**Dynamics and shear wave generation from cavitation bubble pair interaction in soft matter**

1Yuzhe Fan\*; 2Hengzhu Bao; 1Fabian Reuter; 1Claus-Dieter Ohl;

*1Faculty of Natural Sciences, Institute for Physics, Department Soft Matter, Otto-von-Guericke University Magdeburg,*

*39106 Magdeburg, Germany*

*2School of Science, Nanjing University of Science and Technology, Xiaolingwei, Nanjing, 210094, Jiangsu, China*

**Abstract**

Cavitation may occur in tissue during interventional therapy in medicine. The dynamics of cavitation in this context is commonly studied using a Newtonian liquid such as water. Tissue, however, possess elastic properties. Here, using high-speed photography, we study the case of two interacting cavitation bubbles in gelatin gel and compare it to the case of water. In the case of gelatin gel, shear waves formed during bubbles’ interaction are studied using photoelastic imaging. For simplicity, two almost identical bubbles are generated in clean water (Newtonian liquid) and in gelatin gel (tissue phantom) using focused laser pulses. The distance and the initiation time difference between the bubbles are varied. Particularly, we pay attention to the anti-phase situation, where the second bubble is generated when the first bubble is at its maximum size. In water, a fast needle-shaped jet is found with an average speed of 200m/s, thus considerably faster and thinner than the standard jetting of cavitation bubble pairs. The jet velocity decreases with increasing elastic modulus, and, for sufficiently large elastic modulus, it is not able to pierce the second bubble anymore. Instead, the jet bounces back and the bubble collapses into a bowl shape. For the in-phase bubble pair, shear waves are generated by the toward collapse of two bubbles. For the anti-phase bubble pair, a V-shaped shear wave and a parallel shear wave are emitted during the rebound of the elongated neck of the second bubble. The bubble motion after the first collapse is another source of shear wave generation and depends crucially on the initiation time difference. The results contribute to the understanding of multiple cavitation situations in tissue during the thermal ablation process.