Modern medicine faces many challenges. Apart from the recent epidemic related to the new SARS-COV2 virus, or a real plague of cancers, still from time immemorial the most sensitive and unreliable system in the human body is the circulatory system. Heart diseases are the main cause of death both in Poland and worldwide, according to WHO data, and account for about 30% of global mortality. This state of affairs has not improved for many years despite many turning points in our recent history. In Poland's case, the breakthrough moment in cardiac surgery was the operation led by Professor Zbigniew Religa, who performed the first successful heart transplant in a Zabrze hospital. However, in order for such a transplant to take place, it is necessary to provide equipment which can sustain the patient's life until the time of transplantation or, in certain cases which exclude the possibility of transplantation - to save life in the long term. This is where materials engineering and the design of modern materials that are able to work in the patient's body for many years is leading the way. Cardiovascular diseases are classified as chronic, which means that the patient remains under permanent or periodic medical care. Taking this into account, there is a need for continuous development of methods of treating chronic cardiovascular diseases, including the design and implementation of new materials that can stay in the human body for longer and longer periods of time and form ever more perfect cooperation. Patients with implanted devices in the bloodstream after the first few days are primarily at risk of thrombosis. The thrombi that form break off into smaller blood vessels and block the lumen of their flow, causing ischaemic strokes. The formation of thrombi can be explained by Virchow's triad: stasis, endothelial damage and hypercoagulability. Cardiac prostheses are treated by the body as foreign bodies which causes activation of the clotting system (they are thrombogenic), this immune system response can lead to ischaemic disease, stroke and even death. It has been shown that platelet deposition on implanted valve rings already occurs within the first 24 hours after implantation. Because of these complications, patients are forced to take anticoagulant drugs strictly. What if modern science could minimise the clotting effect associated with implantation in the bloodstream? The most recognisable metal materials used in the human body are titanium alloys. The idea of the following project is to create a thin coating deposited on titanium, which will consist of the best known noble element - gold. The coating, enriched with a biocompatible noble metal, will be able to reduce thrombus formation and allow for an increase in the useful life of the implant while reducing possible postoperative complications. Additionally, in order for the coating to be strongly bonded to the substrate, laser alloying is planned to produce intermetallic compounds of titanium and gold. This will increase the durability of the solution and enable control of the surface topography, which is also important for processes called surface wettability and surface free energy. The material obtained in the test cycle will be characterised in terms of both chemical composition and topography. For this purpose modern investigative techniques will be used such as scanning electron microscopy, atomic force microscopy, confocal microscopy as well as secondary electron spectroscopy and structural X-ray imaging. The surface itself will be examined for wettability and surface free energy. The material science research will culminate in transmission electron microscope layers imaging and biological tests: cytotoxicity tests and platelet adhesion tests in flow simulation. Before the empirical start of the laser processing experiment, the phenomena of light beam interaction with matter will be modelled by means of numerical analysis in a virtual environment