CFADAGA2004/678
Determination of the upper boundary in the energy distribution involved in the collapse of sonoluminescing bubbles

T. Lepoint[a], F. Mullie[a], S. Labouret[b], C. Pétrier[c], D. Kefting[d], R. Geisler[d], R. Mettin[e], T. Kurz[d] and W. Lauterborn[d]

[a]Laboratoire de Sonochimie et d'Etude de la Cavitation, Institut Meurice, av E.Gryzon, 1, 1070 Bruxelles, Belgium

[b]Service de Physique-Electricité, Institut Meurice, Av E. Gryzon, 1, 1070 Bruxelles, Belgium

[c]LCME, Université de Savoie - ESIGEC, 73376 Le Bourget-du-Lac, France

[d]Drittes Physikalisches Institut Göttingen, Bürgerstr. 42-44, 37073 Göttingen, Germany

[e]Drittes Physikalisches Institut, Buergerstr. 42-44, 37073 Goettingen, Germany

tlepoint@meurice.heldb.be

Multibubble sonoluminescence (MBSL) spectra of $95 - 98\% \, H_2SO_4$ solutions containing noble gas consist of a continuum which extends from ˜250 to ˜1000 nm. For $\lambda < 250$ nm, there is no observable emission. With Kr or Xe as the dissolved gas, small-intensity lines are observed in the 700 - 950 nm wavelength range. By comparison with appropriate lamps, we attributed them to $Kr[4s^2 4p^5 5p^1$ - $4s^2 4p^5 5s^1]$ and $Xe[5s^2 5p^5 6p^1 - 5s^2 5p^5 6s^1]$ electronic transitions. This means that energy levels of 11.3-12.1 eV are populated in the case of Kr and ˜9.9 eV in the case of Xe. When Ar is the dissolved gas, no Ar lines (which would involve a populating in $3s^2 3p^5 4p^1$ levels characterized by energies of 12.9-13.3 eV) are observed. Given the absence of emission below 250 nm, these observations show that the upper boundary in the distribution of energu released to the intracavity medium upon the collapse of sonoluminescing bubbles is ˜12 eV. These observations enable to understand the reason of the absence of the hydrogen 'Balmer' series in water MBSL. Indeed, transitions leading to $H_\alpha \, (656.28 \, nm)$, $H_\beta \, (436.13 \, nm)$, $H_\gamma \, (434.05 \, nm)$ and $H_\delta \, (410.37 \, nm)$ lines requires $H \rightarrow H^*$ electronic excitations over a range of 12.10-13.11 eV. Moreover, the absence (or negligible) emission below 250 nm discards thermal or plasma origins for MBSL. The ˜12 eV upper boundary in the energy distribution associated with the collapse of sonoluminescing bubbles indicates that MBSL spectra are mainly molecular.

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