Thermo-responsive polymer hydrogels are materials which consist of three-dimensional polymer network and water fulfilled it. Content of water or water solution in these systems is usually higher than the polymer one. Moreover, polymer network is able to collapse abruptly if threshold temperature is exceeded. In result water or water solution is throw out. Described phenomenon is called Volume Phase Transition as a rapid decrease of hydrogel size is observed. Mentioned properties of thermo-responsive hydrogels result in numerous applications, used as implant elements, artificial muscles, micro-actuators, lenses with variable focal length, micro-valves and smart delivery systems for example fertilizers or drugs.

Temperature and dynamic (speed) of Volume Phase Transition are very important parameters determining an applicability of thermos-responsive hydrogels. They depend on many factors, which can be grouped in two classes. The first one includes structural factors associated with chemical structure of polymer network (amount and arrangement of hydrophilic groups in network), its density (mesh size) and regularity. The second class of factors includes diffusion properties (mobility of molecules in hydrogel system), which depends not only on structural factors but also on interactions between water (and substances dissolved in water) and polymer network.

One of the most promising group of thermo-responsive polymers are poly(oligo(ethylene glycol)methyl ether methacrylates). Too slow reaction for temperature changes (stimuli) is the main disadvantage of these hydrogels. The speed of an answer to stimuli is determined by polymer chain dynamic (mobility of polymer chains) and diffusion properties (capacity of water solution to leave polymer matrix). Knowledge about these properties is necessary to conscious design of useable hydrogels based on poly(oligo(ethylene glycol)methyl ether methacrylates). Thus, the main goal of the project is determination of relationships between architecture of polymer network, mobility of liquid phase (water or water solution), network dynamics and temperature and dynamics of Volume Phase Transition in thermo-responsive hydrogels made of poly(oligo(ethylene glycol)methyl ether methacrylates) with various side group lengths.

Getting knowledge about Volume Phase Transition mechanism on molecular level will be important effect of this project. These results are necessary to create the hydrogels with well-defined properties fulfilled needs and requirements of particular application. Planned research should be recognized as interdisciplinary, because they will have impact on many areas of human activity including: medicine, pharmacy, agricultural science, micro-mechanics, robotics, and many others.