Supporting Information

Ion Permeation by a Folded Multiblock Amphiphilic Oligomer Achieved by Hierarchical Construction of Self-Assembled Nanopores

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1. Conductance Recordings

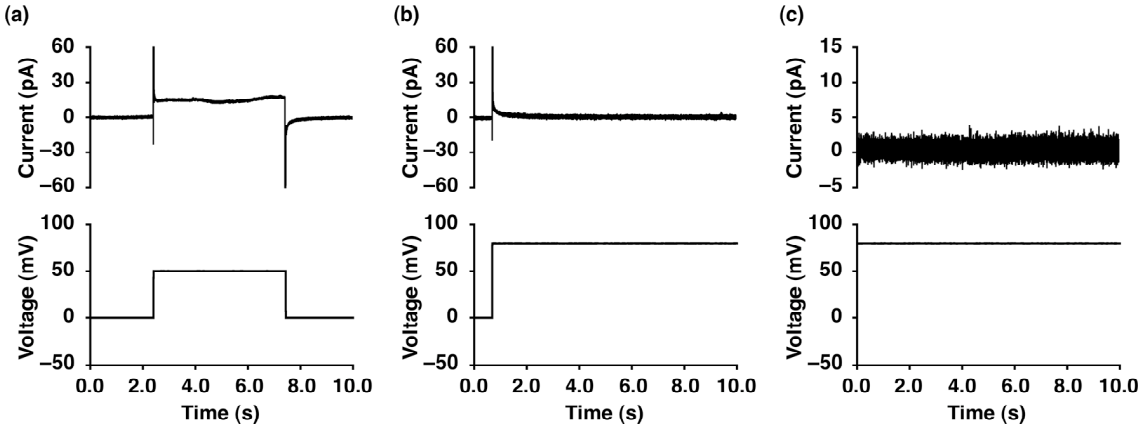

Figure S1. Ion channel current recordings of a DOPC liposomal membrane containing **1** ((a) 10 nM) and **2** ((b) 10 nM, (c) 1.0 pM) in HEPES buffer (20 mM, containing 50 mM KCl, pH 7.5) at 20 ºC

2. Time Course Fluorescence Measurements

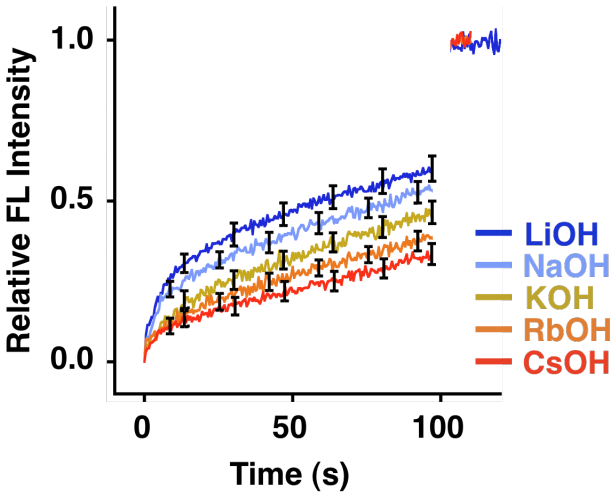

Figure S2. Changes in fluorescence intensity of HPTS entrapped in LUVs containing **1** ([**1**]/[DOPC] = 0.0075) in 20 mM HEPES at 20 ºC (excitation at 460 nm, emission at 510 nm) as a function of time after the addition of an alkali metal hydroxide (LiOH, NaOH, KOH, RbOH or CsOH) at 0 sec followed by 1% triton X-100 at 100 sec. ΔpH = 0.8 (7.1 to 7.9). Data are means (± standard deviations at every 16 s for clarity) of three independent experiments.

3. Calculation of Bending Elastic Modulus[1,2]

Aspiration pressure (P) applied to a GUV produces a membrane tension τ, which can be described as below,

$$\tau = PD_p/4(1 - D_p/D_{ves}) \quad \text{(S1)}$$

where D_p and D_{ves} are the diameters of pipette caliber and of the GUV spherical segment outside the pipette, respectively. An increase of the aspirated projection length (ΔL_p) of the vesicle membrane inside the pipette provides a direct determination of the area expansion (ΔA) of the aspirated vesicle membrane by a proportional relationship expressed as equation S2 based on a first-order approximation.

$$\Delta A \approx \pi D_p(1 - D_p/D_{ves})\Delta L_p \quad \text{(S2)}$$

Changes in the vesicle membrane area and volume were calculated from L_p using the geometric relationship for the total membrane area (A_{tot}) and volume (V_{tot}) of the aspirated GUV. Because a pressurized fluid bilayer vesicle is a perfect sphere, the membrane areas and the volumes of the hemispherical cap portion (A_{cap} and V_{cap}, respectively) and of the cylindrical portion of the projection inside the pipette (A_{cyl} and V_{cyl}, respectively) can be evaluated by equations S3–S6.

$$A_{cap} = \pi D_p^2/2 \quad \text{(S3)}$$

$$A_{cyl} = \pi D_p(L_p - D_p/2) \quad \text{(S4)}$$

$$V_{cap} = \pi D_p^3/12 \quad \text{(S5)}$$

$$V_{cyl} = \pi D_p^2(L_p - D_p/2)/4 \quad \text{(S6)}$$

The membrane areas and the volumes of the GUV spherical segment outside the pipette (A_{ves} and V_{ves}, respectively) can be evaluated by equations S7 and S8.

$$A_{ves} = \pi D_{ves}^2(1 + u)/2 \quad \text{(S7)}$$

$$V_{ves} = \pi D_{ves}^3(2 + 3u - u^3)/24 \quad \text{(S8)}$$

$$u = [1 - (D_p/D_{ves})^2]^{1/2} \quad \text{(S9)}$$

A_{tot} and V_{tot} were evaluated by equations S10 and S11.

$$A_{tot} = A_{cap} + A_{cyl} + A_{ves} \quad \text{(S10)}$$

$$V_{tot} = V_{cap} + V_{cyl} + V_{ves} \quad \text{(S11)}$$

D_p, D_{ves}, and L_p were measured at the beginning of each experiment, which were used to calculate the changes in either area (for the volume V_{tot} held constant) or volume (for the area A_{tot} held constant).

The bending elastic modulus B is evaluated by the logarithmic dependence of the apparent area expansion on the tension τ expressed as below,

$$\log\Delta\tau \approx (8\pi B/k_BT)\Delta A/A_o$$

where k_B is the Boltzmann constant, T is the temperature, and $\Delta A/A_0$ is the area expansion.

4. References

(1) Olbrich, K. C.; Rawicz, W.; Needham, D.; Evans, E. *Biophys. J.* **2000**, *79*, 321–327.

(2) Rawicz, W.; Olbrich, K. C.; McIntosh, T.; Needham, D.; Evans, E. *Biophys. J.* **2000**, *79*, 328–339.