Single-bubble sonoluminescence in aqueous solutions of NaCl

W. Winiarczyk *, K. Musiol

Institute of Physics, Jagiellonian University, ul. Reymonta 4, 30-059 Krakow, Poland

Received 27 April 1999; received in revised form 30 August 1999; accepted 16 September 1999

Abstract

We present the results of single-bubble sonoluminescence experiments in aqueous solutions of NaCl at different concentrations and temperatures. We show that sonoluminescence is observed from a bubble moving along quasistable trajectories in solutions of appropriately high concentration. © 1999 Elsevier Science B.V. All rights reserved.

Keywords: Sonoluminescence

The main experimental parameters on which sonoluminescence depends are the type of the liquid, the nature and the amount of gas dissolved in the liquid, the frequency and the amplitude of the applied acoustical pressure and the temperature of the liquid [1]. These parameters decide the value of the ambient radius $R_0$ of the bubble which together with the amplitude of the acoustical pressure, the amount of the gas dissolved in the liquid and the temperature of the liquid define the parameter space in which existence of sonoluminescence is described [2–4]. In dependence on the values of above parameters we observe stable or unstable sonoluminescence [5–7]. The stable sonoluminescence is characterised by the light pulses being emitted at equally distanced time moments (the phase of light emission as measured in relation to the phase of acoustical field is constant). For the unstable sonoluminescence phase of the light pulses drifts in time exhibiting sudden jumps after which drift is continued. We show in this article that between sudden phase jumps sonoluminescing bubble can move along the quasistable trajectories. Most of the research on single-bubble sonoluminescence was done with water. The intensity of the sonoluminescence pulses rises when the temperature of the water is lowered [8]. If this also holds true for the liquids of lower than water solidification temperature, it should be possible to obtain sonoluminescence of higher intensity. The results of experiments with various alcohols published in Ref. [9] showed that, although in all the investigated cases the sonoluminescence intensity increased with decreasing temperature, it was always lower than observed using water at room temperature.

In this article we present results of sonoluminescence experiments carried out on aqueous solutions of NaCl of different concentrations (up to 4.5 M) and different temperatures (from $+10^\circ$C to $-10^\circ$C). We used cylindrical resonator of 65 mm diameter, one end open with piezoelectric ceramic glued to the bottom of this resonator. The resonator made of pyrex, was supplied with two observation windows distant from the resonator wall by 35 mm. The