Electronic Supplementary Material (ESI) for Soft Matter

One-step Vapour-Phase Formation of Patternable, Electrically Conductive Superamphiphobic Coatings on Fibrous Materials

Hongxia Wang, Yuhua Xue, Tong Lin*

Centre for Material and Fibre Innovation, Deakin University, Geelong, VIC 3217, Australia

Electronic Supplementary Information

S1 Experimental Details

Materials and characterisations: Pyrrole (C_4H_5N), 1H, 1H, 2H, 2H-perfluorodecyltriethoxysilane ($C_{16}H_{19}F_{17}O_3Si$) (FAS), $FeCl_3{\cdot}6H_2O$ and ethanol were purchased from Aldrich and used as received. Commercial polyester (plain weave, 168g/m^2), wool (plain weave, 196g/m^2) and cotton (plain weave, 160g/m^2) fabrics were used as substrates.

Electron microscopic images were taken on a scanning electron microscope (Leo 1530, Gemini/Zeiss, Oberkochen). A transmission electron microscope (TEM, JEM-200 CX JEOL, Seike Instruments) was used to observe the coated films. Fourier Transform Infrared (FTIR) spectra were measured on an FTIR spectrophotometer (Bruker Optics, Ettlingen) in ATR mode. Contact angles were measured using a commercial contact angle meter (KSV CAM101 Instruments Ltd) using water droplets of 13 μL in volume. X-ray photoelectron spectra (XPS) were collected on a VG ESCALAB 220-iXL spectrometer with a monochromated Al Kα source (1486.6 eV) using samples of approximately 3 mm^2 in size. The x-ray beam incidence angle was 0° with respect to the surface normal, which corresponds to a sampling depth of ~10 nm. The obtained XPS spectra were analysed by the XPSPEAK41 software (Shanghai, China).

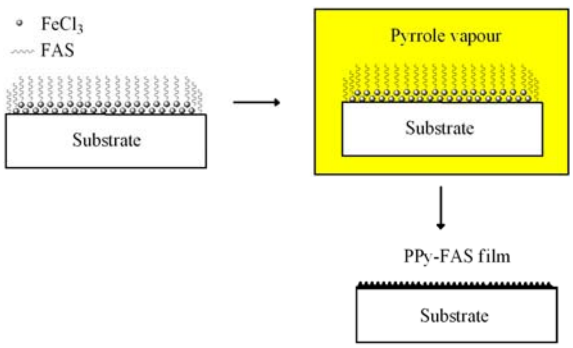

Fig. S1 Illustration of the procedure for PPy-FAS coating.

Coating process: 5% (w/v) $FeCl_3{\cdot}6H_2O$ and 1% (w/v) FAS in ethanol were ultrasonicated for 5 minutes to get a homogeneous solution. The as-prepared solution was then applied onto fabric substrates by a dip-coating method. The coated fabrics were dried at room temperature for 30 minutes. After putting the $FeCl_3$-FAS coated substrate into a small chamber filled with pyrrole-saturated nitrogen for 10 minutes, the fabric was rinsed with ethanol and water to remove the side products.

Formation of PPy-FAS patterns: A fabric sample that was pre-treated with $FeCl_3$/FAS was covered with a screen-frame having a pattern image. An aqueous solution containing Indalca PA3 (5%, w/v) and tetraethylene triamine (3%, w/v) was then applied to the fabric using a standard screen-printing technique. After putting the treated fabric into a chamber filled with pyrrole vapour for 10 minutes, PPy-FAS patterns were formed on the areas where the Indalca PA3/tetraethylene triamine did not cover.

S2 FTIR spectra of PPy-FAS treated and untreated polyester fabrics

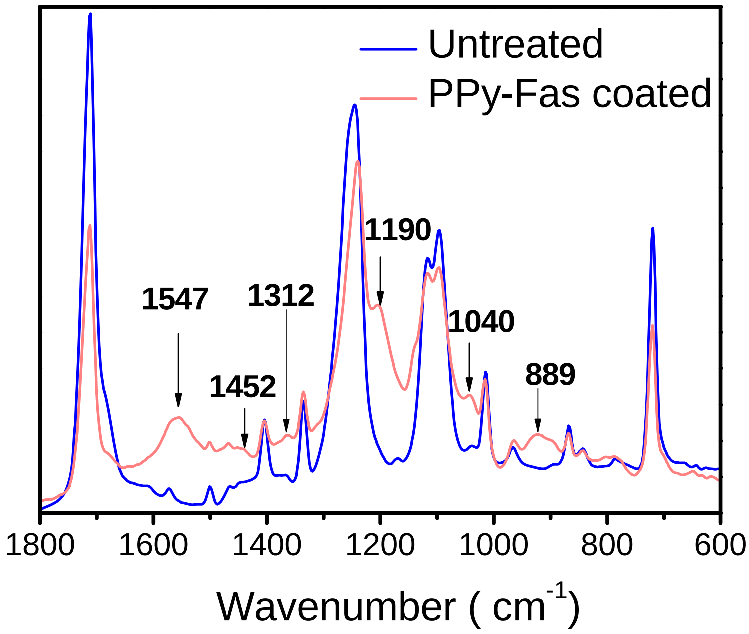

Fig. S1 FTIR spectra of polyester fabric before and after the PPy-FAS treatment.

S3 XPS spectra of the PPy-FAS treated and untreated fabrics

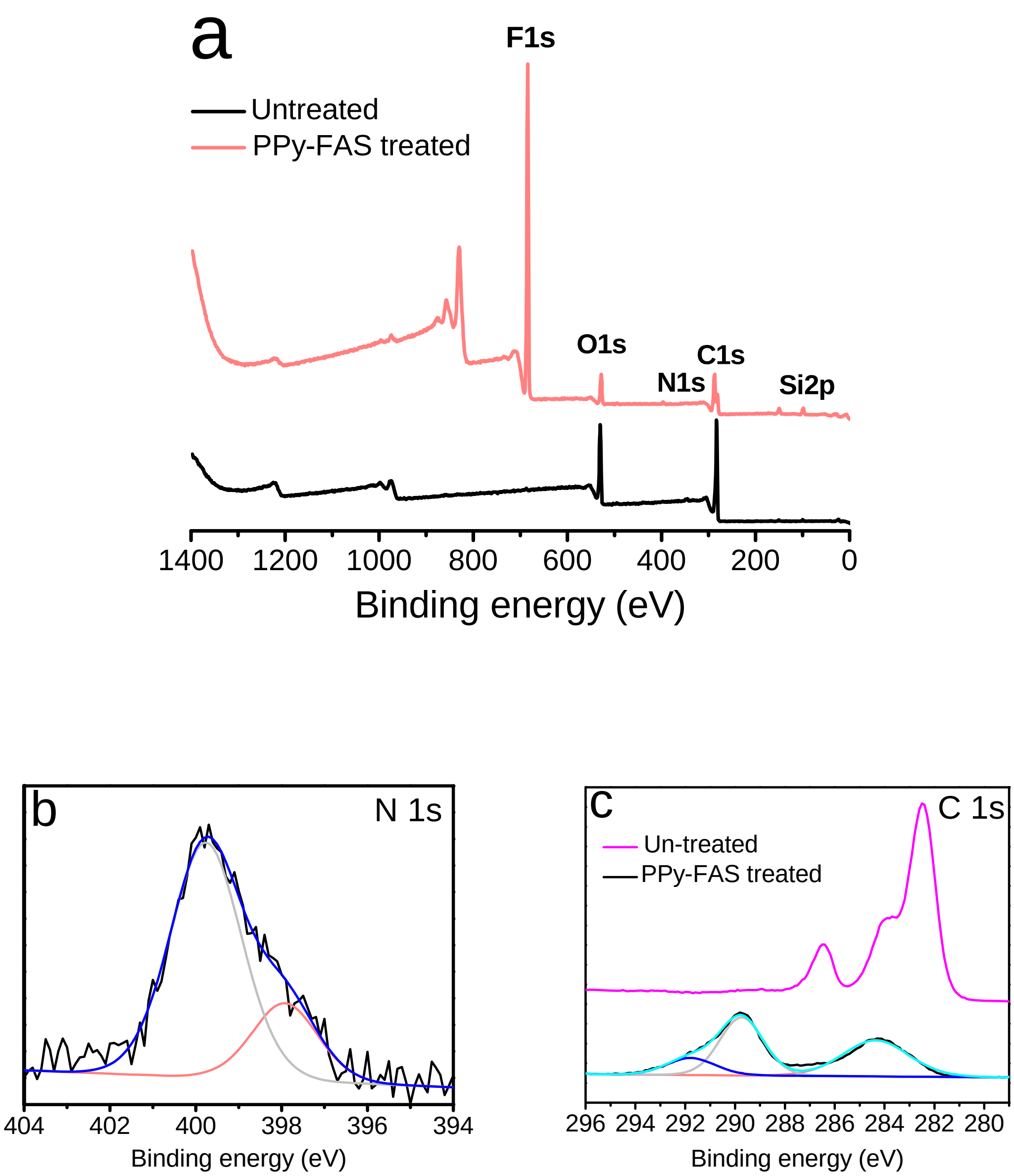

Fig. S3 a) XPS survey spectra, b) N1s high resolution XPS spectrum of the PPy-FAS treated polyester fabric, c) C1s high resolution XPS spectra of the PPy-FAS treated and un-treated polyester fabrics.

S4 Water contact angle of untreated polyester fabric changes with contact time

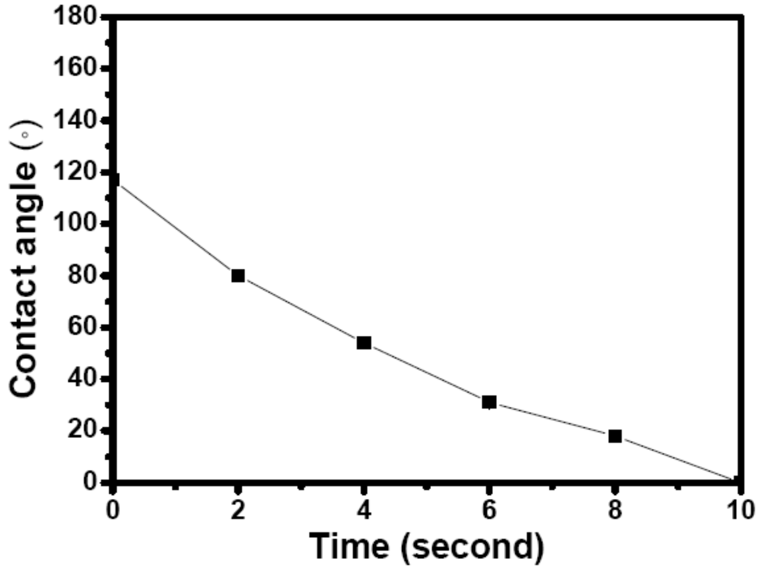

Fig. S4 Change of water contact angle with time. (Substrate: un-treated polyester fabric)

Water drop on the untreated pristine polyester fabric is unstable. It can just stay a few seconds before spreading out. A possible reason is that polyester hydrolyses slightly in the moisture environment, leading to the formation of OH and COOH groups on the fibre surface.

S5 Contact angle data of various liquid droplets on PPy-FAS treated polyester fabric

Liquids	**Surface Tension (mN/m)**	**Contact angle (°)**
n-Pentane	15.5	0
n-Octane	21.6	106 ± 2
Ethanol	22.1	120 ± 3
Methanol	22.7	124 ± 2
Decane	23.8	136 ± 2
Dodecane	25.2	150 ± 2
Hexadecane	27.5	154 ± 3
Toluene	28.4	155 ± 1
N,N´-Dimethylformamide	37.1	158 ± 2
Dimethyl Sulfoxide	43.5	161 ± 2
Water	72.8	165 ± 2

S6 Contact angles and surface resistance of the treated fabrics

	Properties	Polyester	Cotton	Wool
untreated	θ^0_{water} (°)	117±2	38±3	108±3
	α^0_{water} (°)	>60	>60	>60
PPy-FAS coated	θ_{water} (°)	165±2	168±3	161±2
	α_{water} (°)	9±3	12±4	8±3
	$\theta_{hexadance}$ (°)	154±2	142±2	152±1
	$\alpha_{hexadance}$ (°)	15±5	18±4	20±3
	R (KΩ/□)	0.5±0.1	0.7±0.2	0.5±0.2
PPy coated	θ_{water} (°)	138±3	139±2	134±2
	α_{water} (°)	>60	>60	>60
	$\theta_{hexadance}$ (°)	0	0	0
	$\alpha_{hexadance}$ (°)	---	---	---
	R (KΩ/□)	0.5±0.2	0.8±0.1	0.5±0.2