

Postdoctoral fellowship

“Numerical modeling of the rupture of microcapsules in flow”

Laboratory	Biomechanics & Bioengineering (UMR 7338), CNRS – Université de Technologie de Compiègne, CS 60319, 60203 COMPIEGNE, France.
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Funding	ERC Consolidator Grant: <i>MultiphysMicroCaps</i> project
Duration	1 year (potentially extended for another year) – starting date: June 1st 2023
Salary	25 000€ - 40 000€/year depending on experience
Background	Numerical modeling, damage, rupture, fluid-structure interactions

Context of the post-doctoral fellowship:

MultiphysMicroCaps is a large project that explores the use of deformable liquid-core capsules of micrometric size to efficiently transport active material, with a primary focus on health-related applications. It is focused on the design of innovative sophisticated numerical models and high-tech experiments, needed to determine the potential of such vectors to protect and deliver active substances, and to optimize their properties for specific industrial and biomedical applications.

The postdoctoral fellow will be working within the Biological Fluid-Structure Interactions (BFSI) research team of the Biomechanics & Bioengineering Laboratory. It is specialized in the study of hemodynamics, from the microcirculation to large vessels, focusing on therapeutic applications. It combines advanced numerical and experimental approaches, which enables to translate theoretical results into practical applications, such as the mechanical characterization of microcapsules.

Description of the postdoctoral research project:

Encapsulation consists in enclosing an internal medium in a solid semi-permeable membrane to protect it and control the exchanges with the environment. Capsules offer tremendous potential in the fields of biotechnologies, pharmacology, energy storage and food industry, but scientific challenges remain to be met, such as finding the optimal compromise between payload and membrane thickness, characterizing the membrane resistance and controlling the moment of rupture.

The objective is to numerical model the breakup of a microcapsule subjected to hydrodynamic stresses. The microcapsule will be modeled as a liquid droplet enclosed in a thin membrane with hyperelastic properties. The challenges of such simulations come from the multiple phenomena governing the problem: the inner and outer fluid flows, membrane deformation and initiation of damage, crack formation and propagation. The goal will be to enrich our existing in-house numerical code, considering the induced membrane porosity, working on the code acceleration and introducing new algorithms (e.g. for crack tracking). It will also be to study practical cases to understand the capsule breakup mechanisms depending on the flow dynamics.

Documents required to apply: We are looking for highly motivated, dynamic and rigorous candidates, who will be fully involved in the project and eager to integrate the interdisciplinary BFSI research team.

Interested candidates should send an application letter along with a full CV, copies of the PhD reports and reference letters from 2-3 referents.