European Research Council
Established by the European Commission

Postdoctoral position in Grenoble, France

Physics of new swimming particles based on pulsating microbubbles

The context This project plans to take advantage of novel 3D microfabrication techniques and chemical techniques to develop innovative applications using microfluidics and acoustics. These applications, which were out of reach without current techniques, are based on the use of microbubbles with a huge acoustic resonance. Even under medium amplitude acoustic driving, non-linear effects appear around vibrating bubbles, generating strong steady flows called acoustic streaming. We propose to use these flows in order to achieve propulsion of small scale, and to generate a new class of micro-swimmers. Their application is to behave as carriers, such as drug carriers, activated at a distance, or to be active tracers that enhance mixing.

The challenges The first objective is to understand the physics of swimming particles remotely powered by ultrasound and to control their direction of motion. For this purpose, we plan to build *rigid capsules* holding a bubble by 3D fabrication (see figure a). The bubble is free to pulsate at the capsule orifice, generating streaming under ultrasound (figure b). To control the direction we plan to fabricate micro-swimmers with different propellers (see figure c).
The second objective is to obtain by chemical synthesis a large number of *flexible shell* micro-swimmers that pulsate with large amplitude, exhibiting repeated shell buckling (figure d).
The third objective is to study the collective motion of these swimmers in microchannels, in order to capture their original swimming physics and understand interactions with each other or with boundaries.

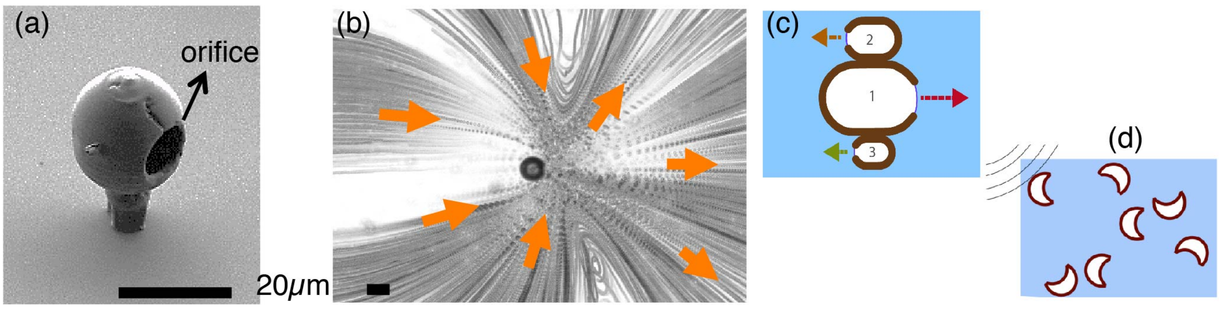

Figure (a) *Fabricated micro-capsules containing bubbles (SEM image).* (b) *Capsules in water, under ultrasound: streamlines, image from Physical Review Applied, 4, 064012 (2015).* (c) *Example of a micro-robot made of several capsules with different sizes and thus different resonance frequencies.* (d) *Flexible shells, undergoing periodic buckling deformation under oscillating pressure.*

Your profile A PhD degree in physics or fluid mechanics with skills in microfluidics is required. Some knowledge of acoustics is preferred but not mandatory. The candidate will be involved in the microfabrication process.

Environment The Laboratoire Interdisciplinaire de Physique is located on Grenoble campus, France. The postdoc will be working with Olivier Stephan (rigid capsules), Gwennou Coupier and Catherine Quilliet (flexible shell) and Philippe Marmottant (microacoustics). We will collaborate with Nicolas Tsapis (Institut Gallien Chatenay-Malabry) for chemical mass synthesis, and Eric Lauga (Cambridge) for theory. The position is funded by the ERC Consolidator Grant BUBBLEBOOST. The starting date is february 2017, for one year, and can be extended another year.

Applications: Candidates are invited to contact Philippe Marmottant at the e-mail address philippe.marmottant@univ-grenoble-alpes.fr. The following items will be required: a PhD diploma, a CV with publication list, names and contact information of several references, together with a letter outlining past research activities and future research interests.

Contact Philippe Marmottant, Mél: philippe.marmottant@univ-grenoble-alpes.fr, page web
Laboratoire Interdisciplinaire de Physique, CNRS/Université Grenoble Alpes, Campus de Grenoble