

# Supplementary Materials: Functionalized Cellulose Networks for Efficient Oil Removal from Oil-Water Emulsions

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**Table S1.** Filter paper different treatment conditions.

Samples	Paraffin wax (% <i>, w/v</i> )	PDMS- <i>b</i> -PEO (% <i>, w/v</i> )
Untreated	--	--
5% PFW	5%	--
10% PFW	10%	--
0.5% PDMS- <i>b</i> -PEO	--	0.5%
1.0% PDMS- <i>b</i> -PEO	--	1.0%
1.5% PDMS- <i>b</i> -PEO	--	1.5%
2.0% PDMS- <i>b</i> -PEO	--	2.0%
5% PFW/0.5% PDMS- <i>b</i> -PEO	5%	0.5%
5% PFW/1.0% PDMS- <i>b</i> -PEO	5%	1.0%
5% PFW/1.5% PDMS- <i>b</i> -PEO	5%	1.5%
5% PFW/2.0% PDMS- <i>b</i> -PEO	5%	2.0%
10% PFW/0.5% PDMS- <i>b</i> -PEO	10%	0.5%
10% PFW/1.0% PDMS- <i>b</i> -PEO	10%	1.0%
10% PFW/1.5% PDMS- <i>b</i> -PEO	10%	1.5%
10% PFW/2.0% PDMS- <i>b</i> -PEO	10%	2.0%

**Table S2.** Water contact angle, water / oil recovery percentages, filtration time, and young's modulus of different treated and untreated filter papers.

Sample	Water CA (°)	Water recovery (%)	Oil recovery (%)	Filtration time (s)	Young's Modulus (MPa)
Untreated	0.0	85.6	85.0	147	521.3 ± 50.1
5% PFW	125.8 ± 4.0	93.75	91.5	570	1389.2 ± 54.2
10% PFW	125.8 ± 2.8	97.5	92.0	546	1181.3 ± 55.9
0.5% PDMS- <i>b</i> -PEO	0.0	87.5	99.0	70	524.6 ± 90.2
1.0% PDMS- <i>b</i> -PEO	0.0	87.5	98.0	124	552.4 ± 129.5
1.5% PDMS- <i>b</i> -PEO	0.0	86.3	98.0	89	523.7 ± 125.2
2.0% PDMS- <i>b</i> -PEO	0.0	85.0	97.5	59	661.9 ± 148.8
5% PFW/0.5% PDMS- <i>b</i> -PEO	49.3 ± 10.7	98.1	95.0	201	1037.5 ± 92.6
5% PFW/1.0% PDMS- <i>b</i> -PEO	9.3 ± 9.1	98.8	95.5	135	1238.6 ± 62.9
5% PFW/1.5% PDMS- <i>b</i> -PEO	0.0	91.3	97.0	67	937.8 ± 63.1
5% PFW/2.0% PDMS- <i>b</i> -PEO	0.0	87.5	98.0	75	843.3 ± 101.5
10% PFW/0.5% PDMS- <i>b</i> -PEO	60.1 ± 13.2	95.0	95.0	153	1221.8 ± 132.1
10% PFW/1.0% PDMS- <i>b</i> -PEO	0.0	93.8	99.0	55	1271.0 ± 37.0
10% PFW/1.5% PDMS- <i>b</i> -PEO	0.0	93.1	99.0	52	1030.8 ± 145.8
10% PFW/2.0% PDMS- <i>b</i> -PEO	0.0	88.8	99.0	51	864.1 ± 77.1

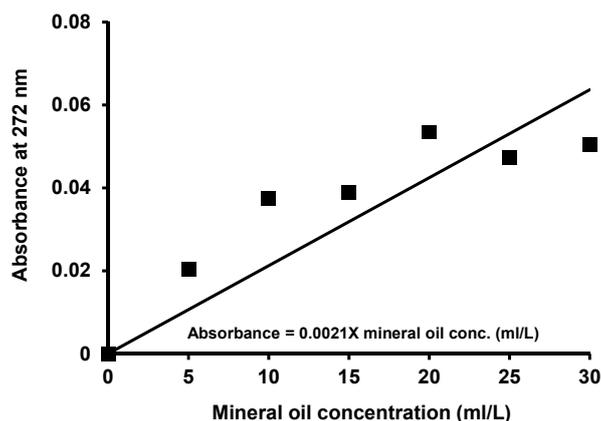


Figure S1. Calibration curve of mineral oil.

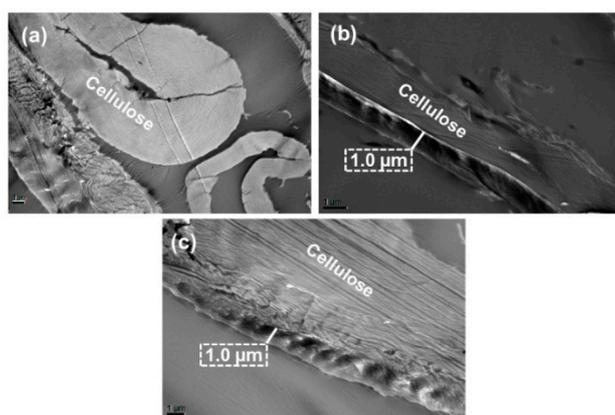


Figure S2. Cross-sectional TEM images of the (a) untreated, (b) PFW, and (c) PFW/PDMS-*b*-PEO treated FP. TEM images were collected with a JEOL JEM 1011 electron microscope, operating at an acceleration voltage of 100 kV, with a 11 Mp fiber optical charge-coupled device (CCD) camera (Gatan Orius SC-1000).

Table S3. Porosity of the untreated, PFW, PDMS-*b*-PEO, and PFW/PDMS-*b*-PEO treated FP.

Sample	Porosity
Untreated FP	52.9% ± 0.1%
10% PFW treated FP	42.8% ± 0.9%
1.0% PDMS- <i>b</i> -PEO treated FP	53.5% ± 0.2%
10% PFW/1.0%PDMS- <i>b</i> -PEO treated FP	40.8% ± 0.1%

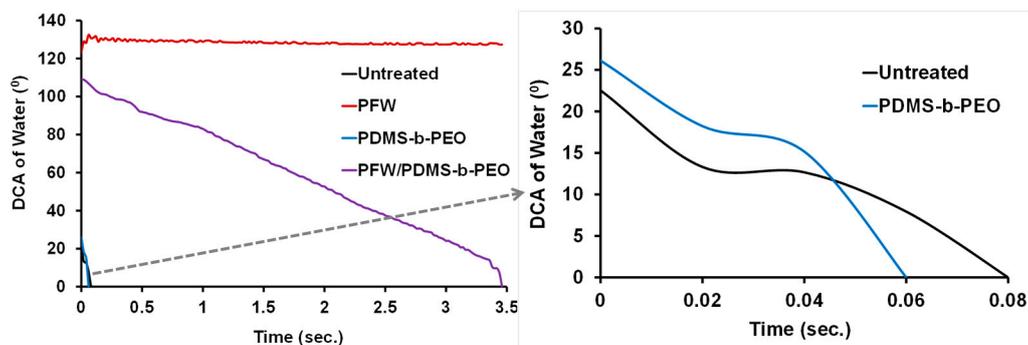
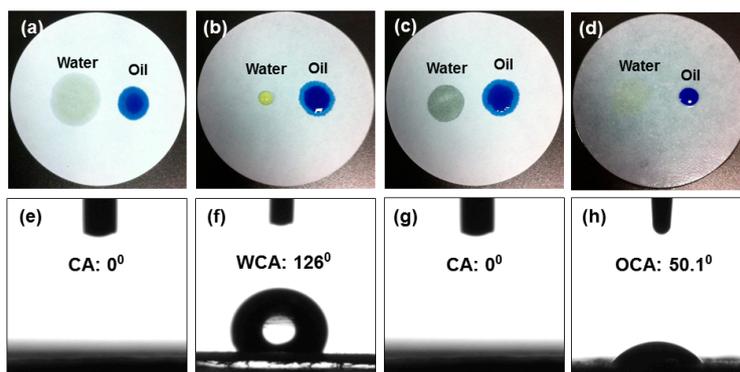
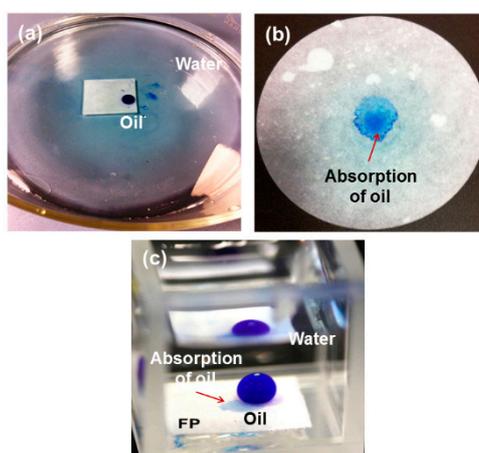


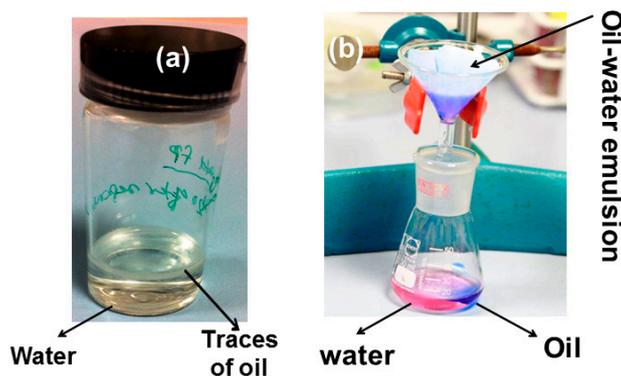
Figure S3. Dynamic water contact angle (DCA) of untreated, PFW, PDMS-*b*-PEO, and PFW/PDMS-*b*-PEO treated FP.



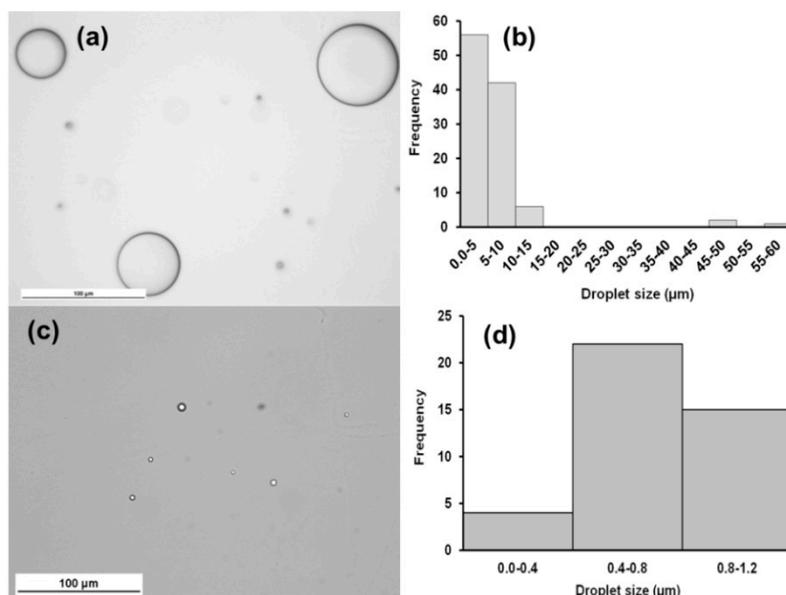
**Figure S4.** Wettability and contact angle (CA) of (a,e) untreated, (b,f) PFW treated FP, (c,g) PFW/PDMS-*b*-PEO treated FP in dry-solid state, and (d,h) water adsorbed PFW/PDMS-*b*-PEO treated FP. Here WCA means: water contact angle, OCA means: oil contact angle.



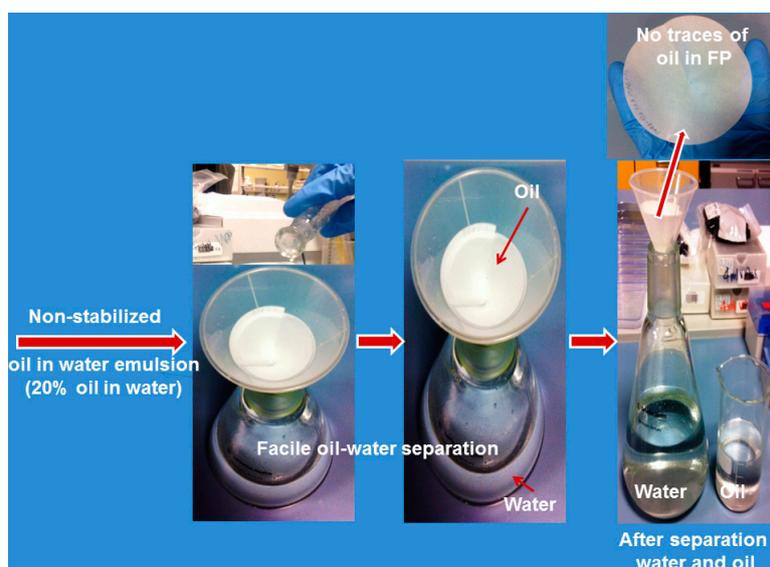
**Figure S5.** Underwater oleophobic properties of untreated and PFW treated FP. (a) Oil (DCM) droplet on untreated FP, (b) oil (DCM) droplet on wetted untreated FP, indicating the absorption of oil in wetted FP and (c) PFW treated FP, indicating the absorption of oil in underwater FP.



**Figure S6.** Photographs of the filtered water after the emulsion separation using (a) untreated and (b) PFW treated FP, indicating the traces of oil floating on water. In Figure (b), the water was colored with food grade red colorant and the oil with Sudan blue, for better visualization.



**Figure S7.** Microscopic analysis of the oil droplets size. (a) Microscopic image of non-stable emulsion droplets (20% oil in water), (b) size ( $\mu\text{m}$ ) of the oil droplets of the non-stabilized emulsions before filtration, (c) microscopic image of the residual oil droplets in filtered water, and (d) size ( $\mu\text{m}$ ) distribution of the oil droplets in filtered water. For the analysis of droplets size, the non-stabilized emulsions of 20% oil in water and the filtered water of PFW/PDMS-*b*-PEO were used at room temperature (21 °C). The droplet size distribution was obtained by placing a small drop of the non-stabilized emulsion and a small drop of filtered water on glass slides. The drop was then flattened by placing a smaller glass slide on top of the droplet. Thereafter, at least ten pictures of the non-stabilized emulsion droplets and filtered water were taken by a Nikon Eclipse 80i microscope equipped with NIS elements F software. The diameter of the droplets was then measured with ImageJ software. In order to get a reliable impression of the droplet sizes at least 100 droplets for non-stabilized emulsions and 40 droplets of filtered water were counted in the distribution population.



**Figure S8.** Separation of large volume (1000 mL) of non-stabilized emulsions through PFW/PDMS-*b*-PEO treated FP.

