

# **ABSTRACT PhD THESIS**

## **Biomaterials based on synthetic and natural polymers**

**Mădălina Pandeale**

Biopolymers such as chitosan, polyvinyl alcohol and alginate are widely used as scaffolds for biomedical applications, especially in tissue engineering and drug delivery systems due to their excellent properties such as biocompatibility, biodegradability to non toxic products, bioactivity, etc. For tissue engineering and drug delivery system the biopolymers were processed in different forms such as films, sponges, beads, hydrogels and capsules. Despite their high biocompatibility these biopolymers show hard processability and low mechanical properties. In the first part of the thesis we have been blended these biopolymers with graphene or graphene oxide in order to overcome the above mentioned drawbacks and to synthesize a series of Biopolymer/GO nanocomposites with potential applications for bone regeneration. First, we use complex computational tools of molecular modelling at atomistic scale in order to perform a preliminary screening for many materials to select the most promising material for experimental synthesis. Since a significant amount of graphene has been added we could not see an important improvement of the mechanical properties which may be due to the tendency of graphene agglomeration. Therefore, for the experimental assay, graphene oxide has been considered as a reinforcing agent for the polymer matrix. Graphene oxide presents different reactive groups on its surface which hinder the agglomeration process.

Within the experimental framework two different methods were used to synthesize the composite materials such as casting method and freeze drying. The obtained composite films and 3D porous materials were structural, thermal and mechanical investigated and we could see that the presence of graphene oxide within the biopolymers has a positive effect both on mechanical and thermal properties and on the biological response. The excellent biocompatibility, good mechanical properties and thermal stability place biopolymer/GO composites, as materials with remarkable potential in biomedical applications such as bone repair or bone augmentation.

In the second part of the thesis, we used mesoporous silica as drug carrier for a bacteriostatic agent named benzalkonium chloride. The modification process was successfully achieved. The influence of the reaction conditions such as contact time, temperature, solution pH and initial drug concentration on the drug adsorption were considered and the obtained results indicate a spontaneous and physisorption process. In order to improve the diffusion of the drug from the mesoporous silica guest we have been synthesized hybrid materials based on biopolymer/ mesoporous silica/ drug by using two natural biopolymers such as chitosan and alginate. It has been proved that the presence of the polymer reduces the agglomeration tendency of mesoporous silica and allowed a good release of the drug.