

ENHANCING THE REPRODUCIBILITY OF CAVITATION CONDITIONS IN VITRO

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Cavitation conditions reproducibility dependence on different parameters have been studied experimentally. It has been shown that the most strongly influencing factors are as following: uncontrolled deviation of the resonance frequency of the transducer (transducers) from the frequency

The application of ultrasound in experimental and clinical therapies has received an increased attention in recent years [1,2]. It is believed that cavitation plays an important role in most biological effects of power ultrasound, some of which being caused by bubbles pulsation and collapses.

The influence of different factors on the reproducibility of cavitation conditions have been studied experimentally. It has been shown that the most strongly influencing factors are as following: uncontrolled deviation of the resonance frequency of the transducer (transducers) from the frequency of the driving voltage, variation of conditions of reflection of the ultrasound in the reactor, variations of the gas concentration and nuclei size distribution in liquid samples, variation of the liquid height over the transducers.

The deviation of the resonance frequency of the transducer is observed if the power supplier consists of the driving generator and an amplifier. Such systems are used often in experimental investigations. Reasons which may cause deviations of the transducer resonance frequency are as following. 1) Change in average mechanical stresses acting on the piezoplates of the transducer. 2) Change of the load on the transducer. It happens, for example, due to variation of the wave resistance of the liquid when bubbles concentration in cavitation zone is varied or when height of the liquid over the transducer is varied. 3) Heating the transducer due to an increase of the liquid temperature. Deviation of the resonance frequency from the frequency of the driving voltage due to above reasons leads to the increase of heat losses in transducer, its further heating and further deviation of the frequency. As a result acoustic power transferred into the liquid will drop significantly but heating of the liquid and power consumed by the transducer will not.

Uncontrolled variations of the gas concentration and cavitation nuclei size distribution in the liquid sample is caused by the degassing of the liquid under ultrasound or when changing samples of the liquid in the chamber. As a result cavitation activity will be varied during an experiment or from one experiment to another even at constant ultrasound intensity. Nuclei generated during sonification strongly influence subsequent measurements, if the rest time between measurements is not long enough.

Variations of conditions of reflection of the ultrasound wave in the reactor are caused by uncontrolled variations the height of the liquid in the same reactor, by introducing solid samples in the reactor, or due to the changes the sizes and geometry of reactors if measurements are produced in different reactors. It has been shown that proper monitoring the above parameters leads to the significant enhancement of the reproducibility of cavitation conditions in biological experiments.

References

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2. T.J. Mason. *Therapeutic ultrasound: an overview*. *Ultrasonics Sonochemistry*, 2011, p. 847-852.