Université Claude Bernard Lyon 1

Instituts thématiques Inserm
Institut national de la santé et de la recherche médicale

LabTAU - Unité de recherche U1032
Applications des ultrasons à la thérapie

PhD position in Physical Acoustics – 3 Years

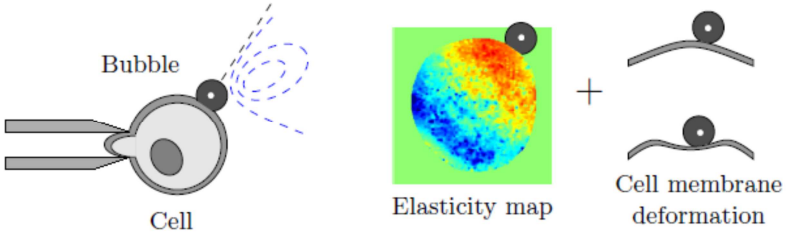
Characterization of biological cell membrane deformation induced by oscillating microbubbles for enhancing sonoporation process

Context of the study

In order to improve the delivery of drugs and therapeutic genes, ultrasound (US) is already widely applied, through the local vector for acoustic energy transfer that are cavitation bubbles. Depending on the cavitation activity (in the case of inertial/collapsing or non-inertial/stable cavitation), cavitation-induced bioeffects are well recognized as key player in a broad range of biomedical applications such as blood-brain barrier opening by ultrasound or sonoporation (cell membrane permeabilization by ultrasound). Despite this, the dynamic process of cavitation bubble interaction with biological tissues and cells are not well understood, mainly due to the lack of techniques allowing the time-resolved description of this complex interaction, particularly at the cellular level. Recently shear-wave elastography was conducted at the scale of a single cell using an optical microscopy technique, and this setup was extended to control single bubble dynamics in the vicinity of a biological cell.

Project objectives

The main experimental aspects of the project concern the manipulation of micrometric bubbles and cells under microscope through micro-manipulation device. The bubble-cell interaction will be captured by high-speed imaging (up to 180 000 frame/second) in order to resolve their oscillatory behavior at the acoustic timescale.



The candidate will work on the characterization of the cell membrane deformation as a function of the bubble oscillation amplitude. The various studied cell lines will first be characterized by a micro-elastography technique. Then, by sonicating the cell lines in in-vitro sonoporation devices designed in the laboratory, the correlation of the sonoporation efficiency of these lines with their mechanical properties could be assessed.

Project tasks

- Conduct experiments on single bubble-cell interaction to assess cell membrane deformation
- Differentiate cell lines through their mechanical properties by elastography techniques
- Correlate the cell membrane properties to the sonoporation efficiency of various cell lines
- Report on the results through communications at international conferences and journal articles

Skills

- The candidate must have a Master degree in one of the following fields: Acoustic instrumentation, Physical Acoustics, Mechanics or Physics
- Programming skills: Python (Matlab)

Contacts

Send a CV and a motivation letter to Claude INSERRA (claude.inserra@inserm.fr) and Jean-Christophe BERA (jean-christophe.bera@inserm.fr)

Expected start of the position: October 2018

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