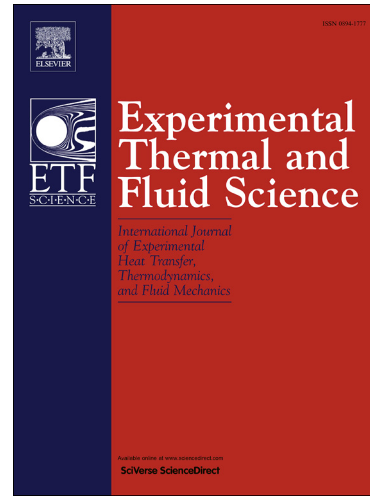

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Dynamic Wetting Behavior of a Triple-phase Contact Line in Several Experimental Systems

Kenji Katoh[1], Tatsuro Wakimoto[1], Yasufumi Yamamoto[2], and Takahiro Ito[3]

[1]*Department of Mechanical Engineering, Osaka City University, Japan*

[2]*Department of Mechanical Engineering, Kansai University, Japan*

[3]*Department of Energy Engineering and Science, Nagoya University, Japan*

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Abstract

Dynamic wetting behavior was investigated experimentally. First, the movement of a liquid column in a capillary tube was observed. Using the measured dynamic contact angles dependent on the contact line velocity, the solution of the modified Lucas–Washburn equation predicts the time variance of the liquid height in the capillary efficiently. Second, the dynamic contact angles were measured for a two-dimensional meniscus and an axisymmetric droplet to detect the influence of contact line curvature. The measured angles coincide well with each other for a two-dimensional meniscus and droplets of various radii. The dynamic wetting behavior is independent of the triple-phase contact line curvature. The dynamic contact angles measured in this study distribute widely from 10 to 170 degrees. The results cannot be arranged by a single function of contact line velocity proposed by Hoffmann. It is suggested that the roughness or impurities on the solid surface could play an important role on the dynamic wetting behavior.

1. Introduction

The wetting behavior between solid and liquid phases is an important topic in various engineering fields that investigate small amounts of liquid on a solid surface. When the triple-phase contact line at the tip of the liquid surface on a solid wall moves with a finite velocity, one can observe that the contact angle varies depending on the velocity. When the capillary number (the ratio between viscous force and surface tension) is greater than approximately 10^{-4}, at which the velocity may typically be 0.1 mm/s, the effect of dynamic wetting should be considered when discussing liquid motion on a solid surface. Many researchers have discussed the mechanism of dynamic wetting from experimental or theoretical viewpoints (Blake 2006, Bonn et al. 2009, Chakraborty et