Mitigating cavitation erosion with structured surfaces: First experimental results

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The mechanism leading to cavitation erosion is under debates for decades, one possible explanation is the self-focussing of the shockwaves emitted by a single cavitation bubble during its late collapse stage [1]. The origin leading to such a stable focusing may relate to the particular way the bubble is generated or the boundary conditions of the experiment. In the present work, we explore experimentally if the focusing of the shock wave can be affected by structuring the surface. Therefore, we create single bubbles in water with optical cavitation using a pulsed laser, and record the bubble dynamics with high speed cameras coupled synchronous to a femtosecond illumination laser to capture the shockwave emission, see Fig. 1a. The topology of the transparent surface is an array of triangular pillars. Figures 1b and c depict the last stage of bubble collapse when shock wave focusing occurs for two different locations of the bubble collapse. We find that the relative position of the bubble with respect to the pillars affects the shockwave focusing. In the presentation, we will discuss the influence of the pillar shape and the array size on the overall cavitation bubble dynamics, the induced microjets, and the shockwave self-focusing. The resulting damage is evaluated with a confocal-microscope. We will reveal which of the structures prevents shock wave focusing and mitigates cavitation erosion.

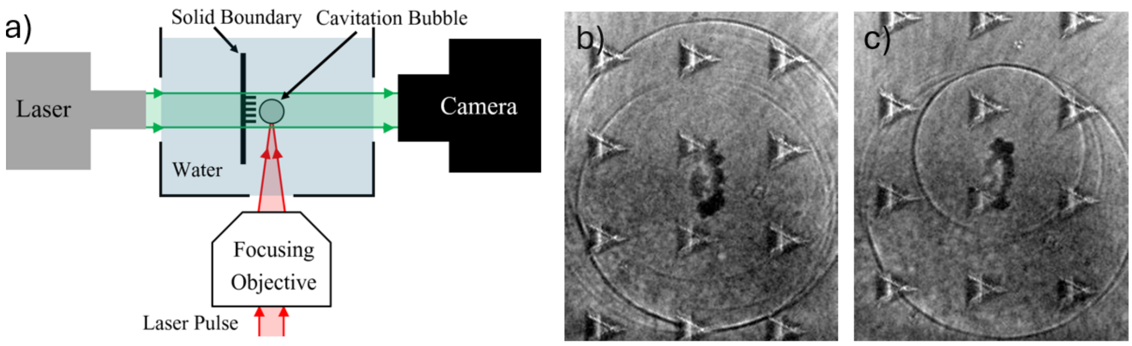

Figure 1: Experimental setup and selected frames from a high-speed recording revealing shockwave emission and focusing. a) Schematic of the experimental setup. b) Top view of the cavitation bubble just after the collapse. Here the bubble collapsed next to a pillar located on its left upper corner and the shockwaves focuses on the distal bubble side. c) Here, the bubble collapse is located on its lower left corner, resulting in the focusing of the shockwaves additionally on the distal side of the bubble.

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[1] Reuter et al., *Ultrasonics Sonochemistry* **90**, 106131 (2022)