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Bubble Nucleation and Streaming in Degassed Water[1] KYOKO NAMURA, SHUNSUKE OKAI, SAMIR KUMAR, MOTOFUMI SUZUKI, Kyoto University, MICRO PROCESS ENGINEERING LABORATORY TEAM —
Marangoni flow around a microbubble has been extensively studied to apply it for microfluidic control. However, precise control of the Marangoni flow is not straightforward because of the difficulty in controlling temperature distribution around the tiny bubble. Especially, the bubble growth under heating affects the temperature gradient on the bubble surface, which is generally induced by the diffusion of the dissolved air gases into the bubble. Here we study the bubble nucleation and subsequent flow generation in well-degassed water. The ultrapure water was sonicated under vacuum (5 kPa) to eliminate the dissolved gases. In order to realize the localized heating of the prepared degassed water, we used the photothermal effect of the gold nanoisland film. By irradiating CW laser on the film immersed in the degassed water, a water vapor bubble was generated. The bubble oscillated at sub-MHz, where its maximum size was 10 μm. The bubble involved significantly rapid flow of the order of 1 m/s under continuous photothermal heating, which is expected to be useful for microfluidic mixing and pumping. The rapid flow generation is attributed to the Marangoni force and bubble oscillation, which are induced under the steep temperature gradient.

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