Supporting information

Ultrathin in situ silicification layer developed by electrostatic attraction forced strategy for ultrahigh-performance oil-water emulsions separation

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**Fig. S1.** The surface zeta potential of nascent PK substrate, APTES-d-PK membrane, and SiO$_2$-d-PK membrane at the PH values of 2-9.
Fig. S2. The mechanism of electrostatic attraction forced in-situ surface silicification for the preparation of SiO$_2$-d-PK membrane: (a) the hydrolysis and condensation process of APTES monomer; (b) the hydrolysis and condensation process of TEOS monomer; (c) the condensation process between the surface silicification layer with APTES layer.
Fig. S3. TEM cross-sectional images of (a) PK and (b) SiO$_2$-d-PK membranes.
Fig. S4. Morphologies and pore size of the SiO$_2$-PK membrane without APTES pretreatment: (a) surface morphology; (b) enlarged surface morphology; (c) cross-section morphology; and (d) pore size distribution.
Fig. S5. The surface morphologies of SiO$_2$-d-PK membranes over the prolonged silicification process: (a) 1h; (b) 3h; (c) 6h; (d) 9h.
Fig. S6. The surface morphologies of SiO$_2$-d-PK membranes with different TEOS concentrations under the same surface silicification period of 6 h: (a) 3 ml, (b) 5ml, and (c) 7 ml in 100 ml ethanol solutions.
Fig. S7. FTIR characterization results of the PK and APTES-d-PK membranes with different deposition time.
Fig. S8. XPS characterization results of PK, APTES-d-PK, and SiO$_2$-d-PK membranes.
Fig. S9. MD simulation results of (a) models between water molecules and PK, APTES, and SiO$_2$ within 3.5 Å, where the molecular chains are colored as follows: PK: blue; APTES: yellow; SiO$_2$: green; water: red; (b) RDF analysis between the oxygen atom of water and the oxygen atoms of PK, APTES, and SiO$_2$. 
Fig. S10. Underwater dynamic oil-adhesion tests on the SiO$_2$-d-PK membranes surface prepared under different silicification periods, and the chloroform was used as the probe oil in this test.
Fig. S11. Antifouling property of SiO$_2$-d-PVDF membrane for soybean oil-in-water emulsion.
Table S1. The surface porosities of the as-prepared membranes

<table>
<thead>
<tr>
<th>membranes</th>
<th>PK</th>
<th>APTES-d-PK</th>
<th>SiO$_2$-d-PK</th>
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<tbody>
<tr>
<td>Surface porosity (%)</td>
<td>44.3 ±4.8</td>
<td>43.4 ±0.8</td>
<td>41.0 ±4.2</td>
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