Title:

Bio-inspired Construction of Polycation-manipulated Covalent Organic Framework Membranes for Efficient Ion Separation

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Abstract:

High-precision ion separation has significant environmental and economic value at the water-energy nexus. Inspired by biological transport profile, manipulating the aperture structure and charged property of nanofluid channels is a promising way for accomplishing delicate ion transport and separation. Herein, a facile polyelectrolyte-assisted interfacial polymerization (IP) strategy is conductive to developing a defect-free ionic covalent organic framework membrane. The polycation chain, poly(diallyldimethylammonium chloride) (PDDA), threaded between TpPa-SO_3H nanosheets provides the homogenously sub-nanometer transport channels with the distribution of reversed charges .

Attributed to the synergistic effects of size exclusion, electrostatic interaction and specific binding affinity, the membrane shows remarkable capabilities of mono/divalent cations sieving, particularly relevant to Li^+ and Mg^{2+} separation, which is of vital significance for salt-lake lithium mining. The rejection of $MgCl_2$ can reach 98.8% and the Li^+ to Mg^{2+} selectivity can approach 60 with mixed saline solution superior to the performance of most polyamide nanofiltration membranes. In view of coupling the rigidity TpPa-SO_3H skeletons and the flexibility of polymer chains, the membrane validates excellent mechanical strength in long-term cross-flow filtration driven by hydraulic pressure. This groundbreaking strategy offers a compelling opportunity to develop versatile covalent organic framework membranes for exquisite ion sieving, which is promising to tackle the realistic challenges of energy and water issues .