SEMS: RESEARCH PROJECT DESCRIPTION

1. Project Background and Description

Generation and deposition of liquid fragments

The great interest of liquid fragmentation derives from the sea of applications within the chemical and biological sciences. For instant, micro-droplets dispersed within an immiscible continuous phase can mimic conditions similar to that of a single cell, allowing ultra-high throughput experimentations to understand the biological and chemical reactions. Other applications include protein crystallization, DNA sequencing, emulsion based bias-free PCR and cell sorting assays. In manufacturing industry, the generation of micro-droplets/jets has the added advantage of printing 2D and 3D structures. Depositing micro-droplets/jets is used for manufacturing TV displays, sensors, optoelectronic devices and conductive tracks for electronics. In biotechnology industry, biopolymer liquid loaded with living cells is dispensed in form of micro-droplets to create biological structures in a layer-by-layer manner allowing for manufacturing organs substitutes. This wide range of applications has motivated scientists to develop technologies in order to generate and deposit liquid fragments in form of droplets and jets. However, there remain significant challenges understanding fundamental interfacial science and optimize the fragmentation process.

The aim of this exciting research project is to explore the underpinning physics of phenomena related to the generation and deposition of micro-droplets/jets by means of external mechanical, hydrodynamic and electrical forces and build upon this knowledge to develop new microfluidic systems to break the limitation of the currently existing technologies. Such system will be used in many applications such as inkjet printing and microencapsulation. The successful candidate will obtain world leading training in a range of disciplines during the PhD including, advanced micro fabrication, high speed visualization, and developing scaling laws and theories.

2. Project Scope

The objectives of the research project are:

1. *Design and build an experimental setup for the generation and deposition process of jets/drops..*
2. *Conducting computational modeling of the process using available open source codes.*
3. *Characterize the parameters affecting the process to understand the physics in this phenomenon and print high quality electronics based on this knowledge.*

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

4- *Some basic programing skills.*

4. Supervisory Team

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

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