Project 3.1 Assembly of particle chains based on dielectrophoretic, magnetic and capillary effects..

Supervisor: prof. Robert Hołyst / K. Giżyński
Institute: of Physical Chemistry
Unit: Living Materials
www: https://janpaczesny.wixsite.com/paczesny,

Background:

A very promising method that might be a breakthrough for large-scale manufacturing of flexible electronic devices was demonstrated two years ago by experimental scientists. They showed that by applying AC electric current, centimetre-long and micrometre-thick chains of particles can be assembled and deposited on substrates to form paths that conduct electric charges. Unlike today's standard manufacturing technologies for electronic components, their method makes it possible to deposit the paths on surfaces that are convex or concave or have irregular geometry, and they can be bent, stretched or compressed.

We aim to extend the original method with the possibility of assembling the desired structures with a magnetic field. This is to enable non-electric field assembly (e.g., for repair of components prone to damage from electric charges) and prevent unordered path formation. The approach is novel compared to the original method and thus is interesting from a basic scientific perspective. On the other hand, it offers an alternative route for the fabrication process of conductive paths composed of magnetic materials. Moreover, such structures have the ability to release energy in the form of heat when exposed to high-frequency alternating magnetic fields. This feature will allow for controllable and contactless heating of fabricated materials while also making use of their conductive properties.

Aim:

This project aims to elaborate a method allowing assembly of magnetic micropaths. To this end, we will design experimental setup where formation of the paths will be achieved by an electromagnet. In the generated magnetic field, magnetic particles will start to behave like small magnets and attract each other with opposite poles to form an elongated chain that can be subsequently deposited on an arbitrary substrate. In this way, the deposited particles will be aligned with superior precision. This method may find application in medicine (fabrication of medical implants) or electronics (flexible electronic devices).

Requirements:

- M.Sc. in physics/chemistry/materials science or related field,
- strong motivation and commitment,
- knowledge of the English language enabling the use of professional literature,
- letter of recommendation.

Nice to have:

- experience in programming