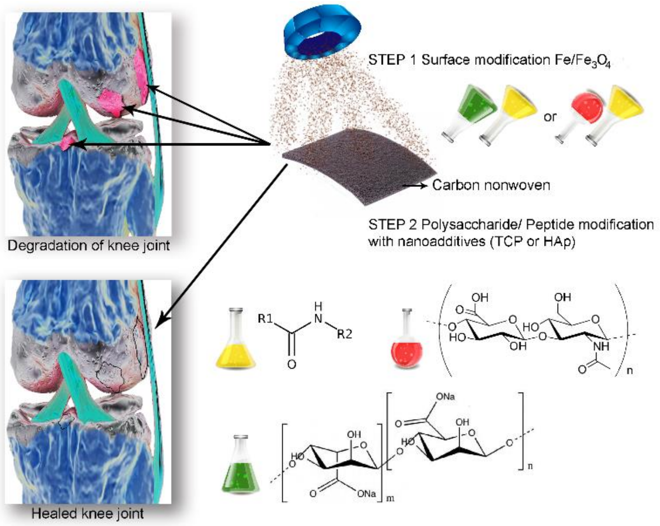
Assumptions and main goals of the project will be implemented as a result of scientific research, with intended effect to develop the latest generation, biocompatible, bioactive hybrid implantable medical device made of fibrous structures - carbon nonwovens. The hybridity of such material is mainly determined by modification and functionalization of carbon structures. Deposition of ferromagnetic supplement on the surface of tested materials will allow for further more accurate diagnostics, due to the ability to image such material after implantation. Functionalization of implant will be conducted by physical deposition of polysaccharide (alginate and/or salt of hyaluronic acid), to which peptides will be chemically attached (figure). Thus, such a material will simulate in structure and functions an extracellular matrix - becoming a biomimetic system. Peptide-polysaccharide conjugates, which will be deposited on the carbon material and then transformed into insoluble form, will mainly decide about high bioactivity and biocompatibility of obtained biomaterial. Implant will contain systems (structure and compounds) which perform functions occurring in the nature of extracellular matrix proteins (ECM) and others functional peptides and polypeptides (such as growth factors). In order to achieve highest biological activity of developed material, peptides which are an active protein fragments (ECM) and bone morphogenetic proteins (BMP), will be selected only. Due to implementation of the preliminary *in vitro* test and investigation of their interactions with antibodies, as well as using only fragments of synthetic proteins, not entire chains, selection of most optimal and suitable structures will be possible to perform.



The starting point for the project implementation will be stage of fibrous structures (nonwovens) formation by a needle punching method using polyacrylonitrile (PAN) fibres, and further low temperature carbonization process of obtained nonwovens. Key issue in those research will based on finding interdependencies and correlations between technical parameters of each process – either nonwoven manufacturing or carbonization, and their impact into structure and properties of precursor fibrous and carbon materials. With the use of magnetron, „roll to roll" type, surface modification by deposition of a ferromagnetic additive will be conducted. Full characteristic of chemical and microscopic structure as well as determination of physico-chemical properties will be carried out. Peptide selection will be implemented based on the synthesis of libraries of ECM or BMP protein fragments covering whole native proteins, then initial analysis of peptides based on studies of interactions with antibodies using dot blot technique will be performed. Finally obtained collection of synthetic fragments of proteins will undergo preliminary *in vitro* tests, in order to select most optimal structures. Coupling polysaccharide systems for further fibrous structures functionalization will be tested based on model peptide objects in the context of their physical and chemical properties. Final analysis of hybrid structure will be carried out in *in vitro* conditions with simultaneously the possibility of imaging those structures using µT/MRI, while with conducting those studies on each stage of the project. Fibrous materials will be biologically evaluated based on tests involving bone and cartilage cells - biocompatibility (cell viability, proliferation), test using bone formation markers: alkaline phosphatase (ALP), or collagen level determination will be performed.

The topics taken up in this project as well as implementation of individual research tasks leads to ability to obtain a proposed solution, which is an innovative approach in the development of biomaterials intended for the treatment of bone and cartilage tissue damage. Either issues taken at this scientific project, proposed research methods or research plan as well as approach to the problem is innovative and unprecedented on a global scale and results in the development of materials engineering, biomedical engineering, while with the possibility of developing a new generation of materials.