Graphene-based nanomaterials for biomedical applications

PhD. Student Elena – Alina CHITICARU

PhD. Advisor Prof. Mariana IONIȚĂ

Abstract

The main goal of this PhD thesis is to contribute to the field of personalized medicine by developing a novel electrochemical biosensor capable of accurately detecting osteogenic biomarkers in real-time, meeting the need for rapid, simple, and continuous in-situ monitoring for point-of-care applications. The research hypothesis is that modifying electrodes with graphene-based nanomaterials will significantly improve the sensitivity, specificity, and stability of biosensors for DNA hybridization and biomarker detection. The specific objectives of my scientific research involved the modification of two types of electrodes with graphene oxide and the comparison of the two platforms in terms of DNA immobilization and detection, the functionalization of reduced graphene oxide (RGO) with carboxyphenyl groups via diazonium chemistry for the covalent attachment of probes, the RGO functionalization with gold nanoparticles for the immobilization of probes by physical adsorption, the detection of two osteogenic biomarkers, alkaline phosphatase (ALP) and Runt-related transcription factor 2 (RUNX2). In this thesis there are described fabrication protocols for several detection platforms based on graphene-related materials, that were extensively characterized by several relevant techniques, and the results showed that screen printed electrodes are very advantageous for biosensing applications, functionalization of RGO leads to superior biosensing properties, and optimized RGO-based biosensors could detect not only generic DNA sequences, but also osteogenic biomarkers, indicating their versatility and potential for real-time monitoring of various biomarkers in medical applications.