Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Linear Stability Analysis of an Acoustically Vaporized Droplet[1]

JUNAID SIDDIQUI, ADNAN QAMAR, RAVI SAMTANEY, King Abdullah University of Science and Technology — Acoustic droplet vaporization (ADV) is a phase transition phenomena of a superheat liquid (Dodecafluoropentane, C_5F_{12}) droplet to a gaseous bubble, instigated by a high-intensity acoustic pulse. This approach was first studied in imaging applications, and applicable in several therapeutic areas such as gas embolotherapy, thrombus dissolution, and drug delivery. High-speed imaging and theoretical modeling of ADV has elucidated several physical aspects, ranging from bubble nucleation to its subsequent growth. Surface instabilities are known to exist and considered responsible for evolving bubble shapes (non-spherical growth, bubble splitting and bubble droplet encapsulation). We present a linear stability analysis of the dynamically evolving interfaces of an acoustically vaporized micro-droplet (liquid A) in an infinite pool of a second liquid (liquid B). We propose a thermal ADV model for the base state. The linear analysis utilizes spherical harmonics (Y_n^m, of degree m and order n) and under various physical assumptions results in a time-dependent ODE of the perturbed interface amplitudes (one at the vapor/liquid A interface and the other at the liquid A/liquid B interface). The perturbation amplitudes are found to grow exponentially and do not depend on m.

[1]Supported by KAUST Baseline Research Funds.

Ravi Samtaney
King Abdullah University of Science and Technology

Date submitted: 01 Aug 2015 Electronic form version 1.4