"TWO IN ONE" – NOVEL FLUORESCENT POLYMERS FOR SIMULTANEOUS IMAGING AND DRUG DELIVERY

One of the concerns of medicine is using too high drug doses and their side effects. The remedy for this could be an invention of modern Smart Drug Delivery Systems (SDDS). The role of SDDS is to target the drug to the place of its action (diseased cell) and its selective release. Lots of research are published, lots of things were done but still, a huge effort is towards us. The research conducted in our group is focused on the production of modern, polymeric drug delivery systems, which contain targeting molecules such as cholesterol or folic acid. Our recent research showed their affinity to the estrogen-positive breast carcinoma. Next, a consistent step is to find the mechanism of action of our SDD systems. This mechanism not only will satisfy our scientific curiosity but primarily will tell us which SDDS modifications/functionalisation are responsible for its mode of action and the cell penetration mechanism. This knowledge will help us to prepare new, more sophisticated, and more active drug delivery systems. But how we might be able to investigate these mechanisms? The labelling of the SDDS *e.g.* by fluorescence molecule is the answer. The fluorescent drug delivery system can be observed by confocal microscopy where the probe is excited by the higher energy light and the lower energy emission is observed. This phenomenon enables the molecule tracing inside the cell (*in vitro* research). We expect that the proper design and synthesis of labelled drug delivery system will let us know not only the mechanism of SDDS interaction with the cell membrane but also which part of the system is crucial for its activity. This knowledge will allow us to design and produce more active species (targeted therapy).

Application of the fluorescence labelled targeting systems in theranostic, surgical and postsurgical *ex vivo* diagnosis (PSM - Positive Surgical Margins determination) is the added value of our project. Our designed polymeric targeting systems not only is capable of assisting the drug to reach diseased cell but also will enable to measure *in situ* the cytotoxicity of the whole system (introduction of cell proliferation marker into the polymeric structure). Another possible application of our research is the observation of tumour during the surgery. Nowadays, the surgeons based on the visible differences between tumour and health tissue during the tumour resections, but in most cases, it is not enough. The difference between the healthy and diseased cells are not very significant and the accurate tumour resection is often impossible. The introduction of the fluorescent targeting molecule into the human body (just before or during the surgery), which can accumulate in the tumour can help to differentiate the cells. A few CCD systems for fluorescence observation during the surgery are, by now, approved by the FDA (U. S. Food and Drug Administration). This fact opens the new possibilities for design the fluorescent targeting molecules. Properly designed targeting molecule, labelled with a fluorescent marker, and with the affinity to the tumour, can find application in the surgery for the accurate tumour discovery and resection. Accurate tumour resection (in the Negative Surgical Margins) increase the remission rate in the *e.g.* colorectal and breast cancer. Also the accurate resection with as less as possible health tissue removal is very important especially in patients with breast cancer. Nowadays only several methods for the tumour labelling are used during the surgeries. Our research can help to develop this topic and in the future to broaden the application of these procedures during the tumour removal. Probably it is not the next few years perspective, but without modern, properly designed and conducted basic research none of the popular technics, which are used now in the medicine, would be implemented.