**Sonofluorescence Image in Analogous Sonochemical Reactor**

Huamao Li  Andong Xie  Fan Zhong  Huijun Wan  Lijun Liu and Ruofeng*

Scientific Research Managerial Office, Ji'an Teachers’ College, Ji'an 343009, P.R. China

*State Key Laboratory of Modern Acoustics, Nanjing University, Nanjing 210093, P.R. China

Abstract: The sonofluorescence images taken by the authors show that the cavitation field appears symmetrical and uniform distribution in symmetrical sonochemical reactor and nonsymmetrical and nonuniform distribution in nonsymmetrical sonochemical reactor, but the nonsymmetrical field distribution can be guided along some curved way.

INDUCTION

One main aim for making sonochemistry research is to increase reaction yield, thus, it is very important to reveal the cavitation field distribution in sonochemical reactor. Here, the sonofluorescence image method and its principle are available to observe and record the spatial field distribution in whole solution directly, and to improve on the sonochemical reactor design.

PRINCIPLE

Upon the enhanced sonochemiluminescence principle proposed by the authors, one can obtain the enhanced sonofluorescence spectrum of chemiluminescent agent “luminol (C₆H₇N₃O₂)” in aqueous alkaline solution by ultrasonic cavitation oxidation reaction. As refs. 1-2, the emission wavelengths of the enhanced sonofluorescence of aqueous luminol-KOH solution drop mainly into visible 370-750nm (by Spex 1403), and the measured wavelength for the sonofluorescence peak is of 427.4nm and presents light-blue. The wavelength range is suitable to expose ordinary colour film.

EXPERIMENTS AND RESULTS

1. For symmetrical sonochemical reactor

As fig.1(a), the glass reactor is stretched tight with a thin plastic film at its bottom, and injected with aqueous luminol-KOH solution, and its top-outlet goes together with the air. Thus, one can let a power ultrasound (1.45MHz, 20W) to transmit into the solution through the ultrasound-transparent film, and make the solution to luminesce based on its ultrasonic cavitation oxidation reaction. By naked eyes, one can observe the reactor filling up with the light-blue sonofluorescence in darkroom. With a general camera and a colour film, one can make photo of the sonofluorescence image. As fig.1(b), the image shows the cavitation field in the reactor appearing symmetrical and uniform distribution.

Fig.1  Sonofluorescence image in symmetrical sonochemical reactor

2. For nonsymmetrical sonochemical reactor

As fig.2(a), this is a nonsymmetrical sonochemical reactor A, the above experimental procedures are true of this case, but the sonofluorescence image, as fig.2(b), differs from fig.1(b) obviously, it shows that the cavitation field in the reactor appearing nonsymmetrical and nonuniform distribution, and its brightness distribution deviates from the ultrasound transmitting direction and lays particular stress to the upwardly-
inclined curved outlet of the reactor.

Fig. 2 Sonofluorescence image in non-symmetrical sonochemical reactor A

Fig. 3(a) shows another nonsymmetrical glass reactor B, but the thin film is stretched tight at its downward-curved outlet. The experiment procedure is as stated above, however, the result appears intrinsical features. Firstly, the sonofluorescence image presents a nonsymmetrical and nonuniform cavitation field distribution and secondly, the cavitation field between the extended position of ultrasound propagation route and the concave wall of the reactor which reflecting ultrasound, i.e. the main sit of the sonochemical reaction, has been intensified.

CONCLUSIONS AND DISCUSSIONS

Fig. 1 shows that the symmetrical and uniform cavitation field in the solution can be built up when using symmetrical reactor. The field distribution is available to obtain sonochemical reaction identity of whole solution. Fig. 2 and Fig. 3 show that the cavitation field in the solution is nonsymmetrical and nonuniform when using nonsymmetrical reactor. The deviated phenomenon of image brightness distribution from ultrasound radiating direction, as fig2(b), presents that the reactor structure may allow the ultrasound radiating force and its streaming to drive the host cavitation events to upwardly-inclined curved outlet. Fig3(b) presents that the nonsymmetrical cavitation field distribution can be built along some curved way, and the reactor structure can make stronger cavitation field to be initiated at the main site of sonochemical reaction. In summary, figs. 1-3 are sufficient to state that the sonofluorescence image method upon the enhanced sonochemiluminescence principle can be used to observe and record the spacial cavitation field distribution of whole reaction solution directly, and to help improving on sonochemical reactor design.

ACKNOWLEDGEMENTS

The work is supported by State Key Laboratory of Infra-Red Physics, Shanghai, P.R China, and Science Foundation of Ji’an Teachers’ College, Ji’an, P.R. China.

REFERENCES