# Supplementary Materials

## Composite Anion Exchange Membranes Based on Quaternary Ammonium-Functionalized Polystyrene and Cerium(IV) Phosphate with Improved Monovalent-Ion Selectivity and Antifouling Properties

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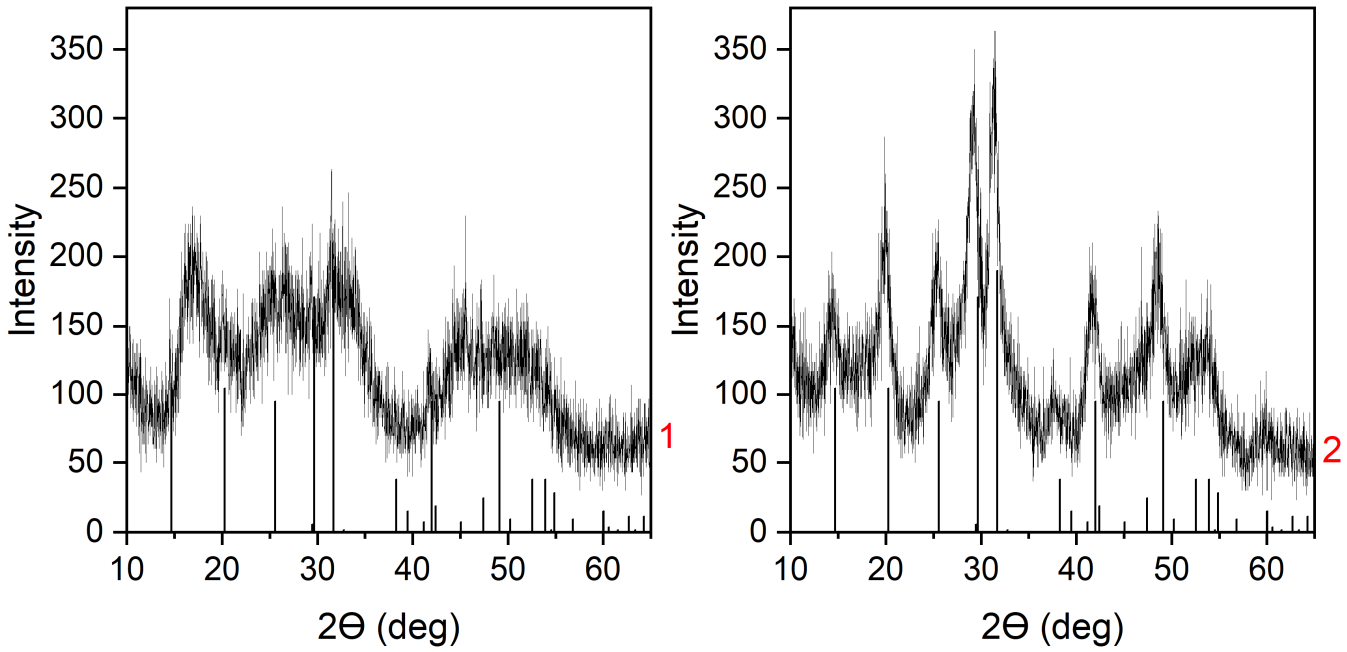


**Figure S1.** XRD pattern of (1) CeP-NH, (2) CeP-HP and reference diagram of $CePO4 \cdot H_2O$ (PDF-2 card No. 35-0614)

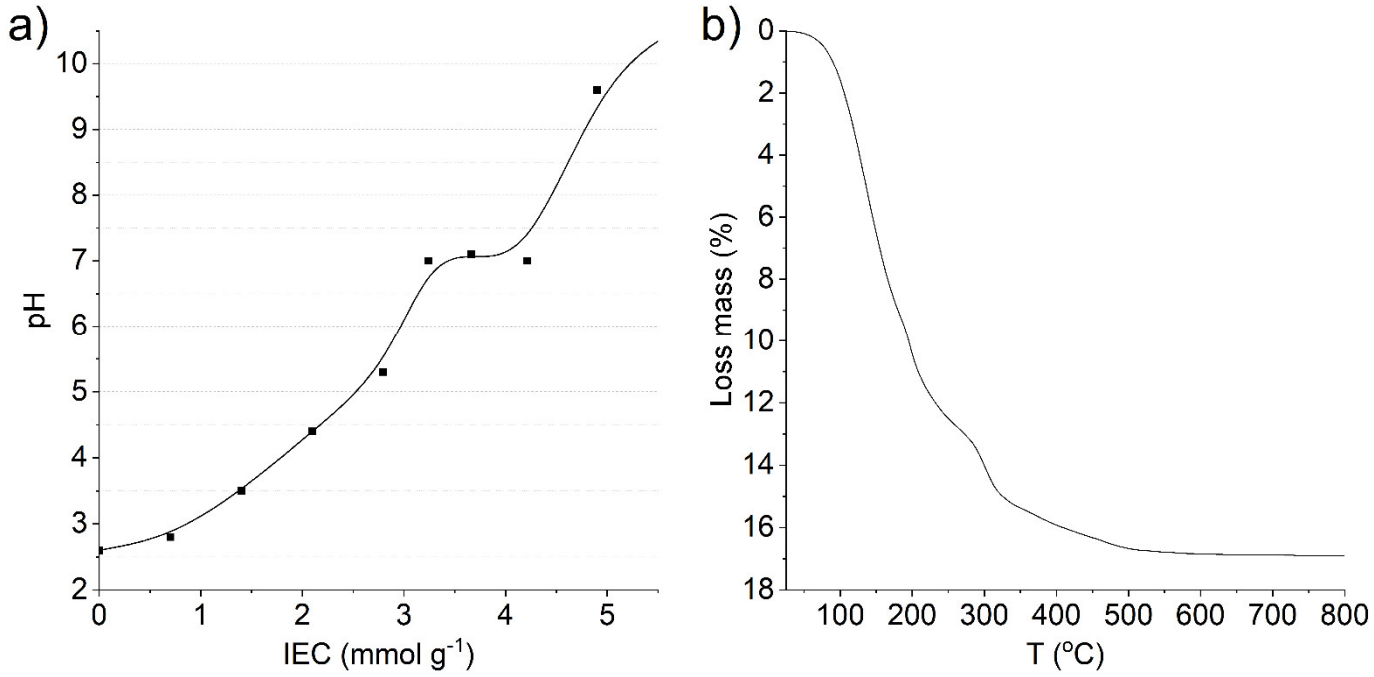


**Figure S2.** (**a**) Dependence of the ion exchange capacity of CeP-HP powder on pH and (**b**) mass loss vs. temperature for CeP-HP

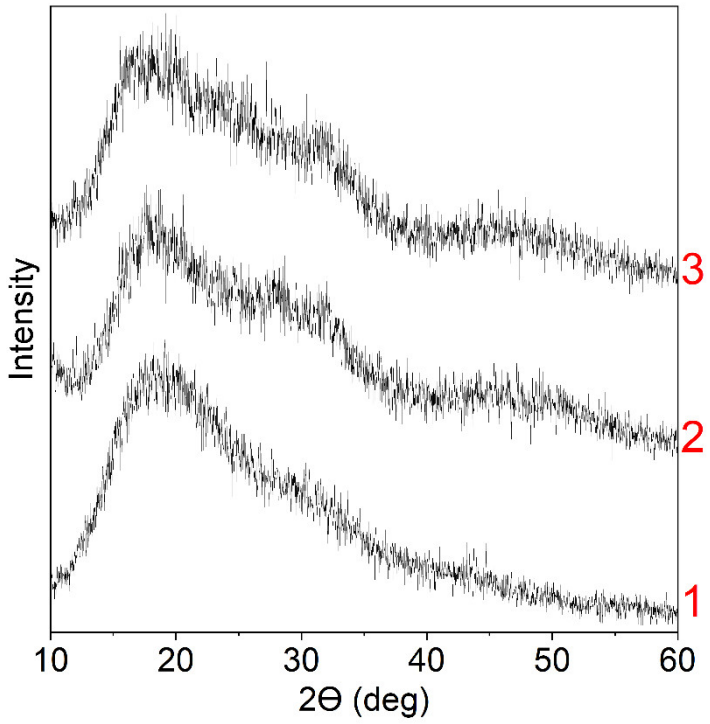


**Figure S3.** XRD pattern of (1) I-0, (2) I-15-NH, and (3) I-15-HP powders

**Table S1.** Absolute values of Cl/SO4-selectivity and fluxes and sources for different types of modi-fication.

| Modification type | C NaCl/ $Na_2SO_4$, M | J(Cl), nmole/($cm^2$*s) | $Cl/SO_4$ selectivity | Ref. |
|---|---|---|---|---|
| Polydopamine (PDA) modified with amino-benzenesulfonic acid surface layer (FujiFilm AEM T1) | 0.05/0.05 | 12<br>20 | 1.0 (pristine)<br>4.66 | [1] |
| | | 12<br>17<br>22 | 0.6 (pristine)<br>1.0<br>1.43 | [2] |
| PDA with N-O-sulfonic acid benzyl chitosan surface layer (FujiFilm AEM) | 0.02/0.02 | 15<br>21 | 0.8 (pristine)<br>1.3 | [3] |
| Surface covalently bound polyethyleneimine (tailor-made, BPPO-based ionomer membrane) | 0.05/0.05 | 15<br>36 | 0.79 (pristine)<br>4.27 | [4] |
| LbL based on chitosan polyelectrolyte surface layer (FujiFilm AEM T1) | 0.05/0.05 | 30<br>99 | 0.81 (pristine)<br>47 | [5] |
| LbL based on chitosan polycations and PS sulfonate (FujiFilm AEM T1) | 0.05/0.05 | 8.6<br>36.2 | 0.39 (pristine)<br>4.36 | [6] |
| Cation exchange surface layer (MK-40, PS-based ionomer) | 0.02/0.01 | 1.5<br>39<br>0.42<br>0.29<br>0.10 | 0.3 (pristine)<br>1.0 (pristine)<br>1.25<br>2<br>3.3 | [7] |
| Amphoteric blend anion-exchange membranes (tailor-made) | 0.05/0.05 | 31<br>22<br>26<br>20 | 8.6 (pristine 20 min)<br>6.5 (pristine 120 min)<br>9.2 (20 min)<br>22 (120 min) | [8] |
| Di-quaternized graphene oxide cross-linking (tailor-made, PSU-based ionomer) | 0.05/0.05 | 44<br>39<br>64<br>81<br>83 | 2.01 (com)<br>1.7 (pristine)<br>3.3<br>4.6<br>5.7 | [9] |
| LbL based on polyallylamine and PS sulfonate surface layer (Neosepta AMX) | 0.01/0.01 | 5.8<br>6.7<br>9.4 | 0.77 (pristine)<br>0.95<br>1.7 | [10] |
| LbL based on polyallylamine and PS sulfonate surface layer (FujiFilm AEM T1) | 0.01/0.01 | 7.4<br>6.7 | 1.3 (FujiFilm T1)<br>7.4 | [11] |
| Surface sulfonated graft AEM (tailor-made, PS-based ionomer) | 0.02/0.02<br><br>0.05/0.05<br>0.1/0.1<br>0.05/0.05<br>0.1/0.1 | 16.2<br>30.6<br>11.6<br>24.7<br>96.5<br>50.4<br>134.7 | 0.741 (pristine)<br>3.21<br>5.26<br>0.92 (pristine)<br>1.4 (pristine)<br>3.6<br>2.7 | [12] |
| BPPO with different tertiary amines and layer-by-layer modified | 0.01/0.01 | 21<br>22 | 0.81<br>1.4 | [14] |

| | | | | |
|---|---|---|---|---|
| | | 29 | 1.8 | |
| | | 37 | 2.9 | |
| | | 35 | 5.0 | |
| | | 35 | 12 | |
| | | 30 | 3.8 | |
| | | 37 | 6.1 | |
| | | 38 | 5.0 | |
| CeP incorporation in Ralex AM and Neosepta AMX | 0.02/0.02 | 18 | 0.58(pristine Ralex) | this work |
| | | 20 | 0.67 | |
| | | 19 | 0.66 (pristine Neosepta) | |
| | | 21 | 0.72 | |
| | 0.5/0.5 | 137 | 4.0 (pristine Ralex) | |
| | | 137 | 4.9 | |
| | | 161 | 7.5 (pristine Neosepta) | |
| | | 163 | 7.7 | |


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