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Electrochemical Impedance Spectroscopy Fingerprints the Ion Selectivity of Microgel Functionalized Ion-Exchange Membranes

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Abstract

1 Surface modification methods are applied to alter interfacial phenomena and
2 improve ion transport through membranes. In this work we present a novel
3 method for tailoring the surface of cation-exchange membranes based on the de-
4 position of thin microgel monolayers. The charge of such layers exerts a strong
5 influence on the monovalent-ion-selectivity, and this is reflected in the electro-
6 chemical impedance responses. Membranes coated with uncharged microgels
7 show similar behavior to that of unmodified ones, with impedance spectra dom-
8 inated by low-frequency diffusional arcs. However, membranes modified with
9 positively charged microgels exhibit an increased resistance due to the hindered
10 transport of cations through the modification. An additional high-frequency ca-
11 pacitive arc is obtained with the monovalent-ion-selective membranes, which is
12 attributed to concentration polarization effects at the membrane/modification
13 interface. The characteristic frequency of this arc decreases with the valency
14 of the ion, thus proving that multivalent ions pass through the modification
15 layer at rates much slower than monovalent ones. Accordingly, electrochemi-
16 cal impedance spectroscopy has been used to feature monovalent-ion-selective
17 properties of layered membranes.

Keywords:

microgels, monovalent-ion-selectivity, impedance spectroscopy, electrodialysis,
ion-exchange membranes

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