

Project 3.11. Artificial pancreatic islets: microfluidics-assisted reaggregation of endocrine cells inside hydrogel microcapsules

Promotor: Prof. Dr hab. Piotr Garstecki/dr Jan Guzowski

ICP PAS Group: Soft granular matter and tissue engineering

Background:

Type 1 diabetes is a devastating chronic disease rapidly becoming a 21st century epidemic. It is characterized by the body's inability to produce insulin, a hormone responsible for regulation of the glucose level in blood. Despite overall progress in treatment, the cause of type 1 diabetes is not known and it is not preventable under current knowledge. One of the most promising methods of treatment, still experimental, is the transplantation of the so-called pancreatic islets, tiny organs (less than 0.5 mm in size) located in pancreas and responsible for the production of insulin. Unfortunately, currently applied transplantation procedures are harmful to the islets which makes the treatment ineffective. In response to the increasing demand on the islets, in the project we aim at formulation of artificial islets in vitro, that is via reaggregation of dissociated pancreatic endocrine cells. In the project, we will explore one of the particularly appealing strategies relying on microencapsulation of cells inside so-called 'microbeads', tiny particles made of hydrogel. The main novelty of the project consists in using droplet microfluidics, i.e., the technique of manipulating nanoliter volumes of fluids in channels of width of a human hair, to form the cell-laden droplets and then to transform them into artificial islets.

Aim:

The goal of the project is to develop a fully functional artificial islet consisting of beta cells and other cells encapsulated in a hydrogel microbead. The planned research tasks will include (i) optimization of the hydrogel and encapsulation of beta cells using microfluidics, (ii) measurements of insulin secretion from the beads (ELISA tests), (iii) co-encapsulation of beta cells with various other types of cells (e.g., endothelial) for improved viability and functionality.

Requirements:

- very good track record from undergraduate studies,
- preferred undergraduate background: chemistry, biology, medicine,
- fluency in written and spoken English