According to the annual report of the European Centre for Disease Prevention and Control, in the EU each year at least 500 000 patients undergo surgeries that required stabilizers and endoprostheses implantation and approx. 2% required revision surgery due to implant-related infections. Only in 2017 in Poland almost 40 000 patients underwent such surgeries and implant-related infections were recorded for over 900 cases (2.25%). Biomaterial-centered infection (BCI) may lead to secondary complications i.e. amputations, morbidity and even mortality. Indeed, infection treatment is associated with significant costs, approx. 6.5 times higher compared to patients without infection. Thus, the prevention of BCI is one of the most challenging issues in orthopedic and trauma surgery. Globally, complex fractures have an overall 5% infection rate when treated with an implant.

Although several BCI preventive strategies have been developed i.e. the preoperative administration of antibiotics, standardized sterilization procedures with restrict, detailed protocols, still more than 25% of all hospital-acquired infections are medical devices-related. These issues apply to all classes of biomaterials: metal, ceramic, polymer and carbon-based. Therefore, the investigations on novel biomaterials should integrate biocompatibility and anti-infection functions and tuned them together, which is a real challenge for surface functionalization. Despite enormous research efforts in the field of biomaterials, there is a lack of solutions with excellent biocompatibility and anti-infection function.

The aim of the project is to determine the role of biomaterials surface functional groups which affect the microbial adhesion to the polymeric implantable devices and tune the surface properties in such a way, to limit the risk of biomaterial-centered infections. The working hypothesis consists of the plasma surface modification of biomedically-relevant polyurethanes which result in the incorporation of surface functional groups e.g. -OH, -COOH, $-NH_2$, -F and identification of their role in the microbial proteins' adsorption. Such conjecture is based on the ability of bacteria to adhere to the abiotic surfaces through the proteins called adhesins. Depending on the bacteria strains, the adhesins can be at the very end of the pili and/or fimbriae (*E. coli, P. aeruginosa*) or anchored in the cell wall (*S. epidermidis, S. aureus*). Although there are numerous reports on the role of surface functional groups formed at the polymeric surfaces in the protein adsorption, all of them are devoted to the proteins responsible for biocompatibility (e.g., albumin, fibronectin), bacterial adhesins and their affinity to the functionalized surfaces are either mentioned briefly or assumed tentatively.

The project has an interdisciplinary character, adhesins affinity to parent as well as functionalized surfaces of polyurethanes will be investigated from the atomistic-, through molecular-, nano- up to microscale. The realization of the proposed research tasks will lead to the development of the guidelines for biomaterial surface design, allowing for patent applications. In the long-term perspective the obtained fundamental insights and experimental know-how will result in the understanding of the bacterial adhesion to biomedical devices, help to prevent BCI and therefore, provide additional value to our society well-being.