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Nano bubble migration in a tapered conduit in the asymptotic limits of zero capillary and Bond Numbers - Theory and Experiments[1]
MICHAEL NORTON, University of Pennsylvania, FRANCES ROSS, IBM Watson Research Center, HAIM BAU, University of Pennsylvania — Using a hermetically sealed liquid cell, we observed the growth and migration of bubbles (tens to hundreds of nanometers in diameter) in a tapered conduit and supersaturated solution with a transmission electron microscope. To better understand bubble shape and migration dynamics, we developed simple 2D and 3D models valid in the limit of zero capillary and Bond numbers. The 3D model is restricted to small taper slope, weakly non-circular contact line geometries and large bubble aspect ratio (high confinement), and was solved using a pseudo-spectral decomposition. Both models utilize the Blake-Haynes mechanism to relate dynamic contact angle to local contact line velocity The influence of pinning of a portion of the contact line on bubble geometry is also considered. Contact line dissipation controls curvature and regulates growth rate. Our 2D and 3D models predict growth rates in agreement with experimental observations, but several orders of magnitude lower than predicted by the classical Epstein – Plesset theory.

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