Supplementary material

1 Contact line dynamics

Movie 1: Contact line capillary number Ca(u_{CL}) is plotted against capillary number Ca for different times where the numerical results are shown with the points while the solid lines are fitting from equation 4.1 for a contact angle of 90, 105 and 120 degrees.
Movie 2: Contact line capillary number Ca(u_{CL}) is plotted against capillary number Ca for different times where the numerical results are shown with the points while the solid lines are fitting from equation 4.1 for a contact angle of 45, 60 and 75 degrees.

Both these movies suggest that Equation 4.1 well represent the dynamics of the contact line after the initial acceleration phase. Some simulations are stopped because of the huge computational costs. There are two major limitations that limit the time until when we can run the simulations: For small capillary numbers the surface tension effects are really strong and the time steps become really small that makes the simulations computationally very expensive as we are time explicit for surface-tension forces. On other hand, for large capillary numbers, when the bubble becomes really large the limitation arises due over refinement of the interface and the simulation become expensive because of enormous increase in the number of points. Note that the interface in our all-Mach method can not have different levels of refinement, so it has to be kept at maximum level of refinement of the initial bubble shape.

2 Effect of slip length

The effect of numerical slip-length is summarized in this section by focusing on a particular case with Ca = 0.54, $\alpha = \pi/2$ and Oh = 0.0373. The slip length is varied from $0.001R_{c,0}$ to $0.024R_{c,0}$, and we plot the results in figure 1. The velocity of the three points defined in figure 4 of main text is shown in figure $1a$, as expected the effect of slip-length is local to the contact line and does not influence the motion of c_m and h. Also, the increase in slip length facilitates the mobility of the contact point, thus the contact line velocity increases causing decrease in microlayer growth rate. This conclusion is supported by the evolution of minimum interface slope represented by α_{app} in figure $1b$. Therefore the the asymptotic values of the contact line capillary number is a function of the slip length imposed in the numerical simulations. The interface zoom close

the contact line shown in figure 1c shows that outside of the bulge region the interface shape overlaps well for different values of slip-length. Therefore, even inside the microlayer region the shape of the interface is not affected by the slip length provided that the value of slip-length is small enough

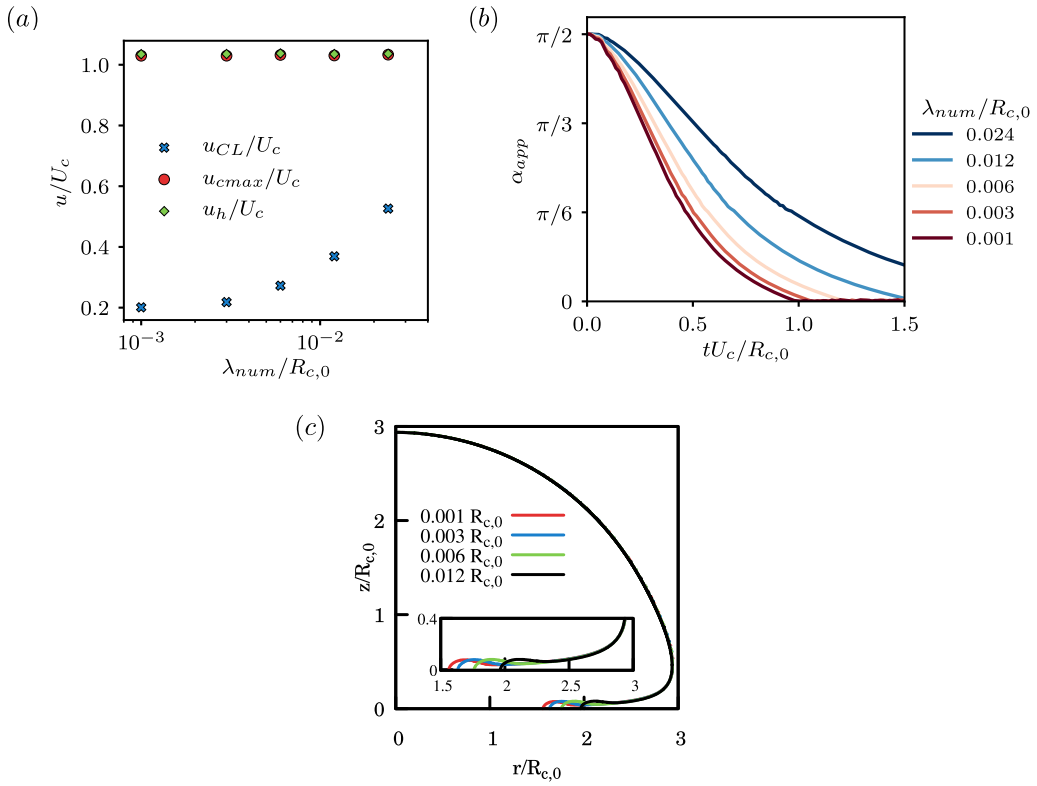

Figure 1: Results for for bubble expansion in the case of $\alpha = 90°$,Oh $= 0.037$, Ca $= 1.4$ and varying $\lambda_{num}/R_{c,0}$. The effect of slip length on the microlayer formation regime. (a) The velocity of three important interfacial points is plotted as a function of non-dimensional slip-length. (b) The evolution of the minimum interface slope for various slip-length. (c) The shape of the interface for various values of the slip length.