Every sixth death in the world is on account of cancer, the second leading cause of death. Esophageal cancer is at the forefront of the most commonly diagnosed cancers, and the sixth main cause of cancer–related mortality. The majority of patients are not eligible for curative treatment, due to either a progressive tumor stage or weak physical conditions. Well–documented and commonly applied on a large-scale for palliative treatments of dysphagia and fistulae caused by advanced esophageal cancer are stent implantations. However, the most common post-operation complications are overgrowth of the stent by the granulation tissue and stent obstructions. The polyurethane membranes of esophageal stents, that prevent tumor overgrowth, should be stable and ensure reliable support against dysphagia, although, in long-term use, a significant loss of biostability is observed.

This project focuses on developing and optimizing the polyurethane surface modification method for applications as a cover for a self-expanding esophageal stent. The overall goal of the project is to obtain scientific foundations for the development of a new generation of esophageal prostheses that will effectively reduce the risk of complications associated with stent obstructions and granulation tissue formation. The side in contact with the cells should be highly biocompatible, supporting the proper function of the esophageal epithelium. In contrast, the side facing inside the stent should exhibit antifouling properties to prevent the clogging of the medical nutrients given to oncological patients.

The scientific goal of the project is to determine the effect of surface functional groups (e.g. -CHO, -COOH, -OH, -F) produced on plasma-modified polyurethanes on the adsorption of RGD sequences (three amino acid sequence: Arg-Gly-Asp). The RGD sequence is by far the most effective and most often employed peptide sequence for stimulated cell adhesion on polymeric surfaces. The proposed research methodology includes both experimental and theoretical approaches.

The pioneering nature of the project is due to the fact that scientific reports lack information on the importance of parallel, dual functionalization of polymers used as a cover for self-expanding esophageal stents.

To achieve the set goals, it is necessary to perform comprehensive studies combining the surface modification of polyurethane materials using plasma and RGD adsorption to modified and unmodified surfaces. Then the in-depth physicochemical characteristics (using a wide range of spectroscopic and microscopic methods) will be carried out and a functional correlation between plasma modification parameters and RGD adsorption will be established. Experimental work will be accompanied by computer simulations using molecular dynamics.

The proposed project will not only provide new basic knowledge in the field of design and engineering of polymer biomaterials but also practical premises for the production of a new generation of polymer surfaces for applications as a cover for self-expanding esophageal stents. The project is part of the global research trends in intelligent biomaterials, the so-called ‘functional hybrid materials’. The interdisciplinary project refers to current problems of implant materials, and its results, in a broader perspective, can have significant practical importance for a better medical care in the aging societies.