P-37: Study of Cavitation Bubbles Size Generated by High Intensity Focused Ultrasound

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1. Context of the study

Sound field parameters (pressure amplitude, frequency, spatial distribution) influence significantly the bubble dynamics. As the phenomenon of cavitation cannot be completely predicted by any tool, each component of the set-up (transducer and sonoreactor) has to be individually characterized [Hallez 2007, 2010] and [Hihn 2011]. Sonication in liquids leads to different kind of cavitation bubbles. On one hand, stable cavitation (long life time of bubbles) which collapse very quietly and on another hand from bubbles showing a life time in the range of the acoustic bubble period which collapse very violently. This second kind of bubble can break solvent molecules and generates radically species. The behavior of cavitation bubbles in an acoustic pressure field is of major interest for the prediction of sonochemical reactions yields. Inertial oscillations appear in the space just above the Blake threshold, and are in fact the only bubbles present in the high-pressure zone of strong sound fields.

2. Results and discussion

The aim of this work is to distinguish the different kinds of cavitation bubbles generated by high frequency transducer having frequency upper than 0,5MHz. The distribution of bubble size generated and collapse conditions was already investigated by pulsed ultrasound [Ashokkumar 2011] and [Lee 2011].

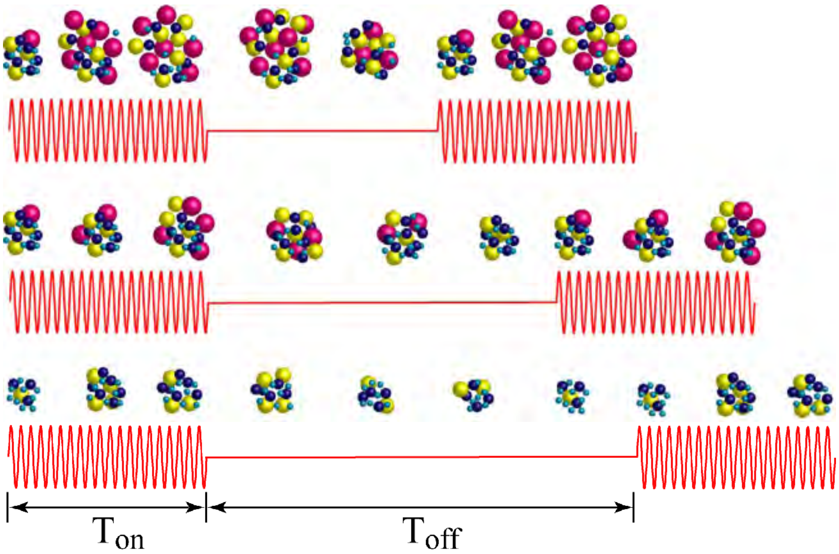

Figure 1: Influence of the increase of time between two ultrasonic pulses $_{T0}$ on bubble size while keeping constant the pulse lenght T

The shape of the acoustic wave can be modified by tuning the duration of emission (T_{on}) and silent (T_{off}) periods. The bubbles are formed during T_{on}, if the silent period is too large, the small bubble cannot reach again an active size during the new period of emission because of the surface tension. Cavitation activity can be correlated to the amount of photons emitted by the sonochemiluminescence (SCL) of luminol during sonication.

In the present work, results of SCL for different pulse conditions and examples of radius bubble calculations are described.

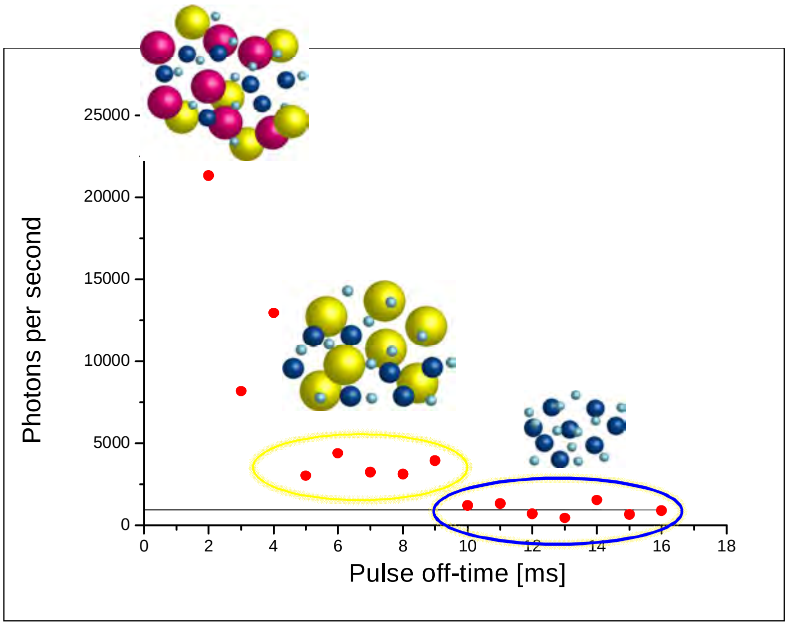

Figure 2 : SCL vs. Pulse separation. Pulse on-time of 4ms. The black line remind the noise level.

This work constituted a preliminary work of the inertial cavitation generated by high intensity focused ultrasound. Results have allowed us to determine the optimal experimental conditions in terms of the wave form and the acoustic power. However, it has to be complete by a systematic study of the parameters that can influence cavitation (geometry of the emission, nature of the dissolved gas, surfactant presence…).

References

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