

Pulsation of cubic bubbles

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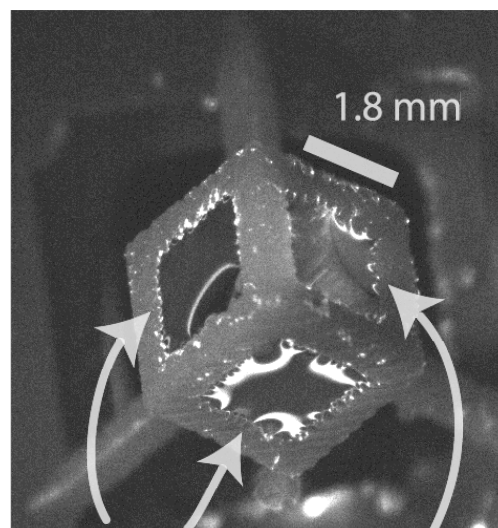
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Due to their great compressibility, bubbles are known to be excellent acoustic resonators and exhibit strong nonlinearities [1]. Furthermore, since the wavelength in the lowest frequency mode (Minnaert resonance) is way larger than the bubble size, they represent perfect candidates for building acoustic metamaterials [2]. One difficulty, though, is to create stable and precisely designed bubbly media.

We propose here to use 3D printing technique to overcome these two problems. We study experimentally the oscillations of a millimetric cubic cavity of air trapped in a 3D printed frame. In this configuration, the water-air interfaces are flat and attached to the printed frame, which increases the stability of the bubble. Furthermore, this new object does not behave as the usual spherical bubble, exhibiting for example a lower fundamental resonance frequency than the Minnaert frequency. Another interesting result is the possibility to shape the bubble frame in order to have different resonance frequencies for each side of the cube, giving the possibility to induce acoustic streaming in a specific chosen direction.

[1] Leighton, T. The Acoustic Bubble. (Academic Press, 1997).

[2] Leroy, V. et al. Design and characterization of bubble phononic crystals. Appl. Phys. Lett. 95, 171904 (2009).



Water/air interfaces

Figure : Example of a 3D printed cubic bubble with six openings, in water. Air gets trapped in the bubble by capillarity, leading to the creation of six water-air interfaces on the faces of the cube (only three of them being visible on the picture).