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PROCEEDINGS

Dynamics of Bubble-Particle Interaction at Different Distances Under Ultrasonic Excitation

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ABSTRACT

The interaction between the particle and the bubble under the ultrasonic wave excitation plays a pivotal role in various applications such as targeted therapy, ultrasonic cleaning, ultrasonography, and microbubble motors. When the particle is in close proximity or even attached to the bubble, a strong fluid-structure interaction occurs, significantly influencing the particle propulsion. The attachment of the bubble to the particle results in distinct bubble pulsation patterns and particle acceleration mechanisms from the non-contact state. Thus, we propose a fluid-structure interaction model based on the boundary integral method (BIM) to comprehensively consider the distance between the bubble and the particle under ultrasonic wave excitation. Our findings highlight the dependency of bubble dynamic characteristics on key parameters, particularly the properties of the ultrasonic wave (frequency, amplitude, and initial phase), which govern the expansion and collapse of the bubble. Furthermore, the variation of the bubble jet morphology and the particle propulsion mode with governing parameters is also revealed. These results contribute to an enhanced understanding of the physics underlying ultrasonic bubble-particle interactions, thereby informing the development of future technologies.

KEYWORDS

Fluid-structure interaction; numerical methods; bubble dynamics; particle propulsion

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