POLY(3,4-ETHYLENEDIOXYPYRROLE) – NOVEL CONDUCTING POLYMER WITH BIOMEDICAL APPLICATIONS

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Introduction

Biomedical engineering requires constant development of new types of biomaterials with specific properties. Conducting polymers have found to be promising materials applicable in the field of biosensors, artificial scaffolds and neural probes [1]. Nevertheless, only several conducting polymers exhibit biocompatibility and stability which are properties necessary for such type of applications. Poly(3,4-ethylenedioxypyrrole), PEDOP (FIG. 1), is a novel conducting polymer which is the most promising candidate to become an alternative for polypyrrole and poly(3,4-ethylnedioxythiophene) in a field of electroactive biomaterials [2,3].

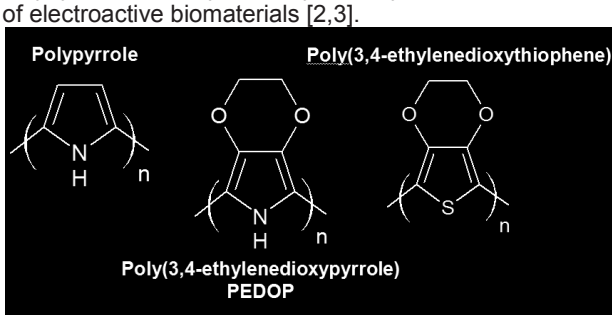

FIG. 1. Chemical structures of conducting polymers applied in biomedical engineering.

In this study, the description of physicochemical properties of PEDOP matrix is presented, involving electrochemical, spectroscopic and microscopic analysis. PEDOP is also used as a drug carrier for model drugs – ibuprofen, quercetin and ciprofloxacin.

Materials and Methods

The process of drug immobilization was realized with the use of electrochemical techniques, i.e. cyclic voltammetry and chronoamperometry. The efficiency of drug immobilization was studied by means of UV/Vis spectrophotometry. Raman spectroscopy and scanning electron microscopy were used to analyze structural and surface properties of polymer matrices, while electron paramagnetic resonance data allowed to follow the changes in spin concentration resulting from reduction-oxidation processes.

Results and Discussion

The voltammetric studies on EDOP showed that this monomer can be oxidized at very low potential (Eox = 0.7 V), substantially lower than for EDOT (Eox = 1.0 V) and similar to pyrrole (Eox = 0.7 V). This indicated that the process of drug immobilization can be carried out under mild conditions, not destructive for drug molecules. The highly controlled, regular growth of polymer, as well as its substantial stability, were proven by means of UV-Vis spectroelectrochemical studies.

The immobilization of drugs was performed via performing polymerization procedure in the presence of drug molecules. Due to the possibility to control the growth of polymer film, PEDOP matrices of different thicknesses (obtained via different number of CV cycles) were synthesized and used for the release experiments. FIG. 2 shows how the choice of drug and matrix thickness influenced the drug-loading efficiency of PEDOP, as well as the ratio of passive to active release modes.

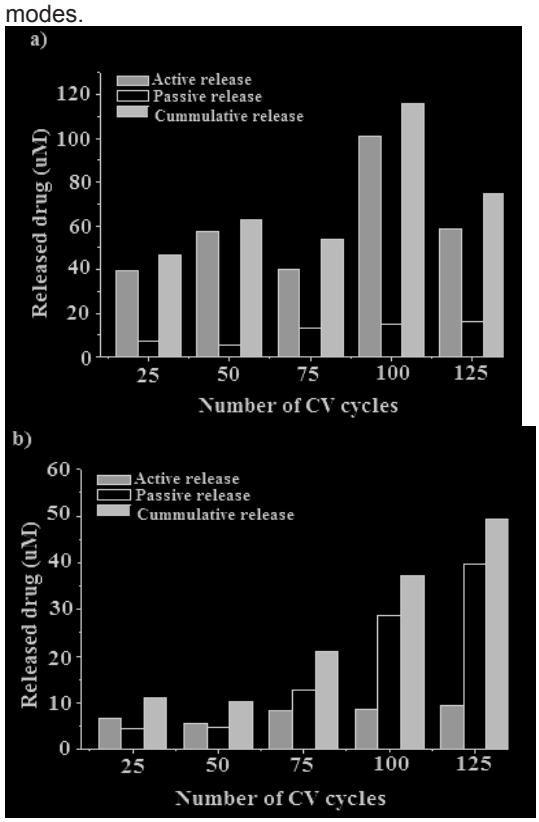

FIG. 2. The amount of ciprofloxacin (a) and quercetin (b) released from PEDOP matrix as a function of matrix thickness expressed in the number of CV cycles.

Conclusions

The physicochemical properties of PEDOP indicated this polymer as being the favourable among conventional materials, i.e. polypyrrole and PEDOT. The high drug loading efficiency of PEDOP and the possibility to immobilize a variety of biologically active compounds proved that it is advantageous drug carrier and can be used as the matrix for controlled drug delivery systems.

Acknowledgments

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