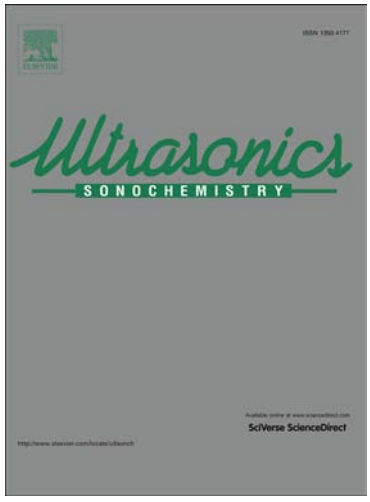

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Visualization and optimization of cavitation activity at a solid surface in high frequency ultrasound fields

Markus Kauer[1,2,*], Valentina Belova-Magri[1], Carlos Cairós[2], Hans-Jürgen Schreier[1], Robert Mettin[2]

[1]*Atotech Deutschland GmbH, Erasmusstraße 20, 10553 Berlin, Germany*
[2]*Drittes Physikalisches Institut, Georg-August-Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany*

Abstract

Despite the increasing use of high frequency ultrasound in heterogeneous reactions, knowledge about the spatial distribution of cavitation bubbles at the irradiated solid surface is still lacking. This gap hinders controllable surface sonoreactions. Here we present an optimization study of the cavitation bubble distribution at a solid sample using sonoluminescence and sonochemiluminescence imaging. The experiments were performed at three ultrasound frequencies, namely 580, 860 and 1142 kHz. We found that position and orientation of the sample to the transducer, as well as its material properties influence the distribution of active cavitation bubbles at the sample surface in the reactor. The reason is a significant modification of the acoustic field due to reflections and absorption of the ultrasonic wave by the solid. This is retraced by numerical simulations employing the Finite Element Method, yielding reasonable agreement of luminescent zones and high acoustic pressure amplitudes in 2D simulations. A homogeneous coverage of the test sample surface with cavitation is finally reached at nearly vertical inclination with respect to the incident wave.

Keywords: Sonochemistry, sonoluminescence, sonochemiluminescence, sonoreactor characterization, cavitation activity

* Corresponding author: Email address: markus.kauer@phys.uni-goettingen.de (M. Kauer)