European Research Council
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Postdoctoral position in Grenoble, France

Ultrasound Powered Micro-Swimmers: mass fabrication and controlled direction

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. Microswimmers are mechanical analogues to RFID devices (where electromagnetic vibration is converted into current): here sound is converted into motion at small scales.

The challenge The first objective is to build swimming micro-robots remotely powered by ultrasound (see an example using 3D fabrication, figure a-b below), and to control their direction of motion. For this purpose, we plan to build microswimmers with different propellers (see figure c). The second objective is to obtain a large number of free swimmers by chemical synthesis and study their collective motion in microchannels. Rigid and also flexible microswimmers (insert figure d) will be under study, in order to capture their original swimming physics.

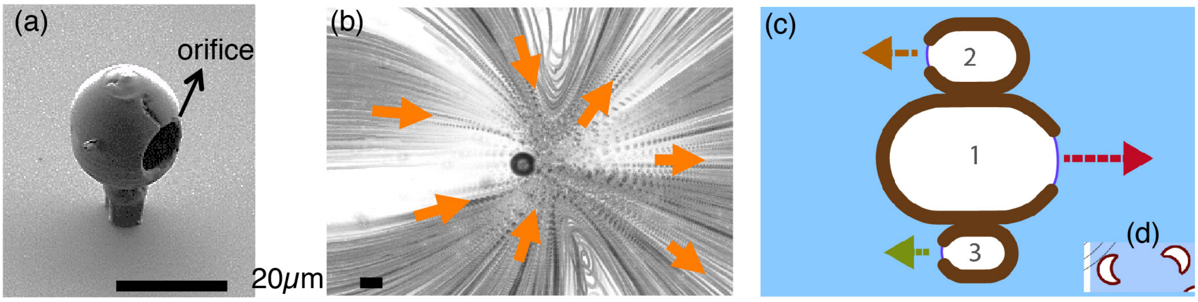

Figure *(a) Capsules containing bubbles (SEM image). (b) Capsules in water, under ultrasound: streamlines, image from Physical Review Applied, 4, 064012 (2015). (c) Example of a micro-robot made of several armoured bubbles with different sizes (and thus different resonance frequencies). (d) Flexible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

Your profile A PhD degree in physics/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 Michel Bouriau, Olivier Stephan (microfabrication), Gwennou Coupier and Catherine Quilliet (flexible buckling swimmers) and Philippe Marmottant (microacoustics). We will collaborate with Nicolas Tsapis (Institut Gallien Chatenay-Malabry) for mass fabrication. The position is funded by ERC Consolidator Grant BUBBLEBOOST. The starting date is October 2016, 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
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