Transmembrane Anion Transport by Imidazolinium-based Multiblock Amphiphile

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Preservation and regulation of ion-concentration gradients across the biological membranes is important in cellular events, such as apoptosis and proliferation. In nature, ion transport across the membranes is realized by membrane transporters embedded in the lipid bilayer membranes. Meanwhile, dysregulation of ion transport, especially that of anion transport, is considered to cause serious diseases such as cystic fibrosis.

Previously, our group has reported that multiblock amphiphiles, consisting of alternatingly aligned hydrophobic aromatic units and hydrophilic oligo (ethylene glycol) chains, can transport ions across the lipid bilayer membranes1). In this study, we newly developed an imidazolinium-based multiblock amphiphile (IMA), which bears imidazolinium ion at the center of hydrophobic unit as an anion recognition site (Figure).

We investigated the ion transport activity of IMA using liposomes as model membranes. Interestingly, IMA transported anions as a mobile carrier, with selectivity for nitrate. 1H NMR titration experiment in solution indicated that IMA recognizes anions via (C–H)···X– hydrogen bond of imidazolinium ring. Furthermore, the results of all-atom molecular dynamics simulation were consistent with experimental results, suggesting that the IMA forms dimeric species during anion transport2).


Figure. Molecular structure of IMA