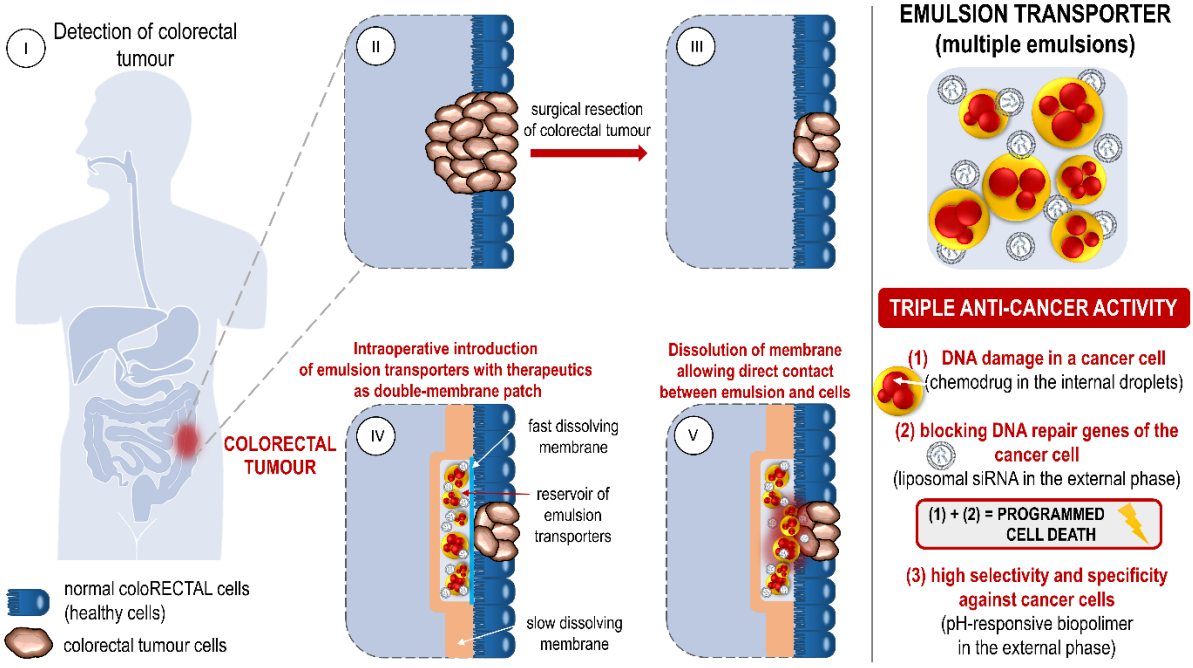
**Multifunctional emulsion-based transporters for personalised cancer treatment**

Cancer, including colorectal cancer, is one of the biggest health problems in the world today. In many cases, colorectal cancer can be prevented by performing non-invasive preventive tests, but despite this, it is still diagnosed too late and requires intensive and devastating treatment. Current forms of treatment for colorectal cancer mainly depend on the location of the tumour and the stage of the disease. Typically, treatment includes resection of the tumour, and complementary chemotherapy (preoperative/postoperative) and/or radiation therapy. The radio/chemotherapy used is highly cytotoxic and is associated with dangerous and debilitating side effects. In addition, in many cases, it does not lead to the complete eradication of cancer, resulting in the appearance of recurrences. Thanks to the development of genetics and molecular diagnostics, personalised (molecularly targeted) therapies, or "tailor-made" therapies based on the identification of specific mutations in genes related to the tumorigenesis process determining the response to chemotherapy, among others, have been developed. In cancer cells, overexpression of protein-coding genes is observed, leading to the production of excessive amounts of proteins necessary for the proper functioning of the tumour cells. Currently, much research is devoted to the mechanism of silencing these genes through small interfering RNA (siRNA) molecules in order to induce a lethal effect in cancer cells and their death. The main problems of the effectiveness of personalised therapies, relate to the low efficiency in drug delivery (lack of selectivity against disrupted cells while maintaining a certain drug concentration over time).
The aim of the project will be to develop a new method for the delivery of drug-chemotherapeutics (to damage the DNA of cancer cells) + siRNA molecules in liposomal form for personalised therapy of colorectal cancer, based on the design of multiple emulsions (droplet-in-droplet system) as effective multifunctional transporters for modified release of drugs acting on specific mechanisms of cancer cells (Fig). The transporter is designed to perform several functions: to deliver two therapeutics and ensure their controlled and selective release at a specific rate in the tumour cell environment. The drug emulsion can be introduced intraoperatively into the site after tumour resection, in the form of a dressing bounded by a biodegradable membrane that is rapidly soluble on one side and difficult to solubilise on the other. The goals of the project also include the development of a method for mathematically modelling the therapeutic delivery process (a tool to support therapy planning) and an imaging method based on advanced techniques of two-dimensional and three-dimensional digital microscopy and holographic tomography for spatial-temporal analysis of processes occurring in the emulsion drug transporter-tumour cell system.




The research objectives will be carried out by a team of the applicant from WUT (Faculty of Chemical and Process Engineering) with the participation of contractors from the Faculty of Biology UW, the Institute of Biochemistry and Biophysics of the PAN, and the Faculty of Mechatronics and Faculty of Physics at the Warsaw University of Technology.