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Oscillations of a cylindrical bubble attached to a wall BHARGAV RALLABANDI, CHENG WANG, SASCHA HILGENFELDT, Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign —
Sustained bubble oscillations in a liquid can result in steady streaming flows that may be exploited as a powerful tool of fluid manipulation at the micron scale. While the oscillations and the resulting streaming of a bubble in bulk fluid are well understood, the practically relevant case of a bubble attached to the wall of a microfluidic device has not been studied extensively, as additional complexity is introduced by the presence of the wall and the bubble contact lines. We provide here an asymptotic theory by which a long-wavelength ultrasound excitation is translated into shape oscillations of the bubble via its surface dynamics. We show that viscous effects near the contact lines entail a coupling mechanism between volume and surface mode oscillations, which governs the features of the frequency response curves obtained. The amplitudes and phases of the bubble oscillation modes are then used to calculate the streaming flow, which is a combined effect of wall-induced streaming and mode-interaction near the surface of the bubble.

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