

Abstract

Aim of the work was the built-up and characterisation of new ultrathin films and membranes containing macrocycles, polyelectrolytes and polyelectrolyte blends with improved separation characteristics and suitability for controlled drug release. The membranes were built up upon electrostatic layer-by-layer-assembly on a porous PAN/PET supporting membrane.

In the first part of the work, the permeation behaviour of membranes prepared from polyelectrolytes and macrocycles such as 1,4,7,10,13,16-hexaazacyclooctadecane hexaacetic acid (**az6ac**) and per-6-amino-cyclodextrins was studied. The incorporation of anionic **az6ac** resulted in membranes with improved cation selectivity under dialysis conditions, the separation factor $\alpha(\text{Na}^+/\text{Mg}^{2+})$ being about 28. Under conditions of nanofiltration and reverse osmosis the total flux could be enhanced up to $14 \text{ l m}^{-2}\text{h}^{-1}$ at 40 bar, while a very good rejection for Ca^{2+} and Na^+ ions of up to 96 and 85 %, respectively, was found.

By incorporation of cationic per-6-amino-cyclodextrins size-selective membranes suitable for separation of aromatic compounds such as naphthalene, pyrene or perylene in alcoholic solution could be prepared. The permeation rates of these compounds were found to be highly affected by the anionic polyelectrolyte and the ring-size of the cyclodextrins.

In the second part of this work, a first study of the ion permeation behaviour of membranes prepared from anionic polyelectrolyte blends is presented. The blends consist of a strong and a weak polyelectrolyte, i.e., poly(styrene sulfonate) (**PSS**) and poly(acrylic acid) (**PAA**), which were used in different compositions. Under dialysis conditions, an improved ion selective transport was found compared to membranes, which were built up from pure compounds. Blend composition, pH and salt content of the dipping solutions were found to have a great influence on the separation behaviour. Membranes made from dipping solutions of pH 1.7 showed a highly improved anion selectivity with a separation factor $\alpha(\text{NaCl}/\text{Na}_2\text{SO}_4)$ up to 200, while membranes made from dipping solutions of pH 7.5/3.5 exhibited a cation selective transport.

The pH-dependent protonation of **PAA** could be used to vary the morphology of the **PAH/PSS-PAA** blend multilayers prepared from dipping solutions of pH 7.5/3.5. A porous structure was obtained, if the multilayers were immersed in acidified water in a post-assembly treatment. The use of the porous multilayers for controlled drug release was investigated. Release times of up to 17 days for ibuprofen and a released drug amount of up to 379 ng cm^{-2} were found. Release time and released drug amount were highly dependent on the blend composition and the pH used for the post-assembly treatment.