Public summary of the deliverable D3.4:
"Experimental facility for producing tunable microbubble populations"

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Ultrasound is the most widely used medical imaging technique, in large part because it offers low risk, portable imaging and produces real time images. The natural sources of contrast in ultrasound are inhomogeneities in the body. Blood, however, is a poor ultrasound scatterer and blood vessels are therefore difficult to visualize in ultrasound images. The visibility of the blood pool can be enhanced by using ultrasound contrast agents (UCAs) that scatter ultrasound very effectively owing to their gas core. In addition to imaging applications, microbubbles have also been shown to enhance the transport and uptake of drugs in tissue. In medical applications, bubbles undergo volumetric oscillations inside or near soft and biological [1].

The physics governing the nonlinear dynamics of a microbubble in an infinite liquid is well understood and modelled. It is also known that microbubbles dynamics strongly depend on both the coating and the surrounding medium. However, the impact of tissue properties in conjunction with that on the bubble shell is still poorly understood [2][5].

Soft and biological materials, including cells, tissues, and gels, exhibit a viscoelastic behavior that is an intermediate between that of fluid and that of a solid. The goal of this project is to investigate the influence of the viscoelastic medium on the linear and nonlinear behavior of phospholipid-coated microbubbles. To that end, we produce and characterize monodisperse microbubbles using an in-house built microfluidic platform (Fig 1a). The microbubbles are coated with a monolayer of phospholipid molecules and can be produced with a size ranging from 1 to 5 μm in radius and display a resonance frequency ranging from 0.3 to 3 MHz at high pressures. These bubble population can be suspended in tissue-mimicking, viscoelastic gels consisting of polyacrylamide [3][4].

Fig 1b shows how the bubble behavior is influenced by the ultrasound: the resonance frequency of the microbubbles shifts towards higher frequencies in viscoelastic medium while the effect of the shell becomes less pronounced at high pressures.

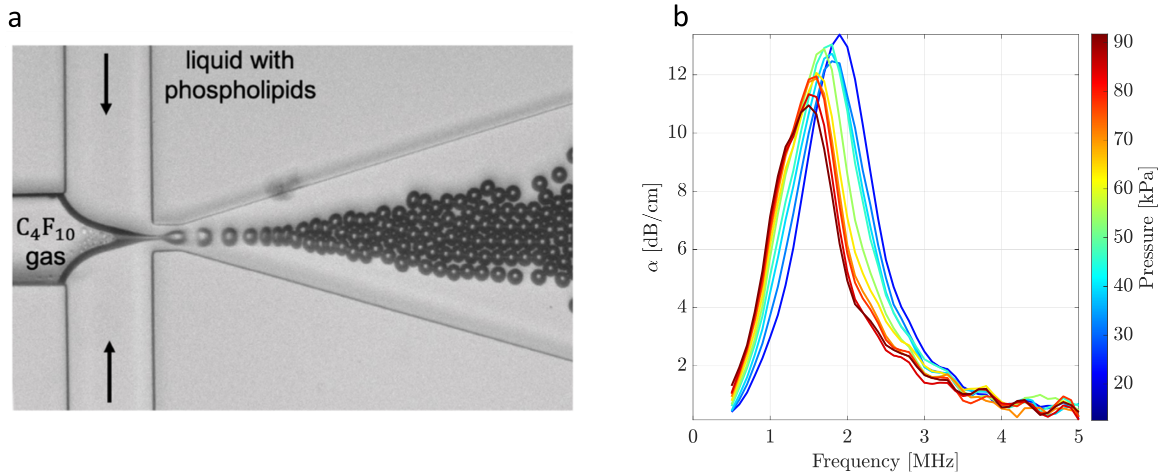

Figure 1, Image of the custom-made flow-focusing device used to produce C_4F_{10} filled monodisperse microbubbles. *b) Acoustical characterization of phospholipid microbubbles suspended in water. The Y-axis shows the attenuation coefficient.*

References

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