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Sheltering of microbubbles in the inner part of boundary layer and non-condensable gas diffusion sustain attached cavitation inception[1]

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— High-speed imaging and high-resolution PIV are used to study the onset of cavitation on smooth surfaces with sharp pressure minimum, followed by strong adverse pressure gradients. Slightly below the cavitation inception pressure, short-lived isolated cavitation patches form when a free stream nucleus approaches the minimum pressure location, and evolve into traveling bubble cavitation downstream of the minimum pressure point. Numerous residual microbubbles, generated as the attached cavities collapse migrate slowly upstream, against the flow, if the adverse pressure gradient is sufficient to form a low momentum region inside the thickened boundary layer. These microbubbles migrate for 2-20 ms, and grow by 3-4 times in diameter until their size becomes comparable to that of the low momentum region sheltering them from the free stream. The pressure changes along their track cannot account for their growth, and 1D solution for relevant conditions indicates that they grow by non-condensable gas diffusion. At this time, these bubbles are either swept downstream or become nuclei for new attached cavitation patches, which generate new microbubbles, thus creating a self-sustaining cavitation inception mechanism.

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