Mechanical Separation Process of the Micro-Robots MagnetoSperms (MATS)

Introduction

Targeted therapy using MagnetoSperms have the potential to mitigate the negative side-effects associated with conventional treatment. We fabricate MagnetoSperms by an electrospinning technique using polystyrene, dimethylformamide and iron oxide nanoparticles. An empirical model of the size of the magnetic micro particles and the parameters (electric potential, concentration of the solutions and nanoparticles, and dynamic viscosity of the fluid) of the electro spraying technique is developed.

The magnetic dipole moment of the microparticles is characterized using an electromagnetic system and a force sensor at the microscale. In addition, we experimentally demonstrate closed-loop motion control of the microparticles under the influence of the controlled magnetic field gradient in three-dimensional space.

Objective

This work aims at optimizing the fabrication process of a biologically-inspired micro robot, which we refer to as MagnetoSperm (Fig. 1).
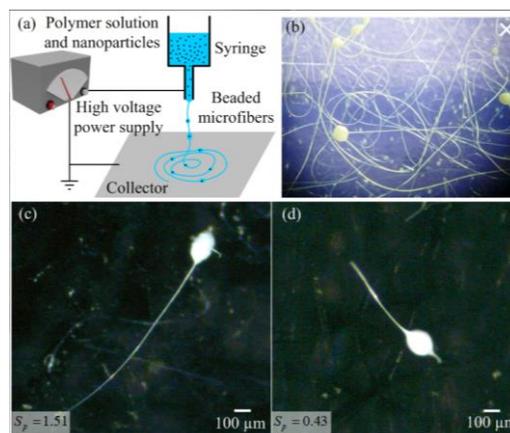

Figure 1: Fabrication of Micro-Robots MagnetoSperms

The fabrication is done using the electro-spinning workstation of MNR Lab, whereas the locomotion is achieved under the influence of oscillating magnetic fields. These fields are produced using an Electromagnetic system.

Tasks

- Fabrication of MagnetoSperms using electrospinning;
- Optimization of the process to obtain single / fragmented robots by developing a rotary collector which mechanically collects the magnetosperms at the desired pattern to facilitate their separation.

Materials

- The electrospinning workstation in MNRLab;
- Chemical solvents
- Polystyrene, dimethylformamide and iron oxide nanoparticles.

PREREQUISITES

- Students are expected to have basic knowledge about polymers and nano particles and their behavior
- Students are expected to have a working knowledge of control theory, differential equations, linear systems, Statics, kinematic and dynamics.
- Familiarity with programming, especially with Matlab and C++.

OTHER NOTES

This project will involve a weekly meeting with the instructors and progress reports have to be prepared. All reports should be written in academic paper format.