Synthesis Characterization & Biofunctionalization of gold nanoparticles for future using biosensors for early detection of acute myocardial infraction

The purpose of the present study is synthesis, characterization and biofunctionalization of AuNPs, which due to their excellent physical properties such as electrical conductivity or color, and in combination with peptides can be used as signal transducers (electrical interface and bioreceptor respectively) in biosensors. The systems that were examined in the present work are intended for utilization as signal transducers for early detection of AMI. The objective of this study is to investigate and compare the different nanoparticles that were synthesized, to optimize the concentration of chitosan and to biofunctionalize them, always targeting to the optimal electrical response.

Specifically, AuNPs were synthesized by the Turkevich method and by a modified method, where chitosan acts as reducing and stabilizing agent. Three different chitosan concentrations were used, i.e., 0.01% w/v, 0.05% w/v and 0.1% w/v, for the reduction of tetrachloroauric acid and the nanoparticles with optimum concentration were chosen for biofunctionalization. The nanoparticles were characterized according to their size, surface morphology, zeta potential and surface chemistry. In addition, they were deposited on poly (3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT: PSS) films, in order to measure their electrical conductivity with Van der Pauw method. Their sizes and the zeta potential were measured via Dynamic Light Scattering (DLS), whereas morphology and topography of the surface were investigated via Atomic Force Microscopy (AFM). X-ray Photoelectron Spectroscopy (XPS) was used for analyzing their surface chemistry.

Moreover, surface modification of Turkevich nanoparticles with chitosan took place, and binding of streptavidin onto their surface, for binding of biotinylated antibodies. Also, PET/SiO_2 surfaces were biologically modified with biotin-streptavidin chemistry, for further binding of biomolecules. Finally, biofunctionalization of the nanoparticles took place with anti-troponin peptide, so they can be used as a platform for biosensors to allow early detection of AMI.

In summary, chitosan-capped AuNPs and Turkevich AuNPs were successfully synthesized. Surface modification of Turkevich nanoparticles with chitosan was

performed and also binding of streptavidin onto their surface. PET/SiO_2 surfaces were also modified with the biotin-streptavidin method for specific binding of biomolecules. Characterization and biofunctionalization of nanoparticles with anti-troponin followed. The novelty of this study lies in the combination of materials and characterization methods, i.e. anti-troponin, PEDOT: PSS and electrical characterization.

Conclusively, the reason for elaborating this thesis is the synthesis, optimization, biofunctionalization and study of functionalized AuNPs and elicitation of conclusions that will help in the improvement of their properties and the creation of more sensitive systems with optimum electrical response for implementation as signal transduction in biosensors.