DEVELOPMENT OF POLYMER BLEND ULTRAFILTRATION MEMBRANES WITH COMBINED SIZE AND CHARGE SELECTIVITY

Clélia Emin, Lehrstuhl für Technische Chemie II, Universität Duisburg-Essen, 45117 Essen, Germany
clelia.emin@uni-due.de
Iradani Katalia, Lehrstuhl für Technische Chemie II, Universität Duisburg-Essen, 45117 Essen, Germany
Eliezer Kurnia, Lehrstuhl für Technische Chemie II, Universität Duisburg-Essen, 45117 Essen, Germany
Mathias Ulbricht, Lehrstuhl für Technische Chemie II, Universität Duisburg-Essen, 45117 Essen, Germany

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Protein separation is a relevant technology for pharmaceutical industry, food-processing and biotechnology sector. Research activities are currently actively devoted to the development of high-performance ultrafiltration membranes with high permeability at maximum selectivity. Nevertheless, the efficiency of the fractionation of bio-macromolecules is often hindered by fouling processes which reduce the global performance. Based on size exclusion ultrafiltration separation process, fractionation of proteins can be achieved only for proteins with significantly different molecular weights. However, the introduction of electrostatic repulsion between a charged membrane and a protein could allow to overcome this limitation. From these considerations, we intend to develop polymer blend ultrafiltration membranes with combined size and charged selectivity in order to achieve the challenging separation of two proteins with very similar molecular weight. Amongst different modification approaches, polymer blending has emerged as an interesting method because it allows to develop new or advanced material properties and it is easily scaled up. More precisely, the use of sulfonated poly(arylsulfone)s became more and more attractive since it could be used to enhance the membrane permeability and to tune the charge of the membrane surface. In this work, flat sheet ultrafiltration membranes made of polysulfone and various types of sulfonated poly(arylsulfone)s were prepared via non-solvent induced phase separation method (NIPS). The type of sulfonated polymer as well as the overall degree of sulfonation was systematically varied. The performance of the new membranes was assessed in terms of water permeability, molecular weight cut-off and fouling resistance. Two types of model molecules - bovine serum albumin (BSA) and hemoglobin (Hb) - were then employed to evaluate single protein rejection and protein fractionation selectivity. An optimization of the membrane selectivity was conducted by adjusting the filtration conditions (eg. concentration, pH, ionic strength). Preliminary experiments toward quantitative separation of the two proteins were further conducted in diafiltration mode. In the present study, we demonstrate the possibility to tune the membrane properties using variations of the degree of sulfonation: a broad range of ultrafiltration membranes with different barrier pore sizes and surface charge were developed. Overall, the work provides interesting and relevant findings for the development of robust charged ultrafiltration membranes for protein separation