Bubble Detection

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Bubble activity is detected through its effect on some interrogative mechanism, whether it be a laser beam, a hydrophone signal, or a monitored sonochemical reaction. The act of detection therefore relies on the interaction of the bubble with the probe, which will depend on the type of cavitation present. Whilst shadowing (both optical and acoustical) and acoustic resonance techniques are generally suitable for long-lived stable bubbles, more energetic cavitation may be detected through certain emissions (eg. pressure waves and luminescence) associated with the relatively large changes in volume and rapid wall velocities which characterise this activity. Such high-energy cavitation may occur when high amplitude pressure pulses are passed through a liquid. However as a result of the flux into the bubble of gas that was previously dissolved within the liquid, the end result of such high-energy cavitation may be stable bubble fragments, for which the resonance and shadowing techniques are suitable detectors. Appropriate choice of technique therefore allows one to interrogate a liquid sample for a specific activity.

Choice of technique will also depend on the nature of the medium, for example the extent to which it attenuates a signal, and the number of false signals/scatterers it may host. Since many relevant materials are optically opaque, acoustic techniques are often most suitable. The bubble resonance may conveniently be employed, since at resonance the acoustic scattering cross-section of a bubble is much larger than the geometric cross-section (by up to several orders). However resonance scattering exhibits only a local maximum at resonance, so that larger, non-resonant bubbles may give rise to signal that could be interpreted as being due to much smaller, resonant bubbles. There are in contrast nonlinear signals which exhibit a global maximum at resonance. Certain of these can however be produced through nonlinear processes in bubble-free water.

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