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Preparation and characterization of PVA-based charge mosaic membranes

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Charge mosaic (CM) membranes consist of parallel arrays of cation-exchange and anion-exchange elements passing through the membrane. Since CM membranes have respective pathways for anion and cation, they have high permselectivity for electrolytes. These properties are desired for desalination of water or purification of biochemical materials or food additives. There have been many reports on attempts to prepare such membranes; however, it is difficult to make CM membranes for practical applications. The aims of this study are to prepare poly (vinyl alcohol) (PVA) based CM membranes, and to perform permeation experiments for salt and sucrose to examine its permselectivity for salts.

Permeation experiments were performed using an apparatus shown in Figure 1. The solution in the chamber at the low-concentration side was sampled to measure the concentration of K^+ ions by a conductivity meter (HORIBA Ltd., ES-12). The concentration of sucrose was also measured by using a UV-VIS detector (MILTON ROY CO., SPECTRONIC 20D).

Figure 2 shows a photograph of the CM membrane. The cation-exchange and anion-exchange domains of the CM membrane is formed finely. The average distance between the two ion-exchange domains is ca. 1080 μm.

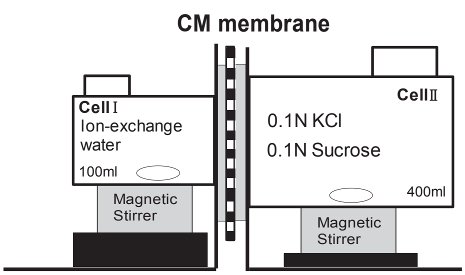

Figure 1. Apparatus for permeation experiment.

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Figure 2. Photograph of charged mosaic membrane. The purple color parts correspond to the cation-exchange domains, the orange color parts to anion-exchange domains.

Figure 3 shows time-concentration curves of KCl and sucrose through membrane CM-1. The permeability coefficient of KCl, P_{KCl}, and that of sucrose, P_{suc}, were obtained from the slope of the curves. Permselectivity between KCl and sucrose, $\alpha \equiv P_{KCl}/P_{suc}$, was obtained from the ratio of the coefficients. The permeability coefficients and the permselectivity through the other membranes were also obtained from the permeation experiments and listed in Table I as well as Desalton® (Tosoh Co., Ltd.). The flux of both KCl and sucrose decrease with decreasing water content. P_{suc} decreases more rapidly than P_{KCl} does. Hence, the permselectivity increases with decreasing of the water content. CM-3 has the highest permselectivity in all the membranes because it has optimum low water content. Desalton® was prepared using a microphase separation of pentablock copolymers so that it has the best salt flux in the reported mosaic charged membranes. Although the domain size of CM-2 and CM-3 is over 50000 times larger than that of Desalton, The permeselectivity of CM-3 is 8 times higher than that of Desalton because of the lower flux of sucrose through CM-3.

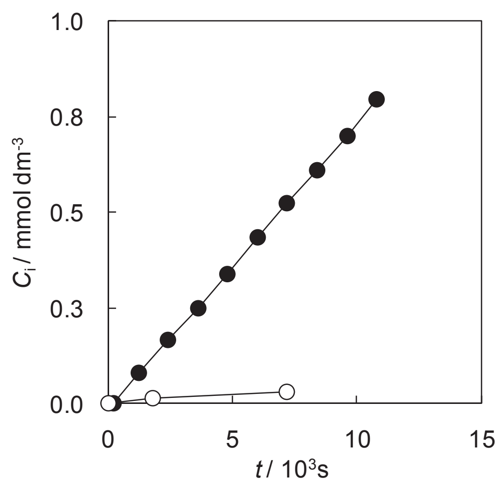

Figure 3. Time-concentration curves of KCl and sucrose through the charged mosaic membrane CM-1. (●) and (○) are the data for KCl and sucrose, respectively.

Table I Characteristics of charged membranes obtained in this study: water content, *H*, permeability coefficient of KCl, and sucrose, P_{KCl} and P_{suc}, respectively, and permselectivity between KCl and sucrose, α .

Membrane	*H*	J_{KCl}	J_{suc}	*α*
	[-]	[mol cm^{-2}s^{-1}]	[mol cm^{-2}s^{-1}]	[-]
CM-1	0.56	1.6×10^{-9}	8.7×10^{-11}	18
CM-2	0.41	1.3×10^{-9}	6.3×10^{-12}	202
CM-3	0.40	8.5×10^{-10}	2.7×10^{-12}	315
Desalton®	-	9.3×10^{-7}	2.4×10^{-8}	39

[1] M. Higa, D. Masuda, E. Kobayashi, M. Nishimura, Y. Sugio, T. Kusudou and N. Fujiwara, Charge mosaic membranes prepared from laminated structures of PVA-based charged layer 1.Preparation and transport properties of charged mosaic membranes, J. Membr. Sci., **310**, 466-473 (2008)

[2] Brian Bolto, Manh Hoang, Thuy Tran, Review of piezodialysis - salt removal with charge mosaic membranes, Desalination, **254**, 1-5 (2010)

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