Synthesis of superamphiphobic breathable membranes utilizing SiO_2 nanoparticles decorated fluorinated polyurethane nanofibers

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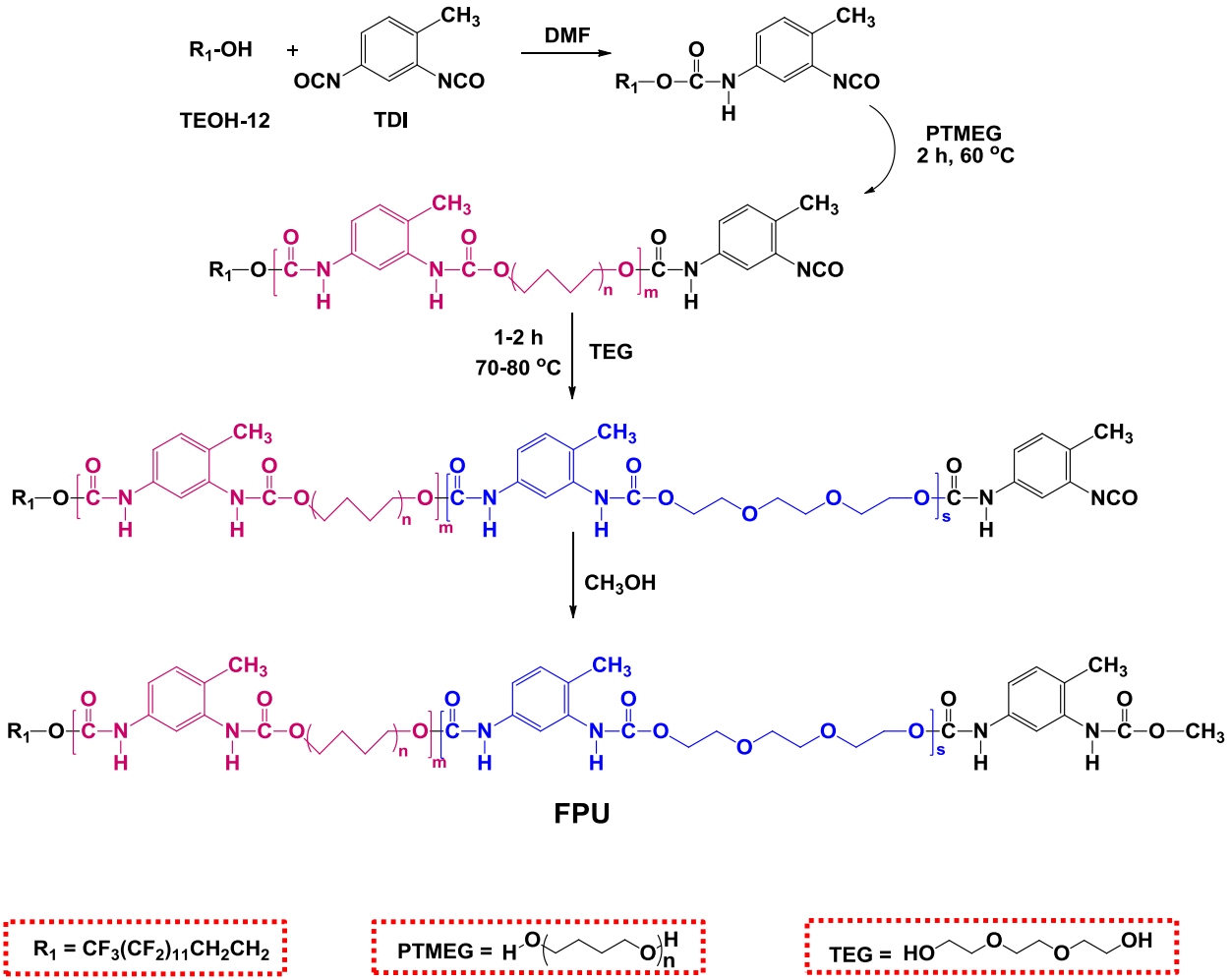
Supporting Information



Scheme 1. Chemical synthetic and polymerization route of FPU.

Table S1. Compositions and properties of different electrospinning solutions.

Sample	Concentration of FPU	Concentration of SiO_2 NPs	Viscosity	Conductivity
	wt%	wt%	(cps)	($\mu S \cdot m^{-1}$)
FPU-14	14	-	25	1.57
FPU-18	18	-	38	1.46
FPU-22	22	-	110	1.27
FPU-30	30	-	435	0.47
FPU-18/SNP-0.1	18	0.1	40	1
FPU-18/SNP-0.5	18	0.5	47	0.75
FPU-18/SNP-1	18	1	54	0.67
FPU-18/SNP-2	18	2	112	0.58

^{1}H and ^{19}F nuclear magnetic resonance (NMR) spectroscopic analysis

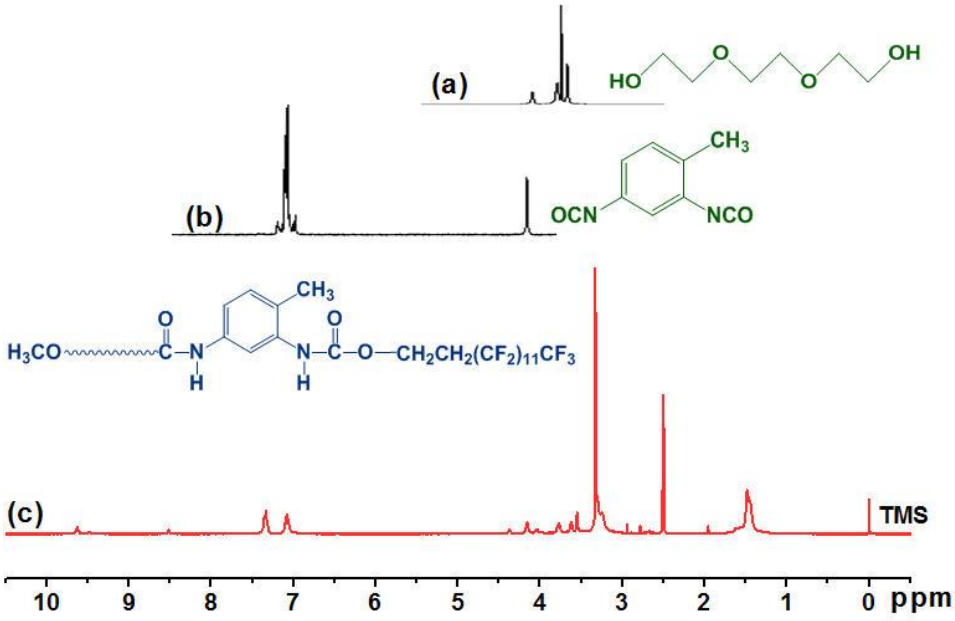


Fig. S1 ^{1}H NMR spectrograph of (a) TEG, (b) TDI and (c) FPU.

The as-synthesized FPU after purification and crystallization was subjected to nuclear magnetic resonance (NMR) spectroscopic analysis. Fig. S1 illustrates the ^{1}H NMR spectrum of FPU. For pure TEG, the chemical shifts for $-CH_2-$ and $-OH$ appeared between 3.60 to 3.72 ppm and around 4.01 ppm, respectively. In case of pure TDI the signals for aromatic protons appeared between 6.90 to 7.16 ppm and for $-CH_3-$ appeared at 3. 89 ppm (Fig. S1a and b).[1, 2] For FPU, the chemical shift for $-CF_2-CH_2-$ appeared at 2.50 ppm. Comparing to ^{1}H NMR of TEG and TDI, the protons of $O-CH_2-CH_2-O$ have given their signal at 3.329 ppm, and protons of benzene ring of TDI have given their chemical shift between 7.08 to 7.34 ppm.

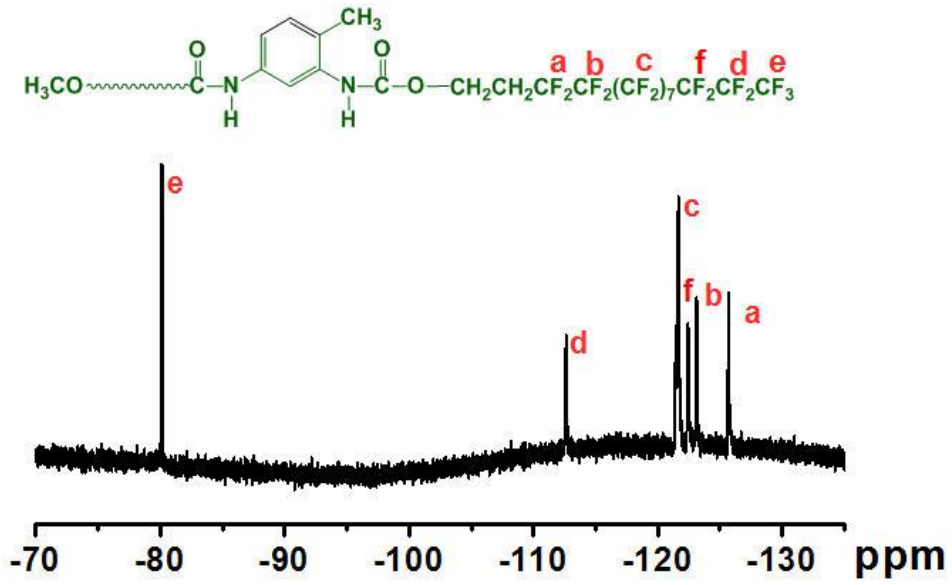


Fig. S2 ^{19}F NMR spectrograph of FPU.

^{19}F NMR has given further structural affirmation of FPU (Fig. S2). The chemical shift for terminal -CF_3 appeared at 80.13 ppm, while for -CF_2-CH_2- appeared at 125.67 ppm. The remaining -CF_2- has given their chemical shift between 112.61 to 123.10 ppm. Acquisition of quantitative results from NMR analysis has confirmed the chemical structure of FPU.

Functional group affirmation of FPU and FPU/SNP membranes

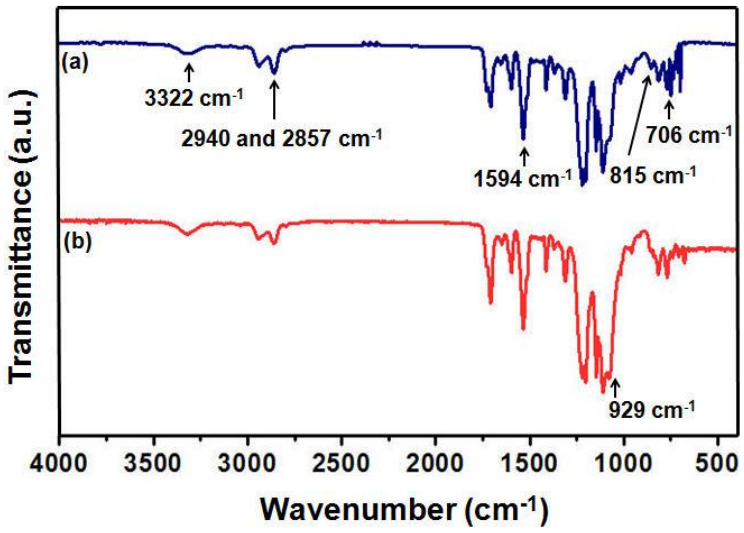


Fig. S3 FT-IR spectra of (a) FPU-18 and (b) FPU-18/SNP-1 nanofibrous membranes.

Fig. S3 shows the comparative FT-IR spectra of FPU and FPU/SNP nanofibrous membranes. The typical absorption features for carbamate group were found at 3322 cm^{-1} (-N-H), 1708 cm^{-1} (C=O), and 1112 cm^{-1} (C-O-C), respectively (Fig. S3a). The $-CH_2-$ specific for PTMEG has given their absorption band around 2857 and 2940 cm^{-1}. The stretching vibrations for aromatic ring of TDI and terminal CF_3 and deformation vibration for $-CF_2-$ appeared at 1594, 815, and 706 cm^{-1}, respectively.[2] The increased in the intensity of absorption bands at 1100 and 929 cm^{-1} specific for Si-O-Si and for Si-OH have confirmed the incorporation of SiO_2 NPs within the FPU nanofibrous membranes (Fig. S3b) .[3, 4]

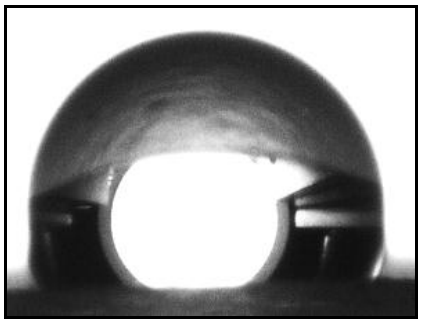


Fig. S4 Optical profile of water droplet measured on a flat FPU-18 film casted on glass substrate.

References

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