Cavitation erosion on a level of a single cavitation bubble

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ABSTRACT

One of the remaining open questions in cavitation erosion research is the one on the importance of the microjet and the shock wave on the formation of the pit. Up until now, no successful attempt has been made to study this in detail, mainly because the damage could only be detected and evaluated after several successive bubble collapses.

A bubble with a maximum diameter of up to 3.3 mm was created during photoionization using a Nd:YAG laser. The damage was observed on a 9 µm thick aluminum foil attached to a glass substrate. Two high speed cameras were simultaneously used. One captured the dynamics of the bubble, while the other recorded the damage of the foil (Figure 1).

We also observed the collapse of a bubble in the presence of shear flow, where most of the damage is created by the microjet mechanism. Sometimes, the collapse of the bubble rim, at the rebound of the initial bubble causes pits in a well-known circular pattern. From the recordings at the very fastest acquisition rate, we determined that the material deforms and then partially relaxes, while a significant deformation remains. The whole process is only 2-3 µs long.

In the second part a possible transfer of knowledge to the field of exploitation of cavitation will be discussed. This is the line that we intend to pursue in the next 5 years in the scope of the ERC (European Research Council) project CABUM, where we aim to use cavitation bubbles for environmentally friendly water treatment - namely bacteria destruction and virus inactivation. Our first attempts of simulations of interaction between a microscopic bacteria and bubbles will be shown (Figure 2).

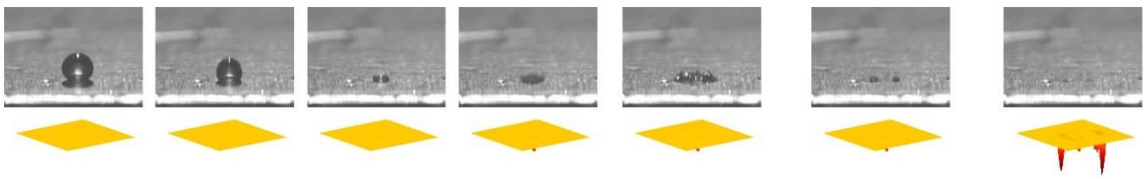

Figure 1: Collapse of a single cavitation bubble and the measured damage beneath it.

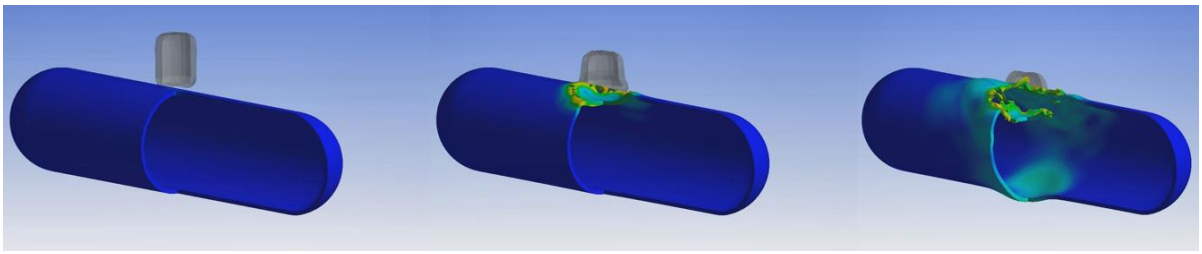

Figure 2: Simulation of a bubble jet impact into a single bacterium.

REFERENCES

[1] Matevz, DULAR, Tomaž POŽAR, Jure ZEVNIK, Rok PETKOVSEK. High speed observation of damage created by a collapse of a single cavitation bubble, Wear, Vol. 418-419, pp. 13-23, 2019