In the face of a recent epidemiological threat, a great interest was focused on the chemical compounds with a disinfecting and antiseptic effect, especially in terms of sanitary and hygienic safety and public health. Antibacterial polymers are important alternative to the low molecular weight antimicrobial agents due to their greater stability, non-volatility, less susceptibility to leaching and impermeability through the skin. What is important, they often enhance the efficiency and selectivity of some low molecular weight bactericidal agents and prolong their lifetime.

Antibacterial polymers, depending on the structure, interact in various ways with components of the bacterial cell membrane, causing its destruction and subsequent cell death. The known polymers for antibacterial applications carry the positively charged atom or are complexed with heavy metals, especially silver ions. These systems, although highly effective, may suffer from the low stability, possible side reactions weakening the overall activity, and potential toxicity to human. There is still a need to search for a new, stable antibacterial polymer systems, especially non-conjugated with heavy metals.

The aim of the Project is to obtain novel stable, and what is important metal-free, antibacterial polymer systems. To achieve this goal, it is proposed to obtain non-toxic polymers and to modify them in such a way, that they were capable of binding some specific molecules from the bacteria cell membrane. The proposed polymer system will not contain heavy metals in its structure, thus, while it exhibits lethal effect on bacteria cells, at the same time it will not be sensitizing for human. Such approach has not been used so far in research on antibacterial polymers.

Poly(2-oxazoline)s (POx), the non-toxic, biomimicking polymers, considered in biomedical applications as poly(ethylene glycol) (PEG) alternatives, will be used in the studies. POx will be conjugated with specially selected compounds - chelating agents, capable of selectively binding some specific cations. As a result of this conjugation, a novel polymer-chelator platform, able to trap cations that are responsible for stabilizing bacterial cell membrane will be obtained. The essence of the research is to modify the polymers and optimize the reactions for the efficient attachment of chelating compounds; and to tailor the properties of the whole system in such a way, that it could selectively bind and remove ions present in bacterial cell membrane.

The ability to trap the divalent cations by the modified POx will be in detail analyzed in the laboratory conditions as the basic research planned by the Project will cover the field of polymer chemistry. The model biological studies with the use of several specified bacterial strains are also planned for a preliminary evaluation of the suitability of such polymer systems. The cytotoxicity studies are important to verify if the obtained systems are antibacterial and, at the same time, not sensitizing for human.

Proposed investigations, although not directly focused on the practical application, should form a background for potential using of such modified poly(2-oxazoline)s in biomedical applications. The results of this Project are expected to redefine the approach to antimicrobial polymers, and importantly, the proposed strategy could also be applied to other polymers in the future.