This work deals with the interaction of cells with surface-modified existing or newly created materials developed for vascular and bone tissue engineering, and also for controlled drug delivery into implants.
In the first part of this work, we modified the surface of the polyethylene foil by Ar plasma, and then we grafted them with bioactive molecules (glycine, polyethylene glycol, albumin) and with C or Au nanoparticles. These modifications improved the chemical and physical characteristics of the material for the adhesion and growth of vascular smooth muscle cells (VSMC), and also for their phenotypic maturation towards the contractile fenotype. In future, these modifications can be also used for material currently used for fabrication of clinically used vascular prostheses in order to increase their biocompatibility.
The aim of the second part of this work was to develop a perivascular drug-delivery system that would release the antiproliferative drug Sirolimus. This perivascular system is designed to be wrapped around a venous graft, implanted to the arterial position, such as in the case of the aortocoronary bypass. The system comprises a polyester mesh, which ensures the mechanical stability of the system and of the venous wall, and a copolymer of L-lactide and ε–caprolactone (Purasorb), serving as a carrier for the antiproliferative drug Sirolimus. We prepared two types of meshes with different concentrations of Sirolimus. Both types of meshes inhibited the proliferation of rat vascular smooth muscle cells during 14-day culture period and preserved excellent cell viability. These positive results were confirmed in experiments in vivo performed on rabbits, where the meshes inhibited the proliferation of VSMC in an implanted venous bypass. The newly developed Sirolimus-releasing perivascular meshes are promising devices for preventing the intimal hyperplasia and autologous graft restenosis.