Chinese Chemical Letters Vol. 15, No. 5, pp 609-610, 2004
http://www.imm.ac.cn/journal/ccl.html

Preparation of Composite Charge-mosaic Hollow Fiber Membrane by Interfacial Polymerization

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Abstract: The preparation of composite charge-mosaic membrane included spinning of hollow fiber as the supporting membrane, preparing a selective layer on the inside surface of the fiber by interfacial polymerization. The charge-mosaic membranes show a high salt permeability while retaining sucrose. The charge-mosaic membrane can be effectively used to separate multivalent salts with organic matter of molecular weight great than 300 g/mol in industry.

Keywords: Charge-mosaic membrane, interfacial polymerization, composite membrane.

A charge-mosaic membrane can be effectively used to separate the salts from the water-soluble organic matter in industry, especially to separate the multivalent salts，such as the salts of Ca^{2+},SO_4^{2-},CO_3^{2-}*etc*., which could not be separated from organic matter by NF membrane.

The concept of charge mosaic membrane was proposed in 1932. Since then, many attempts have been made to develop highly effective charge-mosaic membrane. Most of charge mosaic membranes were made by chemical modifications of two phase polymer system, *i.e.*, block copolymers [1,2], graft modifications[3,4], and. polymer blend[5,6,7]. These studies did not try to prepare composite charge mosaic membrane by interfacial polymerization and were limited to prepare flat membrane. This paper is to develop a membrane consisting of a low cost supporting membrane and a selective thin layer with the mosaic morphology and functionality by interfacial polymerization.

Polyethersulfone (PES) was used as polymer for the support membrane. The resulting membrane spun in the experiment had an inside diameter of 0.630 mm. Its wall thickness was 0.350 mm.

In order to make the charge mosaic membrane (CMM), both anionic and cationic groups have to be introduced by a careful choice of the reactants. Firstly, the support membrane was flushed with water to remove glycerol in the support membrane. Then, the aqueous solution containing 2, 5-diaminobenzene sulfonic acid and polyethylenimine (PEI) was introduced into the fiber from the lumen and kept for about 30 minutes. Different additives and/or acid acceptors were also added to the aqueous amine solution. Then, the dodecane solution containing trimesoyl choride acid (TMC) was gently fed for

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an interfacial polymerization reaction. Finally interfacial polymerization layer was formed on the inside surface of the hollow fiber membrane.

The dialytic separation experiments were carried with an aqueous mixed solution of Na_2SO_4 and sucrose. The initial concentration of Na_2SO_4 and sucrose were 3.7×10^{-3} mol/L and 1.46×10^{-3} mol/L , respectively. The concentration of the permeated salt was measured with microprocessor conductivity meter. The concentration of permeated sucrose was measured by using a UV/Vis scanning spectrophotometer. **Table 1** shows the typical experimental results at 25℃ and 0.2 MPa.

Table 1 The typical experimental results

Jv ($m^3/m^2 \cdot h$)	R_{in}	R_{or}	Js_{in} ($mol/m^2 \cdot h$)	Js_{or} ($mol/m^2 \cdot h$)
7.92×10^{-3}	29.6	98.9	75.6	0.453

Where Jv is the volume flux. R_{in} and R_{or} represent the rejection of Na_2SO_4 and sucrose, respectively. Js_{in} and Js_{or} show the flux of Na_2SO_4 and sucrose, respectively.

Table 2 shows the characteristics of several typical charge mosaic membranes. The dialytic separation experiments were with an aqueous mixed solution of KCl and sucrose in references 2 and references 7.

Table 2 The characteristics of several typical charge mosaic membranes

	Block copolymer[2]	Polymer blend[7]	Interfacial polymerization.
Jv ($m^3/m^2 \cdot h$)	1.0×10^{-4}	3.6×10^{-4}	7.92×10^{-3}
Js_{in}/Js_{or}	200.0	37.8	167.0
△P (MPa)	3.0		0.2

The results indicate that the composite charge mosaic membrane prepared by interfacial polymerization can be operated at lower pressure, because the composite layer is very thin, and the volume flux is near to the flux of NF used in industry[8]. The composite charge mosaic membrane shows a high salt permeability while retaining sucrose. It will be particularly useful to separate multivalent salts from water-soluble organic matter of molecular weight great than 300 g/mol in industry.

References

1. M. Yoshiyuki, N. Hiroshi,T. Fujimoto, *J. of Membrane Science*,**1984,** *20*(3), 313.
2. Y. Isono, I. Hiroshi, T. Fujimoto, *et al.*, *J. of Membrane Science*, **1989,** *43*(2), 205.
3. L. Liang, S. K. Ying, *J. of Membrane Science*, **1992,** *71*(1), 129.
4. N. Saito, S.Yamashita, *J. of Applied Polymer Science*, **1998,** *67*(6), 1141.
5. H. Kawatoh, M. Kakimoto, A. Tanioka, *et al.*, *Macromolecules*, **1998,** *21*(3), 625.
6. H. Ni, G. H. Ma, M. Nagai, S. Omi, *J. of Applied Polymer Science*, **2001,** *80*(11), 2002.
7. K. Ishizu, M. Amemiya, *J. of Membrane Science*, **1992,** *65*(1), 129.
8. R.J. Petersen, *J. of Membrane Science*, **1993**, *83*(1), 81.

Received 21 April, 2003