Ultrasound transmission through microfluidics-generated liquid foams

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While the acoustic properties of solid foams, which are frequently used for soundproofing purposes, have been abundantly characterized [1], sound propagation in liquid foams remains poorly understood. J. Pierre and collaborators have recently investigated the transmission of ultrasound through polydisperse liquid foam samples [2, 3]. Their study showed that the mechanical coupling between the liquid network in the foam and the thin liquid films separating the bubbles could result in a large attenuation, associated to a resonant behavior [4].

The acoustic propagation in a foam strongly depends on its structural parameters (number, surface and thickness of the films, liquid fraction, among others), all of which were not well characterized in previous experiments. Further progress thus requires to investigate the acoustic response of well-controlled foam structures. We introduce a new experimental setup designed to study the transmission of ultrasound (frequencies in the range 70 – 1000 kHz) through model monodisperse liquid foam samples generated by microfluidics. We will present measurements of the acoustic transmission trough monodisperse bubble monolayers of various liquid fractions and bubble sizes. The analysis of these measurements will allow us to retrieve the sound velocity and attenuation in bubble monolayers as functions of their structural parameters.

Additionally, preliminary results on bubble bilayers already show a qualitative difference between the transmission through bubble monolayers and bilayers. This is likely a signature of the free liquid films separating the top and bottom bubbles in the bilayer. This discrete approach, allowing to isolate the signature of a single layer of free films in the acoustic response, will contribute to a better understanding of the dissipation in liquid foams. On the long term, this work could contribute to the design of optimized acoustic metamaterials created by solidification of liquid foams.

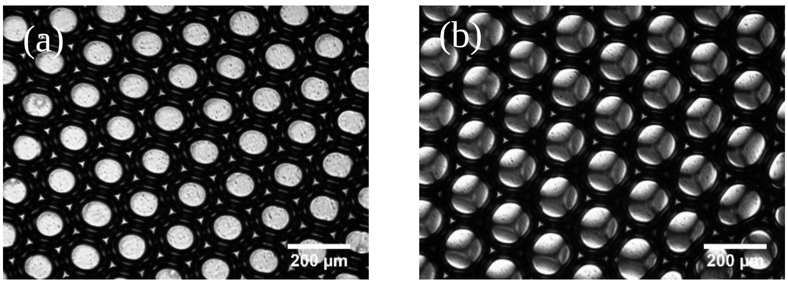

Figure 1: Model foams generated by microfluidics. (a) Monodisperse bubble monolayer – (b) Monodisperse bubble bilayer.

References

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