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Experimental investigation of the effect of heating rate on pre-existing gas nuclei in a viscoelastic medium

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Inertial cavitation is known to play a key role in thermal HIFU therapy, both from the point of view of treatment safety and delivery, and as a potential tool for treatment monitoring. However, bubble behaviour in rapidly changing temperature fields remains poorly understood. Using a theoretical model, we have previously shown that, for a given initial bubble radius, a critical heating rate exists, above which the bubble will grow, and below which it will dissolve. In order to test this hypothesis, an electrical resistor embedded in 0.5% Xanthan Gum solution is used to impose a known temperature profile, measured by an array of thermocouples, on a series of embedded bubbles. An optical arrangement employing a 10 Megapixel CCD and a macro lens is used to image the bubbles within the gel at sufficient resolution for accurate sizing. The radius-time profiles for a range of bubble sizes are thus extracted using image analysis techniques, allowing comparison with model predictions and subsequent refinement of the theoretical model. Future work will focus on the incorporating the effects of acoustic excitation, such as rectified diffusion, to develop a unified model of bubble behaviour in viscoelastic media under the effect of a HIFU field.