

Oriented UiO-67 Metal–Organic Framework Membrane with Fast and Selective Lithium-Ion Transport

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Abstract: Metal–organic frameworks (MOFs) membranes with high pore density and tunable pore size down to subnanoscale exhibit great potentials in ion separation when appropriately designed and prepared. By a washing-assisted secondary growing method, a well intergrown UiO-67 membrane with preferential growth along [022] direction is synthesized on polyvinylpyrrolidone (PVP)-modified AAO substrate. Because of the oriented growth of UiO-67 nanocrystals, highly interconnected ion-transporting channels are created throughout the UiO-67/AAO membrane to achieve record-high Li⁺ permeance record of 27.01 mol·m⁻²·h⁻¹ as well as very decent Li⁺/Mg²⁺ selectivity of up to 159.4. Molecular dynamics simulations reveal that the high selectivity is associated with the large disparity of transport energy barrier between Li⁺ and Mg²⁺, which is caused by different extent of ion dehydration in unique bimodal and oriented membrane channels.

Keywords: metal–organic frameworks, subnanometer pore membrane, ion separation, lithium ion fast transport, ion dehydration