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Geometric Effects on Power Generation by Reverse Electrodialysiswith Self-induced Electrolyte Flow in Ion-Selective Nanochannels BYOUNG JAE KIM, Korea Atomic Energy Research Institue, DONG-KWON KIM, Ajou University, SEUNG-HYUN LEE[1], Korea Institute of Machinery & Materials
— Recently, solid-state nanofluidic channels or nanopores have been demonstrated experimentally to serve as ion-selective membranes for small reverse electrodialysis systems. Ions of opposite charge to that of the surface (counter-ions) are attracted toward the surface while ions of like charge (co-ions) are repelled from the surface. As a result, the counter-ions are preferentially transported over the co-ions in the charged nanochannels. Under a concentration gradient, the ions diffuse spontaneously across the nanochannels, and a portion of the Gibbs free energy of mixing can be harvested continuously from the nanochannels by means of the net diffusion current. In the present study, power generation by reverse eletrodialysis in ion-selective nanochannels is numerically investigated by solving the Nernst-Planck equation for the ionic concentrations, the Poisson equation for the electric potential, and the Navier-Stokes equation for the electrolyte velocity simultaneously. We elucidated the effect of various parameters on power generation such as geometry of channel cross section, channel length, hydraulic diameter and the surface charge density etc.

[1]Corresponding Author

Seung-Hyun Lee
Korea Institute of Machinery & Materials

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