Preface

There is a huge interest and need to applying polymeric membranes for separations and purifications involving organic solvents, especially solution–diffusion membranes in polar aprotic and its mixtures in industries including fine chemicals, pharmaceutical, petroleum, oil, and biotechnology. However, several drawbacks including unpredictable performances, nonuniform characterization models, lack of in-depth understanding for proper system selection, excessive swelling and compaction, irreversible fouling and membranes instability in these environments, among others, have been very deterring. Not much has been done in this area where polymeric pressure-driven solution-diffusion membranes are used for separations involving these organic solvent(s). Moreover, some of the existing models used to characterize polymeric solution-diffusion membranes such as Nanofiltration (NF), Reverse Osmosis (RO), and Pervaporation (PV) in the organic solvents reviewed are deficient in the necessary parameters for characterization; the reasons could include unavailability of necessary published data.

The complexity includes the numerous parameters to be considered in characterization models and how to combine them in a model. Polymeric membranes in these environments, in order to achieve the right performance, are exposed to considerable swelling and/or compaction simultaneously, while membrane is constrained and permeated. This brings into effect the interplay of combined chemical, mechanical, thermodynamics considerations while transporting across these membranes under a driving force. Moreover, depending on the type of organic solvent, membrane material, solute type, applied pressure, and operating conditions there is a difficulty in predicting the performance of the membranes.

My motivation came from the quest to develop a combined chemical, mechanical, thermodynamics model that represents these membranes reliably and provides in-depth explanations to assist in predicting their behaviors and performances for proper selection. In addition, I wanted to use graduate school experiences in organic solvent system separations and application of acoustics, coupled with my industrial experiences, which has prepared me sufficiently to contribute my ideas to this book to bridge some of the gaps lacking in this area.

Weber et al.'s theoretical model for describing membrane constraint in polymer-electrolyte fuel cells provided some insight into developing the model presented in this book on pressure-driven solution-diffusion polymeric membranes applied for separations and purifications involving organic solvents.

This book consisting of six chapters is designed to meet the need of membrane researchers, scientists, and engineers in academia and/or industry, who seek in-depth understanding on factors affecting solution-diffusion membranes, their behaviors, and performances. Chapter 1 presents the introduction, Chap. 2 the background to support the model development, while Chap. 3 discusses how key parameters are correlated in a model with in-depth explanations of their effects on performance and behavior. Moreover, in-depth discussions are provided on effects of combined swelling and compaction on membrane performance. Chapter 4 is on model application to published information while Chap. 5 presents a summary on the key take away or learnings from the book. Chapter 6 is on the future directions since there are a lot more areas to apply the model and extend it to several areas. A spin-off from the developed model in this book led to the definition of a new membrane dimensionless number characteristic of the separation system which will be explored in the future.

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