SEMS: RESEARCH PROJECT DESCRIPTION

1. Project Background and Description

Hydrodynamic fabrication of complex soft matter

Structures with complex patterns are widely dispersed in Nature where they are generated from pre-existing ones (prepatterns, e.g. DNA replication, cell proliferation) or by self-patterning (in the absence of prepatterns). Self-patterning in synthetic chemical systems has also been observed through reaction–diffusion mechanisms whereby dynamic concentration gradients evolve into chemical waves capable of oscillatory propagation or generation of the so-called Turing patterns. The impact of liquid fragments on a surface of another liquid exhibits different behaviours depending on the physical properties of both liquids. Understanding the physics of these phenomena is crucial in a variety of applications, such as the transport of surface contaminants into bulk liquids and the microencapsulation of compounds.

In this project, we aim to exploit how physical perturbation, in the form of liquid drops and jets, can be applied to create spatial patterns in reaction-diffusion systems. The interplay between the physical perturbation, chemical gradients and mass transport will be investigated aiming to define rules for the fabrication of patterns in soft materials.

2. Project Scope

The objectives of the research project are:

1. *Development of methods to study post-impact droplet behaviour.*
2. *Characterization of selected polyelectrolytes and post-impact droplet behaviour.*
3. *Fabrication of hydrogels with defined patterns*

3. Desired Skills from the Student

1- *The ideal candidate will have an MSc or BSc degree (or equivalent) in Mechanical Engineering, Physics, Mathematics or a related discipline.*

2- *Background in fluid dynamics and applied physics.*

3- *Knowledge of biomaterials would be an advantage but not essential.*

4- *Experience of working in a laboratory; conducting experiments and analyzing the results.*

5- *Some basic programing skills.*

4. Supervisory Team

Primary Supervisor: *Dr. Ahmed Ismail, Academic Fellow in Fluid Dynamics*

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Secondary Supervisor: *Dr. Helena Azevedo, Reader in Biomedical Engineering & Biomaterials*

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