular kinetic model focused on the molecular friction of contact line and its frequency. Still there is no consistent agreement between experimental data or numerical simulation results. This is because the variety of dynamic wetting system such as capillary number, equilibrium contact angle, and roughness of solid surface. This work tried to quantify the conditions that judge whether hydrodynamic or molecular kinetic model is dominant at certain system. We compared the force from both models to conclude dimensionless numbers and with it, a phase diagram visualizing the transient is suggested.