Supplemental Information

New Polyethylene Based Anion Exchange Membranes (PE-AEMs) with High Ionic Conductivity

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Membrane Evaluation Procedure:

Water uptake measurement: soak the film on de-ion water for 24h, mop the water on film surface and measure the weight of the film (W_w), dry the film in vacuum oven at 50^o C for 12h, measure the weight of the film (W_d). Water uptake is calculated by the equation: Water uptake% = $(W_w - W_d)/W_d \times 100$, whose unit is g H_2O/100g ammonium-form of dry film. Ion exchange capacity (IEC): film was soaked with 0.5M HCl for 24 h to transfer all amine groups to ammonium chloride, and was washed with de-ion water for several times to remove all free HCl; film was soaked film with 0.2M $NaNO_3$ to extract the Cl^- to aqueous solution; change the solution every 6h for four time and collect all $NaNO_3$ solution; the $NaNO_3$ solution was titrated by 0.10M $AgNO_3$ solution with K_2CrO_4 indicator, the titration was finished when it shown orange precipitate, the volume of $AgNO_3$ is V_2 (ml); some amount of pure $NaNO_3$ was titrated for comparison, the volume of $AgNO_3$ is V_1 (ml); the film was soaked in 0.5M HCl for 24h and washed with de-ion water, and then dried in vacuum oven at 50^{o}C for 12h; measure the weight of the dry film (W, g). IEC was calculated by the equation: IEC = 0.10 $(V_2-V_1)/W$ (mmol eq/g dry membrane) .

The membrane conductivity was measured in a “clip”- type conductivity cell illustrated in Figure S1. (also see Balashov, V.N.; Schatz, R.; Chalkova, E.; Akinfiev, N. N.; Fedkin, M. V.; Lvov, S. N. *J. Electrochem. Soc.* **2011**, *158(3)*, B266). Two titanium disk electrodes are applied to both sides of the membrane. Both compartments of the cell were filled with various solutions of a desired concentration.

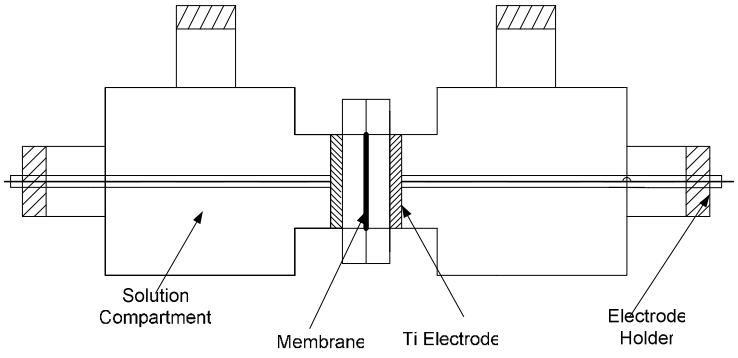

Figure S1. Schematic of the conductivity cell.

The conductivity measurements were performed by two-electrode electrochemical impedance spectroscopy (EIS) using the Gamry Electrochemical Measurements system. The EIS data were fitted to the equivalent circuit model (Figure S2) to extract the bulk resistance. The membrane resistance was estimated as the difference between the cell resistance values measured with and without the membrane at the same conditions. The membrane conductivity (σ) was calculated as $\sigma = l/RA$, where l, R and A are the membrane thickness, resistance, and surface area of the cell, respectively.

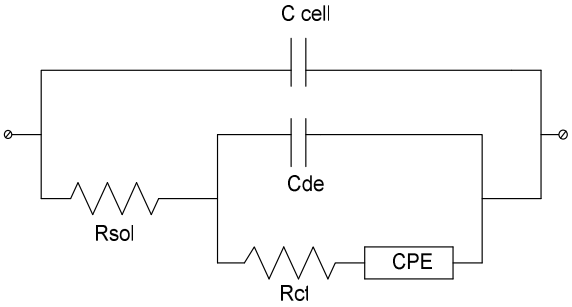

Figure S2. Equivalent circuit for membrane conductivity cell (Figure 10): Rsol – electrolyte solution resistance, Rct - charge transfer resistance, Cdel - capacity of double electrical layer, Ccell – capacity of electrochemical cell, CPE-constant phase element