Supporting Information

On-demand Oil-Water Separation by Environmentally-responsive Cotton Fabrics

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Figure S1. $^{1}$H NMR spectra of epoxide-terminated PDMS in CDCl$_3$.

Figure S2. $^{1}$H NMR spectra of azide-functionalized PDMS [PDMS-(OH, N$_3$)] (1) in CDCl$_3$. 
Figure S3. $^1$H NMR spectra of propargyl 2-bromoisobutyrate (PBiB) in CDCl$_3$.

Figure S4. $^1$H NMR spectra of $\alpha$-alkynyl-$\omega$-bromo-poly(N,N-dimethylaminoethyl methacrylate) (alkynyl-PDMAEMA$_{42}$-Br) in CDCl$_3$. 
**Figure S5.** $^1$H NMR spectra of poly(dimethylsiloxane)-(OH)-$b$-poly($N,N$-dimethylaminoethyl methacrylate) (PDMS$_{64}$-(OH)-$b$-PDMAMEA$_{42}$) in CDCl$_3$.

**Figure S6.** $^1$H NMR spectra of $\mu$-PDMS$_{64}$-$b$-PDMAEMA$_{42}$-$b$-PIPSMA$_{22}$ (P1) in CDCl$_3$.
Figure S7. $^1$H NMR spectra of $\alpha$-alkynyl-$\omega$-bromo-poly($N,N$-dimethylaminoethyl methacrylate) (alkynyl-PDMAEMA$_{121}$-Br) in CDCl$_3$.

Figure S8. $^1$H NMR spectra of poly(dimethylsiloxane)-(OH)-$b$-poly($N,N$-dimethylaminoethyl methacrylate) (PDMS$_{64}$-(OH)-$b$-PDMAMEA$_{121}$) (3) in CDCl$_3$. 
Figure S9. $^1$H NMR spectra of $\alpha$-alkynyl-$\omega$-bromo-poly($N,N$-dimethylaminoethyl methacrylate) (alkynyl-PDMAEMA$_{148}$-Br) in CDCl$_3$.

Figure S10. $^1$H NMR spectra of poly(dimethylsiloxane)-(OH)-$b$-poly($N,N$-dimethylaminoethyl methacrylate) (PDMS$_{64}$-(OH)-$b$-PDMAMEA$_{148}$) in CDCl$_3$. 
Figure S11. $^1$H NMR spectra of $\mu$-PDMS$_{64}$-$b$-PDMAEMA$_{148}$-$b$-PIPSMA$_{25}$ (P3) in CDCl$_3$.

Figure S12. GPC curves of $\mu$-PDMS-$b$-PDMAEMA-$b$-PIPSMA ABC miktoarm star terpolymers.
Table S1. Characteristics of synthesized polymers.

<table>
<thead>
<tr>
<th>Sample</th>
<th>$M_n$ $^a$ (Kg mol$^{-1}$)</th>
<th>$M_w/M_n$ $^b$</th>
<th>$f_{PDMS}^c$</th>
<th>$f_{PDMAEMA}^c$</th>
<th>$f_{PIPSMA}^c$</th>
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<tbody>
<tr>
<td>PDMS$_{64}$-OH</td>
<td>5.0</td>
<td>1.13</td>
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<td>--</td>
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<tr>
<td>$\alpha$-alkynyl-PDMAEMA$_{42}$-N(Et)$_2$</td>
<td>6.8</td>
<td>1.14</td>
<td>-</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>$\mu$-PDMS$<em>{64}$-b-PDMAEMA$</em>{42}$-b-PIPSMA$_{22}$ (P1)</td>
<td>19.2</td>
<td>1.30</td>
<td>26.4</td>
<td>34.9</td>
<td>38.7</td>
</tr>
<tr>
<td>$\alpha$-alkynyl-PDMAEMA$_{121}$-N(Et)$_2$</td>
<td>19.2</td>
<td>1.13</td>
<td>-</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>$\mu$-PDMS$<em>{64}$-b-PDMAEMA$</em>{121}$-b-PIPSMA$_{24}$ (P2)</td>
<td>32.3</td>
<td>1.29</td>
<td>15.6</td>
<td>59.5</td>
<td>24.9</td>
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<tr>
<td>$\alpha$-alkynyl-PDMAEMA$_{148}$-N(Et)$_2$</td>
<td>23.4</td>
<td>1.14</td>
<td>-</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>$\mu$-PDMS$<em>{64}$-b-PDMAEMA$</em>{148}$-b-PIPSMA$_{25}$ (P3)</td>
<td>36.8</td>
<td>1.26</td>
<td>13.7</td>
<td>63.6</td>
<td>22.7</td>
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</table>

$^a$ Determined by $^1$H NMR in CDCl$_3$. $^b$ Determined by GPC with calibrated PS standards at 35 °C. $^c$ The weight fractions (wt%) were determined by $^1$H NMR.
**Figure S13.** SEM image of the fabric used. The scale bar is 200 μm.

**Figure S14.** TGA traces of pristine cotton fabrics and functionalized cotton fabrics with P1, P2 and P3.
Table S2. Mass fraction of grafted block copolymer in the functionalized cotton fabrics.

<table>
<thead>
<tr>
<th></th>
<th>( w_0 / \text{g} )</th>
<th>( w_1 / \text{g} )</th>
<th>( x / % )</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1@CF</td>
<td>0.1908</td>
<td>0.2124</td>
<td>11.3</td>
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<tr>
<td>P2@CF</td>
<td>0.1855</td>
<td>0.2035</td>
<td>9.7</td>
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<tr>
<td>P3@CF</td>
<td>0.1864</td>
<td>0.1994</td>
<td>7.0</td>
</tr>
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</table>

\( w_0 \): weights of the pristine cotton fabrics before dip-coating; \( w_1 \): weights of the functionalized cotton fabrics. Mass fraction of grafted block copolymer \( x \) is determined by the following equation: 
\[
x = \frac{(w_1 - w_0)}{w_0} \times 100\%
\]

Figure S15. XPS spectra of pristine cotton fabrics and functionalized cotton fabrics with P1, P2, and P3.
Figure S16. Underoil water contact angle of P1@CF and P2@CF, the oil is dichloroethane (DCE). And underwater oil contact angle of P1@CF and P2@CF. The oil is hexane.

Figure S17. Oil/water separation efficiency versus recycle numbers. The oil is dichloroethane and the membrane used is P1@CF. The separation efficiency was determined by comparing the weight of dichloroethane before and after separation.
Figure S18. Oil/water separation efficiency versus recycle numbers. The oil is hexane and the membrane used is P1@CF. The separation efficiency was determined by comparing the weight of water before and after separation.
Figure S19. Relationship between breakthrough pressure ($P_{bt}$) and contact angle $\theta'$ given by the equation: 

\[ P_{bt} = \frac{2Ry_{12}}{D^2} \frac{1 - \cos(\theta')} {1 + 2(R/D)\sin(\theta')} \]

Here $R$ is the cylinder radius, $D$ is the half of the inter-cylinder spacing, $y_{12}$ is the interfacial tension between the wetting phase and non-wetting phase, and $\theta'$ is the contact angle of the non-wetting liquid droplet on the fabric surface in the wetting phase. For the fabrics used, $R$ and $D$ are 100 and 30 microns, respectively. $y_{\text{water-hexane}}$ is 51.1 mN/m, $y_{\text{dichloroethane-water}} = 30.5$ mN/m.