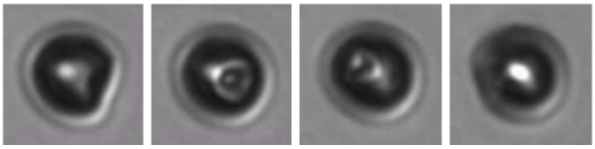
Post-doc position available

Steerable biosourced microswimmer powered by ultrasound

Subject : In the scope of targeted drug delivery, we aim at making a microswimmer both propelled and steered by ultrasound waves. The elementary brick of such a microswimmer is an elastic colloidal shell containing air, which deforms under the oscillating pressure of ultrasounds. With a view toward biocompatibility, these bricks are to be realised by absorption of xyloglucane / cellulose nanocristals multilayers (model system for plant walls [1]) at the surface of micronic bubbles obtained through a microfluidic device [2]. Their randomly oriented swimming, due to deformations induced by pressure cycles, will be studied via statistical methods (projected walk, collective or singular diffusion properties…). In the light of a recent centimeter-scaled study [3], one will tackle the effect of coupling between eigenfrequencies of the shell deformations and pressure excitation frequencies, here ultrasonic, so as to learn how to enhance or repress shell motion.



Picture : micronic shell buckling under 200 mbar pressure

Then shells with different properties (size, thickness) will be aggregated using microfluidic facilities, by capillary confinement in an evaporating droplet [4], in order to build a swimmer which displacement direction depends on the (group of) shells effectively deformed by the ultrasonic wave. The goal of the project is to provide the proof of concept for powering a microswimmer using an ultrasonic wave, and remote steering through mere modulation of amplitude and frequency.

[1] B. Jean, L. Heux & al., *Non-electrostatic building of biomimetic cellulose-xyloglucan multilayers, Langmuir* 25 (2009) 3920

[2] M. Stoffel, E. Lorenceau & al., *Bubble production mechanism in a microfluidic foam generator, Phys . Rev. Lett.* 108 (2012) 198302

[3] A. Djellouli, P. Marmottant, H. Djeridi, C. Quilliet & G. Coupier, *Buckling instability causes inertial thrust for spherical swimmers at all scales*, to appear as Editor's suggestion in *Phys . Rev. Lett.*

[4] V.N. Manoharan & al., *Dense packing and symmetry in small clusters of microspheres*, *Science* 301(2003)483

Skills : Experience in microfluidics and/or image and data treatment and /or ultrasonic waves, plus taste for fine experimentation and yearning for interpretation would be welcome for this interdisciplinary project.
Research will be done in collaboration with Gwennou Coupier, Laurent Heux, Elise Lorenceau, Philippe Marmottant, Yotam Navom, Catherine Quilliet.

Practicals : The location will be mainly at LIPhy, on Grenoble's academic campus, facing Belledonne mountains, 15 mn tramway and 12 mn bike from Grenoble's hypercenter. Part of the work will be done in collaboration with CERMAV, on the same campus. Both labs are internationally renowned and perform competitive research. The postdoc is cofinanced by Laboratory of Excellence TEC21 and Institut Carnot Polynat; salary expectations are based on the grid set up by the CNRS (min. 2300 euros brut / month). Duration : 12 months. Beginning : Feb. To April 2018.

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