Supporting Information

The Kinetics Process of Alkaline-Earth Metal Ions Transmembrane through ZIF-8

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Experimental Section

Materials: Zinc acetate dehydrate ($Zn(Ac)_2 \cdot 2H_2O$, A.R.) was purchased from Energy-Chemical. Imidazole-2-carboxaldehyde (2-MIM, A.R.) was purchased from Aladdin. Ultrapure water (18.2 MΩ) used in the experiments were produced by a Millipore direct-Q system.

Preparation of the membrane： A clean and dry single hole glass film was sputtered on one side of platinum target for 3 minutes in a small ion sputtering apparatus to conduct electricity on one side. 275 mg of zinc acetate dihydrate and 205 mg of 2-MIM (Imidazole-2-carboxaldehyde) were dissolved in 25 mL of methanol. The solution was treated by ultrasonication. The glass film after sputtering platinum was clamped on the copper electrode holder to connect the CHI 660E electrochemical working electrode, the platinum electrode was the counter electrode (**Figure S1a**). The voltage gradually increased with time (**Figure** S1b). After the growth, the glass film was taken out and ultrasonically cleaned with ultrapure water to remove the unreacted molecules adsorbed on the surface.

Measurement of ions transport performance: The current-voltage (*I-V*) curves of the membrane were tested by picoammeter to obtain the ion transmembrane properties. Before changing the test electrolyte solution concentration or solution type, ultrapure water was used to clean the glass/ZIF-8 composite membrane several times and voltage was applied to minimize the impact of the previous test on the next test.

The electrochemical impedance measurements: The working electrode was membrane we prepared and the counter electrode was platinum and the reference electrode was silver chloride electrode. The electrochemical impedance measurements were carried out by using CHI 660E electrochemical workstation in the frequency range 1000 Hz – 0.01 Hz at AC amplitude of 0.05 V. The temperature was varied from 30 ℃ to 70 ℃ (30, 40, 50, 60, 70 ℃).

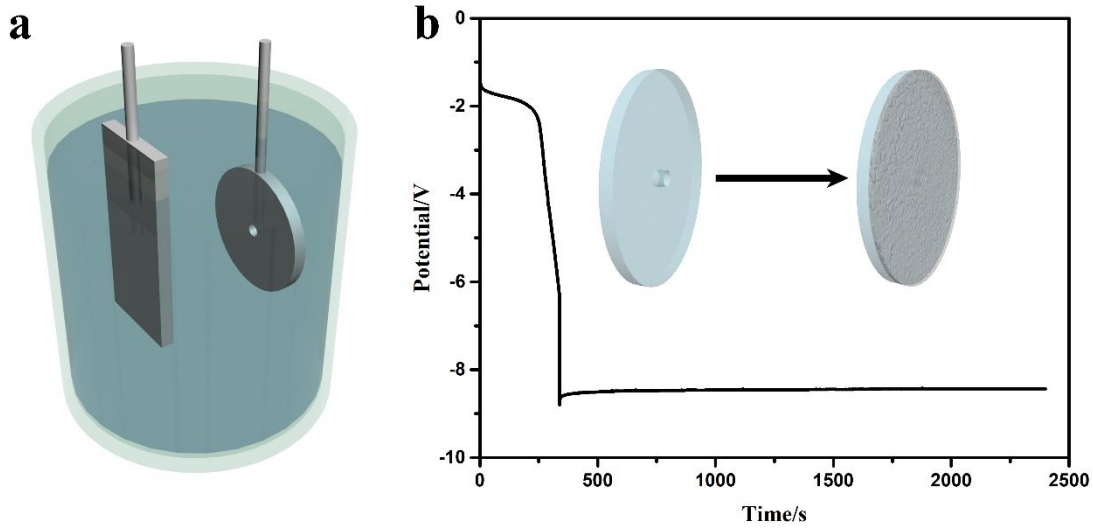

Figure S1. (a) Schematic diagram of electrochemical growth membrane. The glass film after sputtering platinum is clamped on the copper electrode holder to connect the chi660E working electrode, the platinum electrode is the counter electrode. (b) The *V-t* curve of the process. As ZIF-8 gradually grows on the conductive side, the conductivity of the glass film will gradually decrease and the voltage will gradually rise.

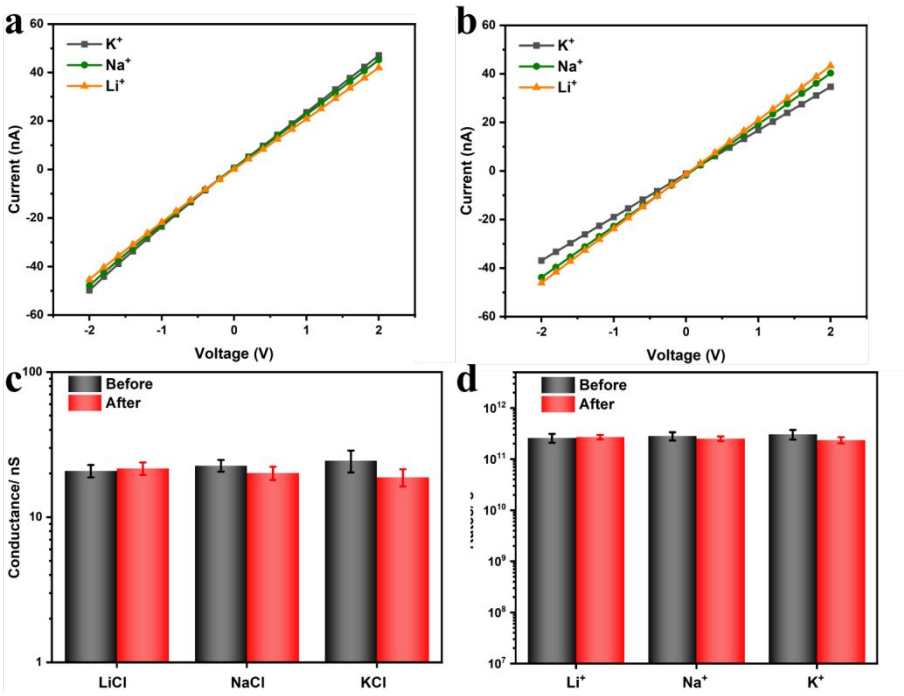

Figure S2. The I-V curves of single pore glass membrane (a) and glass/ZIF-8 composite membrane (b) with different electrolyte solutions (Li^+, Na^+, K^+). (c) The conductance before and after the growth of ZIF-8 in various electrolyte solutions under +2 V. (d) The transport rates of different alkali earth metal ions (Li^+, Na^+, K^+) before and after the growth of ZIF-8.

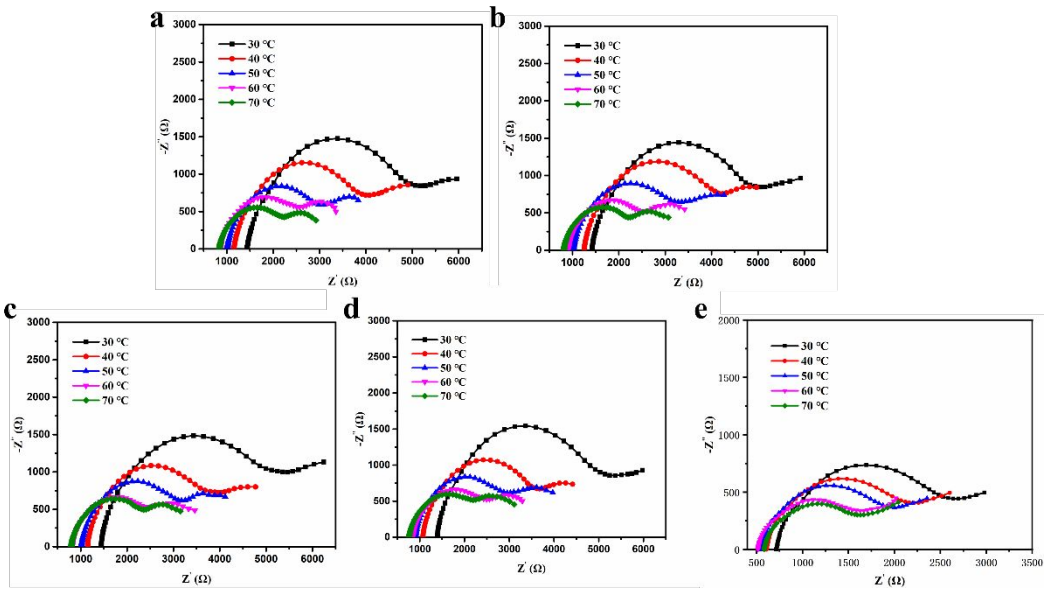

Figure S3. The impedance spectra of different electrolyte solutions (a. $MgCl_2$, b. $CaCl_2$, c. $SrCl_2$, d. $BaCl_2$, e. KCl).

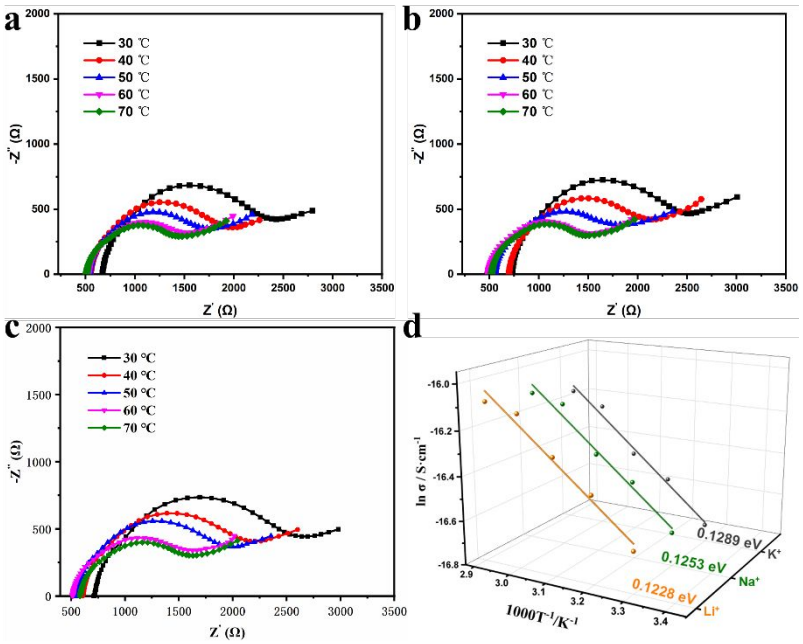

Figure S4. The impedance spectra of different electrolyte solutions (a. LiCl, b. NaCl, c. KCl). (d) Arrhenius plots of the membranes with different electrolyte solutions (Li^+, Na^+, K^+).

Table S1. The parameters of alkali metal ions.

	Radius (Å)	Hydration radius (Å)	Activation energy (eV)	Rate of transmembrane (s^{-1})
Li^+	0.6	3.82	0.1228	2.705×10^{11}
Na^+	0.95	3.58	0.1253	2.513×10^{11}
K^+	1.33	3.31	0.1289	2.351×10^{11}