Optimum design of pore-filled ion-exchange membranes for efficient separation and energy applications

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Ion exchange membranes (IEMs) have been widely employed in various water treatment processes such as electrodialysis for a desalination of sea or brackish water. Recently, they have also gained increased industrial importance in the applications to electrochemical energy conversion and storage processes such as reverse electrodialysis, fuel cells, and redox flow batteries. Their intrinsic properties such as electrical resistance and permselectivity are the key parameters dominating the electrochemical energy conversion efficiencies. The cost-effectiveness of ion-exchange membranes should also be considered for successful commercialization of the IEM process. In recent years, pore-filled IEMs (PFIEMs) in which an inert porous substrate provides excellent mechanical and chemical stabilities while a filling ionomer selectively transports ions through the membrane have been receiving great interests in the application to various separation and energy processes. In this work, we have investigated the optimum design parameters of the cost-effective PFIEMs for successful application to various IEM processes.
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