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Surface stability of an encapsulated bubble subjected to an ultrasonic pressure wave YUNQIAO LIU, KAZUYASU SUGIYAMA, SHU TAKAGI, YOICHIRO MATSUMOTO, Department of Mechanical Engineering, University of Tokyo — A theoretical study on the shape stability of a nearly spherical bubble encapsulated by a hyperelastic membrane in an ultrasound field is performed. To describe the dynamic balance on the bubble surface, the membrane effects of the in-plane stress and the bending moment are incorporated into the equation set for the perturbed spherical flow of viscous incompressible fluid (Prosperetti, 1977). The spherical motion of the bubble is numerically obtained by solving the Rayleigh-Plesset equation with the elastic stress. The deflection therefrom is linearized and expanded with respect to the Legendre polynomial. Two amplitudes for each shape mode are introduced since the membrane has mobilities not only in the radial direction but also in the tangential direction. The eigenvalue analysis on the system determines the higher-order natural frequency. The derived system is applied to the temporal evolution of the higher-order shape mode. Stability diagrams for the higher-order shape mode are mapped out in the driving amplitude versus driving frequency phase space for various elastic moduli of the membrane. The most unstable driving frequency is found to be approximately integer multiples of the higher-order natural frequency.

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