COMPARATIVE ANALYSIS OF POROUS POLYMERIC MEMBRANES AS DRUG CARRIERS

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[ENGINEERING OF BIOMATERIALS 143 (2017) 53]

Introduction

Porous polymer membranes are potential multi-level carriers of bioactive substances or drugs. Their release depends on the type of polymer matrix, and the longer the time of degradation of the matrix, the lower the release rate. Biodegradable polyhydroxyl acids, represented by polylactide (PLA) and aliphatic polyesters including polycaprolactone (PCL), have been used as drug shell for drug delivery. These polymers can be easily formed into granules, fibers or membranes. For example membrane materials can be obtained by the phase inversion method which allows to control the surface and volume porosity. It depends on the conditions of the coagulation bath and the concentration of the polymer.

Two polymers were used as the template: polylactide (PLA) and polycaprolactone (PCL), which were introduced into biofuroxime (Bf) (second generation cephalosporins). The presence of this compound has bactericidal activity against both Gram-positive and Gram-negative bacteria. The efficiency of the modification was confirmed by the SEM/EDS observation. Drug release was monitored by changing the analytical concentration of ions (ICP method) and parallel study in contact with Gram-positive bacteria was conducted.

Materials and Methods

Commercial polymers: PLDLA (Carbochem) and PCL (Sigma-Aldrich) were used in the experiment. Mixture of AC and THF (1:8) was used as the solvent. The precipitating reagent was DMSO. All reagents were purchased from Avator (Poland). The dissolved polymers were doped with 5% wt of biofuroxime (Polfa). The membranes were air dried and then vacuum treated for 48h. Microstructure of membranes was observed by scanning electron microscope (Nova NanoSEM). Other features of membrane were tested during permeability test, drug release (ICP), and durability *in vitro* (PBS/3msc/37°C). Multi-level carrier membranes were tested using an agar-based method. Pure (unmodified) polymeric membranes were the reference in all studies.

Results and Discussion

Addition of the modifier affected microstructure, and the size of pores was reduced: for the PCL-based polymer membrane the diameter of pores decreased from about 60 μm (for PCL) to 22 μm (for PCL/Bf). The same effect was observed in the PLDLA membranes, and the average size of pores decreased from 20 μm (for PLDLA) to 12 μm (for PLDLA/Bf). Release of biofuroxime from the PLDLA membrane was faster than that of the PCL as confirmed by increase in concentration of sulfate ion (analytical group of drug). Drug release process during incubation of PCL/Bf membrane started after 14 days, which resulted from lower degradation rate of the porous PCL membrane. All membranes were characterized by altered morphology (irregular pores with a rough surface), and slight changes in weight and dimensions after degradation.

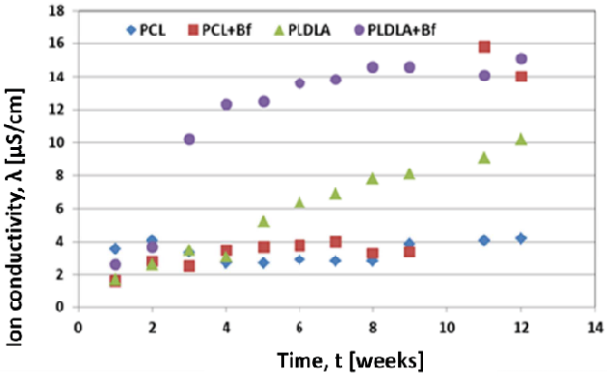

FIG. 1. Stability of polymer membrane materials: PLDLA, PLDLA/Bf and PCL, PCL/Bf.

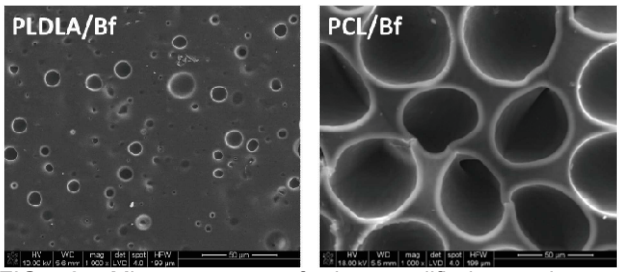

FIG. 2. Microstructure of drug-modified membrane materials (biofuroxsim)

Conclusions

Phase inversion is a method of obtaining polymer membranes, which can be modified with bioactive compounds and drugs. This preliminary study has shown that a more stable PCL matrix releases drug later than the faster degrading PLDL matrix. Both PLDLA and PCL porous membranes were stable for not longer than 3 months.

Acknowledgments

This study was performed within the framework of funding for statutory activities of AGH University of Science and Technology in Krakow, Faculty of Materials Science and Ceramics (11.11.160.182).

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