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Probing slip boundaries by bubble fingering HSIEN-HUNG WEI, Department of Chemical Engineering, National Cheng Kung University, YING-CHIH LIAO, Department of Chemical Engineering, National Taiwan University — Motivated by experimental efforts on determining slip length, we propose the Bretherton-type bubble fingering as an alternative strategy for probing slip effects. We find that at sufficiently high bubble speeds (but still in the small capillary number regime), the film thickness obeys classical Bretherton's 2/3 law. However, when the bubble speed is below some critical value where the film thickness is comparable to the slip length, a new quadratic law will emerge to govern the behavior of the film thickness below the slip length. The critical bubble speed is also found to be proportional to the 3/2 power of the slip length. In the analogous thermocapillary problem, a bubble in a slip channel can travel much faster than in a no-slip channel, at the speed proportional to the 5/3 power of the slip length. Effects of disjoining pressure and surfactant are also discussed and the results also show strong dependence on the slip length.

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