VIBRATIONAL RESONANCE IN A CHARGED BUBBLE DRIVEN BY AN AMPLITUDE-MODULATED ACOUSTIC FIELD

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ABSTRACT

The phenomenon of vibrational resonance (VR) has received considerable research attention due to its numerous potential applications in physical and life sciences, biomedical and medical sciences and many technological fields. Very recently, VR was investigated in an uncharged Rayleigh-Plesset bubble oscillator. In this paper, a report of an investigation on VR in a modified Rayleigh-Plesset oscillator for a charged bubble oscillating in a compressible fluid that is driven by an amplitude-modulated acoustic field is presented. The modified Rayleigh-Plesset equation was used to obtain the equation of motion for a charged bubble as an oscillator moving in a potential well. Using the liquid parameters, the speed of sound in liquid, and the bubbles's physical properties, the variation of the potential function in the absence of acoustic forces was investigated for different values of the quantity of charge. It was found that, when the uncharged bubble (Q = 0) moved in a stable single-well potential, increased amount of charge on the bubble utters the potential structure significantly, and the number and stability of its equilibria - driving it from single-well to double-well potential structure. VR was also numerically investigated by means of a Simulink model of the charged bubble oscillator. It is shown that an increase in the quantity of charge leads to an increased response of the bubble to the amplitude modulation, which leads to the enhancement of VR.

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