Introduction of the nanotechnology into the broadly understood medicine may lead to creation of new therapeutic and diagnostic tools that are unachievable when using solely classic, micro and macro sized biomaterials. Thanks to their sizes within the dimensions of various biomolecules, nanoparticles may induce reactions at a molecular level, leading to enhanced adhesion, growth, proliferation and differentiation of various types of cells. Moreover, due to unique electrochemical, mechanical and physicochemical properties, usage of nanomaterials may lead to fabrication of new class of biomedical devices with properties that are more similar to natural tissues than the ones that are currently in use.

Among different types of nanomaterials, carbon nanotubes are particularly interesting. This is due to some of their intrinsic properties. Their dimensions and morphology is similar to some of natural biological structures (such as peptides). Moreover, high aspect ratio increases the area of contact between the CNTs and the cells (which is regarded as beneficial in the field of drug carriers). Additional advantages of using CNTs lies within their good mechanical properties, good electrical and thermal conductivity – these are the features that are particularly interesting when regarding usage of the CNTs as scaffolds for tissue regeneration.

Regenerative medicine uses various tools to stimulate the repair of the damaged tissues, leading to complete restoration of natural functions. This method is already successfully applied for the regeneration of some tissues, such as skin or, in some cases, bone. However, the solutions that are currently being clinically used can sometimes fail and for some of the tissues that are very hard to heal, still no method of treatment is available. This is true for some of the neurodegenerative diseases, spinal cord injuries or scarification after massive heart attack. Current social growth and ageing of the society call for new solutions in order to be able to restore most of the diseased to the society. Thus, new technologies in the field of regenerative medicine are explored. One of such avenues is usage of stem cells. However those cannot be used without specially designed scaffolds, as when applied alone they have a tendency to form cancerous tissues. Moreover, there is still much work that needs to be done in order to be able to knowingly stimulate the stem cell towards differentiation into certain cell type.

Thus, it seems unquestionable that the progres in the regenerative medicine must derive from the usage of the stem cell and nanomaterials. And the nanomaterials should be selected in such a manner that their specific chemistry, morphology and electrical properties would facilitate adhesion, proliferation, growth and differentiation of the target cells type. Another interesting possibility is the usage of an electrical stimulus that may even furthermore enhance the tissue's regeneration by simulating naturally occurring physiological currents.

The aim of the proposed project is to evaluate an influence of the physicochemical and electrical properties of the nanocomposites made of carbon nanotubes on the ability to stimulate the cells potency to recreate a damaged targeted tissue. It is expected that the obtained results will provide a completely new knowledge and increase understanding of the aware usage of the CNTs in biomedicine. This in turn may lead to fabrication of new class of highly biocompatible medical devices with superb properties when compared to the ones that are currently applied.