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Acoustic Excitation of a Micro-bubble Inside a Rigid Tube ADNAN QAMAR, RAVI SAMTANEY, Physical Sciences and Engineering Division, King Abdullah University of Science and Technology, Thuwal, KSA — A theoretical model for acoustic excitation of a single micro-bubble inside a rigid tube is proposed in the present work. The model is derived from the reduced Navier-Stokes equations and by utilizing Poiseuille pipe flow theory. Wall Frictional losses induced due to fluid motion by the bubble oscillation in response to the acoustic perturbation are taken into account. The proposed model is not a variant of conventional Rayleigh-Plesset (RP) equation and is principally a super-set of all the conventional RP models. The model is first of its kind, which relates the bubble dynamics with the tube geometric and acoustic parameters in a consistent manner. Model predicts bubble oscillation dynamics as well as bubble fragmentation quite well when compared to the available experimental data. Results are computed for three tube diameters of 200, 100 and 12 microns with two initial bubble radiuses of 1.5 and 2 microns. The response of micro-bubble is highly non-linear with the driving acoustic frequency. Bubble response for low acoustic peak negative pressure (PNP) is linear, whereas as the PNP is increase nonlinearity are manifested and eventually bubble fragmentation takes place. For fixed acoustic parameters, an exponential decay in bubble response is observed as the tube length is increased. For very small tube diameters, the predictions are damped, suggesting the breakdown of the inherent model assumptions for these cases.

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