UNIVERSITY POLITEHNICA OF BUCHAREST
Faculty of Applied Chemistry and Materials Science
Department of Bioresources and Polymers Science
Senate decision no. 225/27.09.2013

PhD. Thesis: ***Composite Materials for Tissue Engineering***
Phd. student: **Eng. Andrada Serafim**
Phd supervisor: **Prof. Dr. Eng. Dan Sorin Vasilescu**

ABSTRACT:

In order to generate biomaterials for tissue engineering, the thesis ”Macromolecular Compounds for Tissue Engineering” aims the synthesis of materials with superior properties obtained through simple methods that allow a fine control of in vivo performances through the variation of polymerization mixture.

The first part of the thesis establish a simple synthesis method for a bicomponent system with tunable properties through covalently combining a natural polymer modified with double polymerizable bonds (GelMA) and a synthetic polymer (PAAm). Firstly, the influence of the degree of substitution of the primary amino groups from gelatin with double bonds from the methacrylic anhydride on the features of the obtained materials is evaluated.

Subsequently, the scaffolds were synthesized through radical polymerization of the so-modified natural polymer and acrylamide, with and without supplementary addition of synthetic crosslinker (methylen-bis -acrylamide), leading to a complex network. The obtained hydrogels are bicomponent materials in which sequences of natural and synthetic polymer are macroscopically combined in complex networks. The bicomponent systems were characterized through the investigation of several features: water uptake capacity, stability in aqueous media with various pH values, enzymatic degradation with collagenase, drug delivery potential and biocompatibility. A correlation between the composition of the synthesized materials and their properties has been established.

The second part of the thesis refers to the functionalization of a polymeric support, known as being inert from the point of view of mineralization, with metallic nanoparticles functionalized with anionic groups in order to induce in situ formation of hydroxyapatite. Functionalization of gold nanoparticles has been realized (1) through carboxyl groups form mercaptopsuccinic acid (2) using poly(amidoamine)-succinamic acid (PAMAM-SA) dendrimers. The capacity to induce the formation of biomimetic hydroxyapatite has been evaluated through incubation in synthetic body fluid (SBF) using various methods (FT-IR, SEM, TEM, XPS, EDX, AFM). The analyses revealed the formation of an apatite layer, similar to bone mineral from both structural and compositional point of view. Thus, it has been demonstrated the potential of gold nanoparticles functionalized with carboxyl groups to efficiently promote the formation of biomimetic HA. The study aimed the formation of mineral phase, without any cell-related investigation.