ABSTRACT

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Title of dissertation thesis: Development of new types of biocompatible haemodialysis membranes for separation of biomolecules

This dissertation thesis was focused on the development, preparation, and optimization of flat sheet polysulfone membranes, which would meet the characteristics required for membranes used for haemodialysis treatment. The thin porous membranes were prepared by spin coating method, followed by phase inversion via immersion precipitation. The composition, as well as the preparation process of the membranes, were optimized, to obtain a membrane with good mechanical performance in flow conditions, adequate selective separation ability, and biocompatibility.

The prepared membranes with the appropriate characteristics were modified with bioactive compounds to minimize oxidative stress and/or inflammation, which are common complications in haemodialysis treated patients. Three different modification approaches were used to prepare the bioactive membranes.

The membranes with antioxidant activity were obtained by direct incorporation of α-tocopherol, α-lipoic acid, and of their mixture, into the membrane structure during the preparation process. The concentration of antioxidants incorporated into the membrane had to be optimized, to find an ideal amount to provide antioxidant activity, without altering membrane selective permeability. The effectiveness of antioxidant incorporation into membrane structure was proved by *in vitro* tests.

The other modification approach was superficial adsorption of newly synthetized inhibitors of human neutrophil elastase; three different inhibitors containing β-lactam ring were evaluated. These membranes were prepared to diminish inflammation, caused by elevated level of circulating human neutrophil elastase. The inhibition of elastase activity by these modified membranes was evaluated to select the most promising compound for further *in vitro* experiments.

The last tested membrane modification was by incorporation of molecularly imprinted polymers into the membrane structure during the preparation process, to selectively remove uremic toxins from the blood of patients with renal failure. This preliminary study proved that it will be possible to

incorporate compounds of this type with adequate selectivity for different toxins, in polysulfone members.

Obtained data may contribute to future research work on polysulfone membrane modifications, since membrane preparation and modification processes, using different approaches to improve bioactivity of the membranes, were optimized; the proposed bioactive membranes have potential for haemodialysis membranes and may reduce the cardiovascular risk associated with the high morbidity and mortality in patients on haemodialysis treatment.