ABSTRACT OF THE DOCTORAL DISSERTATION

Electroactive polymer surfaces for controlling the growth of bacterial biofilm and cells

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Biomedical devices, in which neurological electrodes play a key role, may support the diagnosis and therapy of neurodegenerative disorders, including Parkinson's or Alzheimer's disease. Nevertheless, noble metal-based neural implants have a number of limitations related, inter alia, to the mismatch of the material in terms of biocompatibility at the electrode/neural tissue interface. The aim of the thesis was to develop bifunctional bioengineering materials with antibacterial and neuroprotective effects based on conducting polymers, poly (3,4-ethylenedioxythiophene) (PEDOT) and poly (3,4-ethylenedioxypyrrole) (PEDOP), used as carriers of the model antibiotic, tetracycline (Tc).

The starting point of studies was a literature review aimed at determining the possibility of regulating biofilm growth through electrical stimulation or presence of electroactive materials. After performing the experiments confirming susceptibility of platinum to the development of bacterial biofilm, the next step was to develop protective coatings based on selected conducting polymers. PEDOT/Tc and PEDOP/Tc, both exhibiting promising electrical properties and high drug loading capacity, were fabricated using the process of electrodeposition and characterized with electrochemical, spectroscopic and microscopic techniques. The selected polymer matrices were used for the cultivation of the model strain of bacteria (*Escherichia coli*) and cells (rat neuroblastoma cell line B35). As a part of the thesis, the process of preparing biological samples for measurements with the scanning electron microscope (SEM) was optimized. Morphometric analysis allowed the selection of parameters that provide information about the state of cells (growth phase, possibility of division, apoptosis, necrosis, etc.).

Consequently, PEDOP/Tc was shown as an appropriate candidate for neural interface applications, possessing bifunctional biological properties different for eukaryotic and prokaryotic cells, thus constituting a promising alternative to commonly used electrodes.