일반강연 I -12

Mass Transfer Modelling of Asymmetric Membrane Formation by Phase Inversion

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1. Introduction

The growth of membrane science was initiated by the invention of asymmetric membrane which can be formed by the technique known as phase inversion. The basic procedure of phase inversion involves casting a thin film of polymer solution onto a suitable substrate followed by immersion in a coagulation bath (quench step). Therefore, events occurring during the quench period, at which time solvent-nonsolvent exchange and eventual polymer precipitation take place, can play a controlling role in the determination of ultimate membrane structure.

2. Development of Diffusion Model

Several general assumption are summarized as followed; (1) one-dimensional, isothermal diffusion, (2) constant partial specific volume, and (3) no polymer dissolved in the bath side. And appropriate equation for the phase inversion membrane system can be written as

$$\frac{\partial \phi_{1p}}{\partial t} = \frac{\partial}{\partial z}\left(D_{11}\frac{\partial \phi_{1p}}{\partial z} + \frac{V_1}{V_2}D_{12}\frac{\partial \phi_{2p}}{\partial z}\right)$$

$$\frac{\partial \phi_{2p}}{\partial t} = \frac{\partial}{\partial z}\left(\frac{V_2}{V_1}D_{21}\frac{\partial \phi_{1p}}{\partial z} + D_{22}\frac{\partial \phi_{2p}}{\partial z}\right)$$

for the cast film and

$$\frac{\partial \phi_{1b}}{\partial t} = \frac{\partial}{\partial z}\left(D_b\frac{\partial \phi_{1b}}{\partial z}\right)$$

for the coagulation bath. Here, subscripts p and b represent casting film side and coagulation bath side, respectively, and D_b refers to the mutual diffusion

coefficient. The casting film and bath will be treated as finite and infinite domains, respectively.

3. Numerical technique

All ternary phase diagrams were generated using the algorithm developed by Yilmaz and McHugh. In order to solve the coupled, nonlinear partial differential equations and associated boundary conditions, a numerical method must be employed.

4. References

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