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Inertial collapse of a gas-vapor bubble in a viscoelastic medium[1]

KAZUYA MURAKAMI, ERIC JOHNSEN, University of Michigan — Inertial collapse of cavitation bubbles is a key phenomenon in a high strain-rate rheometry for soft material and medical applications. The bubble contents in water are dominated by vapor, while a finite amount of non-condensable gas as well as vapor exist inside cavitation bubbles in soft matter. It is thus important to understand gas-vapor mixture transport on bubble dynamics in a viscoelastic medium. We use a Rayleigh–Plesset-type equation in which we account for variable specific heats ratios for the gas and vapor. During inertial collapse, a large amount of vapor is trapped inside the bubble because a shell of non-condensible gas is formed near the bubble wall and prevents the vapor from condensing. As a result, the bubble does not collapse to as small a minimum bubble radius and rebounds to a larger because of less energy is lost to acoustic radiation near collapse. Furthermore, the maximum temperature is induced near the bubble wall in the gas-dominated region rather than at the center of the bubble in the vapor-dominated region. The assumption of constant specific heats ratio causes some discrepancies when the inertial collapse of gas-vapor bubble is more violent.

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Kazuya Murakami
University of Michigan

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