Using ultrafiltration process is very common in technologies related to water and wastewater purification. In this process, ultrafiltration membranes with pore size in range from 10 to 50 nm are used, which in practice means that this process allows separation of high molecular weight organic compounds, colloids, suspended matter, and bacteria. Because of relatively loose structure of ultrafiltration membrane, they are theoretically not used for removal of low molecular weight organic compounds with diameter around 1 nm and molecular weight in range 150 – 500 Da. In group of those substances there are compounds showing biological activity (e.g. antibiotics, nonsteroidal anti-inflammatory drugs), cancerogenous effect, (e.g. PAHs), teratogenic (np. pesticide) or disrupting functions of hormonal system (e.g. xenoetrogens). Their removal from effluent waters is important not only because of their harmful effect on water quality and living organisms, but also in light of recent regulations regarding water politics in European Union, which determine thresholds of concentrations of priority substances (e.g. organic micropollutants) in water. Currently for their removal form water or effluent it is necessary to use additional processes such as advanced oxidation processes, adsorption, nanofiltration, which significantly complicates and rises the cost of treatment. Therefore developing simple, cheap and effective techniques is a challenge for engineers and technologists dealing with cleaning water and effluent.

In recent publications however, it has been shown that by modifying ultrafiltration membranes we can also obtain retention of low molecular organic compounds on similar level to much more energy consuming ultrafiltration process. For example, ultrafiltration membranes modified with carbon nanotubes, TiO_2 nanoparticles or nanosilver have adsorption, catalytic and antibacterial properties. Undeniable advantage is also fact that ultrafiltration process, because of more porous membrane structure is much more efficient than nanofiltration, in which non-porous membranes are used. Can the potential of these membranes be used? What mechanisms are involved during ultrafiltration carried out with the participation of new membranes? What is the role of individual membrane properties in the separation of the low molecular weight substances? So, how to select conditions and materials for membrane preparation when we know just what effect we want to obtain?

The subject of preparation of polymeric membranes modified with nanotubes has been taken by our team since 2013. The result of long term studies was the fabrication of ultrafiltration membrane with new properties, able to effective retention of low molecular weight substances. Presently, our experience and results of this work have provided a basis and are the starting point for the research in given proposal.

Updated research concept assumes to develop useful model of retention of micropollutants by ultrafiltration with participation of new generation of ultrafiltration membranes. So far, such a model has not been developed, probably due to the fact that research on the modification of existing membranes are still innovative, pioneering, especially in terms of use them to remove micropollutants from aqueous environmental samples. In order to achieve the intended purpose of the proposed project, which is developing a mathematical model of the retention of organic micropollutants by ultrafiltration, firstly it is necessary to carry out preparation and experimental tasks (fabrication and characterization of membranes). This conception will provide reliable experimental material, unique in the world, constituting the basis for the development and verification of this model.

Aside retention tests for each newly-developed membrane, tests allowing designation of structural-surface properties and also computational works describing dependence between parameters characterizing specific membrane properties (e.g. porosity, contact angle, zeta potential) and experimentally determined retention coefficient of micropollutants will be conducted.

This will allow one to select the key parameters from the micropollutants' separation point of view, describing qualitatively and quantatively the new membrane properties, separation process course and effectiveness, modificators and micropollutants interactions.