Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Information

Enhancing the osmotic energy conversion of a nanoporous membrane: influence of pore density, pH, and temperature

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Table S1. Dependence of pore density on pore-pore distance.

Pore-pore distance a_1 (nm)	Pore density (pores/cm^2)
200	2.5×10^9
320	9.8×10^8
450	5.0×10^8
600	2.8×10^8
800	1.6×10^8
1000	1.0×10^8
2000	2.5×10^7
3200	1.0×10^7
10000	1.0×10^6

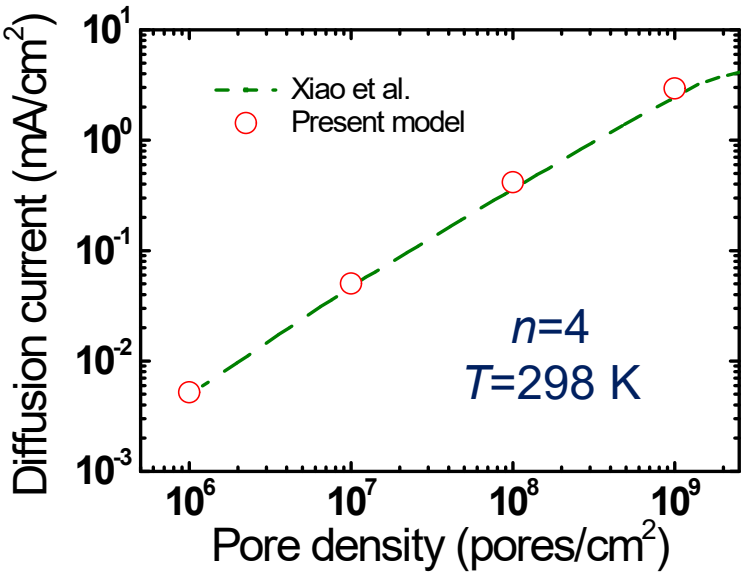

Fig. S1 Variation of diffusion current with pore density for a multi-pore system with a_0=5 μm (infinite reservoir). Parameters used: L=1000 nm, d=10 nm, σ_s=-0.06 C/m^2, C_H/C_L=100 mM/1 mM, and T=298 K, n=4, and H_{res}=2000 nm. The pore density is adjusted by the pore-pore distance a_1 (Table S1).

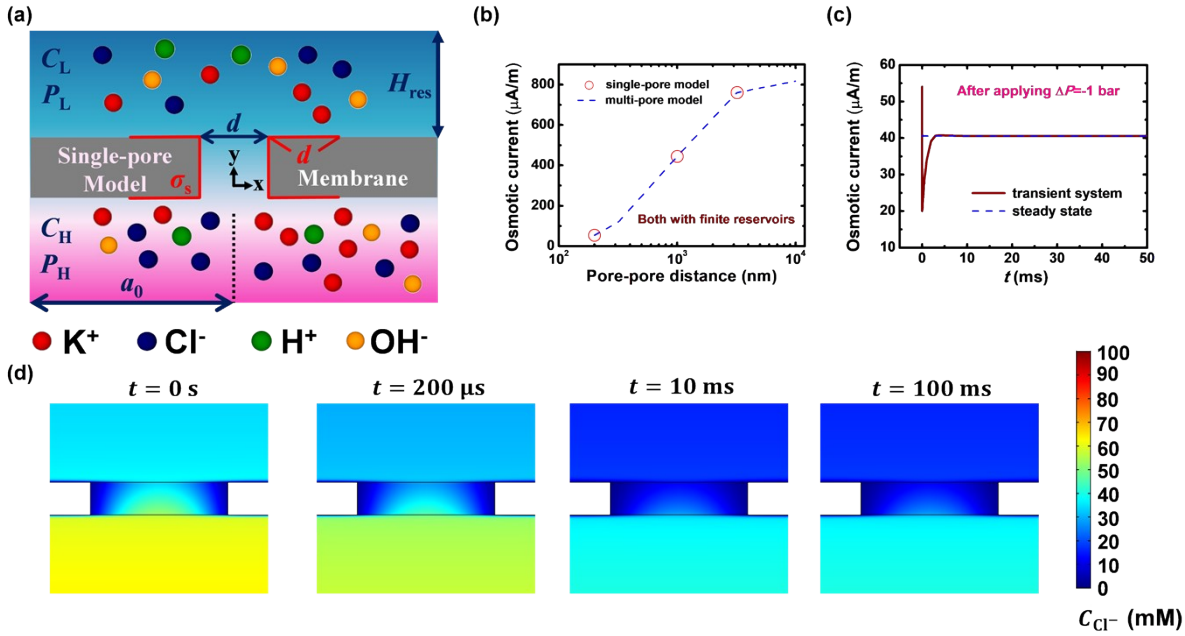

Fig. S2 (a) Schematic representation of a single-pore system, where a cylindrical nanopore connects two large, identical reservoirs with a_0 being half width. The boundary marked red has the surface charge density σ_s. (b) Variation of osmotic current with pore-pore distance; both the results for single-pore and those for multi-pore are presented. Temporal variation of osmotic current, (c), and Cl^- concentration, (d), after a ΔP=-1 bar is applied for the case of a_1=200 nm. The parameters used in (b)-(d) are L=50 nm, d=10 nm, pH 8, C_H/C_L=100 mM/1 mM, T=298 K, H_{res}=2000 nm, and $a_0=a_1/2$.

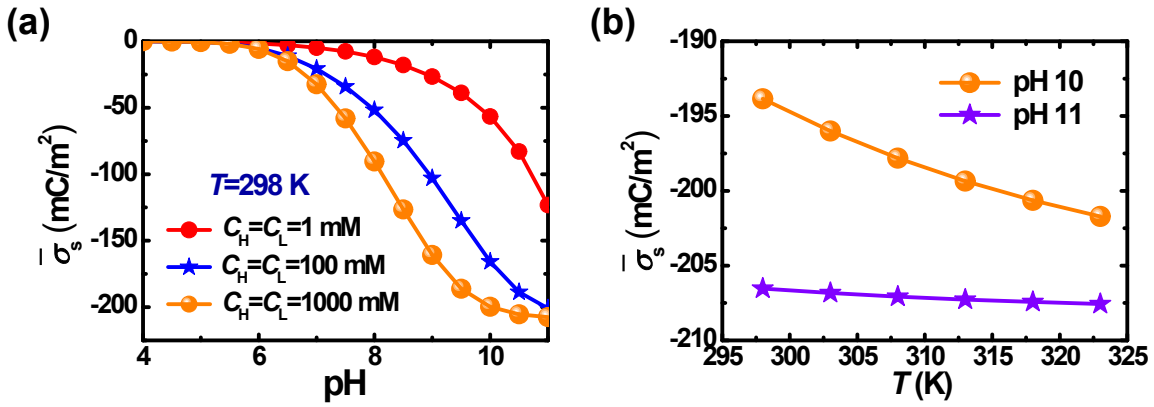

Fig. S3 (a) Variation of averaged surface charge density of the wall $\bar{\sigma}_s$ with pH for different bulk concentrations. (b) Variation of $\bar{\sigma}_s$ with temperature for two pH levels. The parameters used in (b) are L=600 nm, d=10 nm, C_H/C_L=1000 mM/1 mM, H_{res}=2000 nm, and $a_0=a_1/2$=100 nm.

Table S2. Dependence of pore density on pore-pore distance and the corresponding porosity.

Pore-pore distance a_1 (nm)	Pore density (pores/cm^2)	Porosity (%) when d=10 nm
50	4.0×10^{10}	3.142
100	1.0×10^{10}	0.785
140	5.1×10^{9}	0.401
200	2.5×10^{9}	0.196

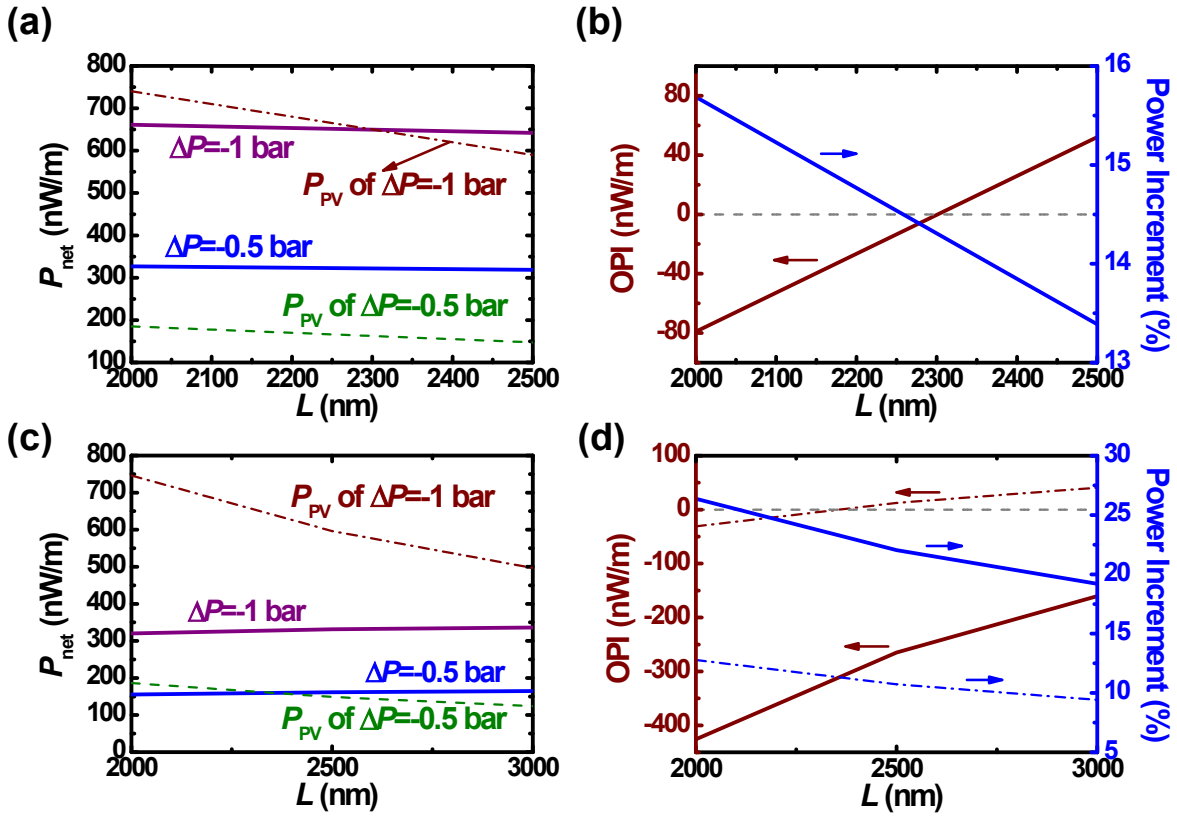

Fig. S4 Variation of the net power P_{net}, (a) and (c), and overall power increment OPI and power increment PI, (b) and (d), with pore length. In (a) and (c), green dashed curve: power of PV work $^{P_{PV}}$ of ΔP=-0.5 bar; wine dash-dotted curve: power of PV work $^{P_{PV}}$ of ΔP=-1 bar. In (b) and (d), gray dashed curve: OPI=0. In (d), dash-dotted curve: ΔP=-0.5 bar; solid curve: ΔP=-1 bar. Parameters used are d=10 nm, C_H/C_L=1000 mM/1 mM, T=323 K, pH 11, H_{res}=2000 nm, and $a_0=a_1/2$. In (a) and (b), a_1=100 nm. In (c) and (d), a_1=50 nm.