Proceedings of 20th International Congress on Acoustics, ICA 2010

23–27 August 2010, Sydney, Australia

Droplet motion and deformation induced by acoustic streaming and radiation pressure

P. Brunet (1), M. Baudoin (1) O. Bou-Matar (1) and F. Zoueshtiagh (1)

(1) IEMN, Université Lille 1 and UMR CNRS 8520, Avenue Poincaré, 59652 Villeneuve d'Ascq cedex, France

PACS: 47.55.D, 68.08.Bc, 47.35.Rs, 47.35.Pq

ABSTRACT

Rayleigh Acoustic waves generated at the surface of a solid substrate can induce deformation, motion and even atomization of partially wetting droplets. The characteristic time scales associated with the droplets response strongly differ from the acoustic period, suggesting the existence of nonlinear coupling between acoustic waves and droplets dynamics. If different behaviors have been observed in different experimental conditions (droplet size, acoustic wave frequency, wetting properties of the liquid), the underlying physics remains unclear. To understand it, a parametric experimental study [P. Brunet et al., *Phys. Rev. E.*, **81**, 036315 (2010)] has been performed at a fixed frequency of 20 MHz, by varying the droplet size, the liquid viscosity and the acoustic wave intensity. In these experiments, the free surface of the droplet is modified in three different way: first a breaking of its symmetry, second global oscillations of the droplet and finally small amplitude and higher frequency "trembling modes". To explain all these deformations, two classical nonlinear acoustic driving can ve invoked: first the radiation pressure and second the acoustic streaming. The relative importance of these nonlinear phenomena strongly depends on the frequency considered. At 20 MHz, the acoustic wave is multiply reflected into the droplet and therefore the acoustic radiation pressure plays an important role. At higher frequencies, the acoustic wave hardly reaches the surface and the radiation pressure plays no role. With our experiments, we show that while both acoustic streaming and radiation pressure can induce the asymmetry of the droplet, the global oscillation mode only appears when acoustic radiation is significant. We therefore exhibit for the first time the role played by the acoustic radiation pressure on droplets dynamics in a certain frequency range. The comprehension of these phenomena is fundamental to minimize the energy required to handle droplet in view of harmless manipulation of biofluids.