POST-DOCTORAL POSITION PROPOSAL

Subject: **Experimental study and modelling of ice crystals size obtained by ultrasound assisted freezing in vials**

Requirements:
Academic level: Ph D
Specialisation: applied physics or mechanical engineering or chemical engineering,
Particular skills: modelling by experimental design, acoustics, thermodynamics, knowledge based modelling

Scientific context:
The control of ice crystallisation is of capital importance for industrial processes where the crystals' size determines entirely the viability of the product, namely: freeze drying of pharmaceutical products, freezing of food and biological products,'cold' storage and cooling by means of ice slurries, cryopreservation of living tissues
The noticeable impact of ultrasound waves on the nucleation and growth rate of ice crystals in a super-cooled aqueous solution has been clearly established in the literature. However, neither empirical nor theoretical correlations between all these parameters and the final crystals number or mean crystal size have yet been published. In the scope of industrial development of ultrasound assisted processes, there is an urgent need for an experimental design or a theoretical model for distinguishing the most influent parameters and for correlating them to the mean crystal size.

Work to do:
- validation of the experimental set-up for ultrasound assisted freezing in vials ;
- experimental design, experimental trials, data analysis and regression, development of correlation between ice crystal mean size and ultrasonic operating conditions;
- modeling of the acoustic cavitation of a single gas bubble in order to determine the temperature and pressure in the liquid near the bubble wall and the number of nuclei produced,
- extension of the single bubble acoustic nucleation model to the multi-bubbles case by considering the interaction between the acoustic pressure field and a gas bubbles population,
- numerical calculation of the number of ice nuclei and of ice crystals' mean size within water solutions in vials generated during ultrasound assisted freezing.

Contact:
Roman PECZALSKI, Professor
Laboratoire d'Automatique et de Génie des Procédés (LAGEP)
Université Lyon 1, Domaine de la Doua, bât. CPE, 69616 Villeurbanne, France
Tél. : 33 (0) 4 72 43 18 70,
E-mail: peczalski@lagep.univ-lyon1.fr