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Surface modes of bubbles in an acoustic field MICHEL VERSLUIS (1), PEGGY PALANCHON (2), DAVID GOERTZ (2), SANDER VAN DER MEER (1), IVO HEITMAN (1), BENJAMIN DOLLET (1), NICO DE JONG (1, 2), DETLEF LOHSE (1), (1) PHYSICS OF FLUIDS, UNIVERSITY OF TWENTE TEAM, (2) EXPERIMENTAL CARDIOGRAPHY, ERASMUS MC ROTTERDAM TEAM — We investigate the nonspherical oscillations, or surface modes, of bubbles of radius between 10 and 60 microns within an ultrasonic field of frequency of 130 kHz. We show experimentally that a threshold in acoustic pressure is required to trigger the surface modes, that they appear only after a few cycles of ultrasons, and that the observed mode number (2 to 6) is linearly related to the resting radius of the bubble and does not depend significantly on the acoustic pressure. We relate the observations to a parametric instability: The amplitude of nonspherical oscillations is modulated by the radial dynamics. Using a simple, linear radial dynamics, we reproduce the dependence of the observed mode number with the radius. A more accurate, nonlinear radial dynamics model determined from a modified Rayleigh-Plesset equation yields excellent agreement, both for the threshold in acoustic pressure and for the mode number, in the whole parameter space. The implications of these results for the coated microbubbles widely used as ultrasound contrast agents in medical acoustics are discussed.

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