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Photo Initiated Chemical Vapour Deposition To Increase Polymer Hydrophobicity

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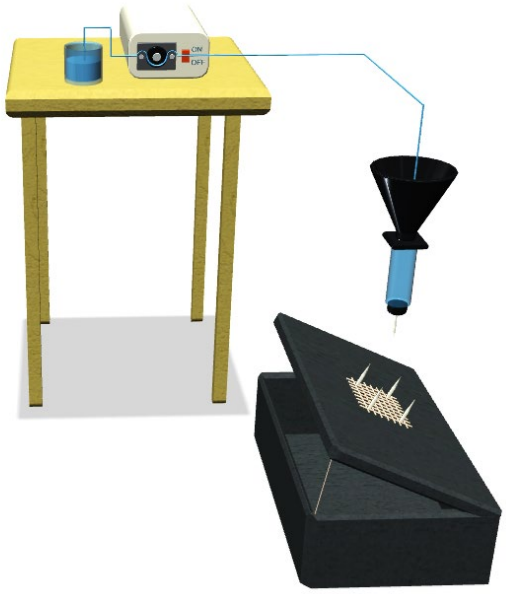
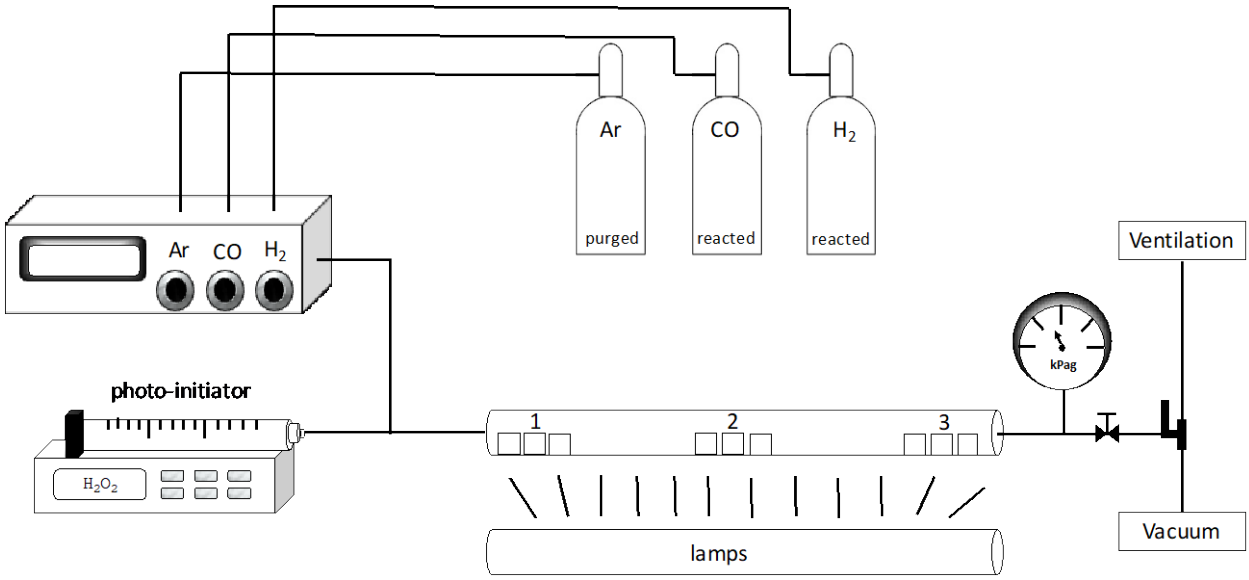
Supplementary information



Supplementary Figure S1: Rain simulator set up (Autodesk 123D®. Autodesk, AutoCAD, DWG, the DWG logo, and Inventor are registered trademarks or trademarks of Autodesk, Inc., and/or its subsidiaries and/or affiliates in the USA and other countries.)

Supplementary Table S1: PICVD parameter ranges

	Range
Pressure	-17 to 17 kPa
Sample position	3 to 87 cm from gas inlet
Ratio H_2/CO	0 to 6.7
Time	0 to 151 minutes
Hydrogen peroxide	0 to 1 ml/h



Supplementary Figure S2: PICVD process diagram

Supplementary Table S2: Contact angle results for HDPE and PET following the three experimental designs.

	No Exp	Time (min) [t]	Pressure (kPa) [Pr]	Ratio H_2/CO [r]	Position (cm) [Po]	H_2O_2 (ml/h) [H_2O_2]	Contact angle HDPE (°) [θ_{HDPE}]	Contact angle PET (°) [θ_{PET}]
Fractional Factorial Design Resolution V	1	120	+ 10	4	70	1	106 ± 3	96 ± 1
	2	30	+ 10	4	20	1	107 ± 3	101 ± 3
	3	120	- 10	4	20	1	33 ± 9	11 ± 1
	4	30	- 10	4	70	1	105 ± 1	51 ± 6
	5	120	+ 10	0.12	20	1	17 ± 8	7 ± 2
	6	30	+ 10	0.12	70	1	113 ± 8	90 ± 7
	7	120	- 10	0.12	70	1	109 ± 2	50 ± 10
	8	30	- 10	0.12	20	1	40 ± 10	50 ± 10
	9	120	+ 10	4	20	0	108 ± 8	13 ± 3
	10	30	+ 10	4	70	0	104 ± 4	85 ± 6
	11	120	- 10	4	70	0	108 ± 2	106 ± 4
	12	30	- 10	4	20	0	106 ± 3	10 ± 2
	13	120	+ 10	0.12	70	0	104 ± 7	112 ± 3
	14	30	+ 10	0.12	20	0	109 ± 9	53 ± 3
	15	120	- 10	0.12	20	0	49 ± 3	30 ± 10
	16	30	- 10	0.12	70	0	106 ± 5	91 ± 3
Central Composite Design	17	151	0	2.06	45	0	117 ± 5	78 ± 2
	18	0	0	2.06	45	0	96 ± 2	84 ± 3
	19	75	17	2.06	45	0	115 ± 2	97 ± 5
	20	75	- 17	2.06	45	0	111 ± 5	78 ± 4
	21	75	0	6.7	45	1	108 ± 2	73 ± 6
	22	75	0	0	45	1	96 ± 4	87 ± 1
	23	75	0	2.06	87	1	115 ±5	14 ± 2
	24	75	0	2.06	3	1	106 ± 2	89 ± 5
Box-Benhken	25	75	0	2.06	20	1	103 ± 5	13 ± 1
	26	75	0	4	70	0.5	111 ± 4	96 ± 6
	27	75	0	0.12	45	0	113 ± 3	96 ± 3
	28	75	+ 10	2.06	70	0.5	114 ± 3	100 ± 9
	29	75	+ 10	2.06	45	0	115 ± 8	100 ± 1
	30	75	- 10	4	45	0.5	111 ± 5	11 ± 2
	31	30	0	2.06	20	0.5	111 ± 3	93 ± 8
	32	30	0	2.06	45	1	110 ± 2	95 ± 4
	33	120	0	0.12	45	0.5	109 ± 1	108 ± 7
	34	120	- 10	2.06	45	0.5	69 ± 5	9 ± 1
Midpoint	35	75	0	2.06	45	0.5	110 ± 6	97 ± 5
	36	75	0	2.06	45	0	112 ± 4	93 ± 7
	37	75	0	2.06	45	1	117 ± 3	98 ± 4
	38	75	0	2.06	45	0.5	118 ± 5	94 ± 4
	39	75	0	2.06	45	0	113 ± 4	95 ± 6
	40	75	0	2.06	45	1	114 ± 3	100 ± 4

Legend: Contact angle uncertainties provide from standard deviation.

Supplementary Table S3: Parameters values for HDPE model

Parameters a_i		
a_0 = 110	a_3 = 9.3	a_6 = 12
a_1 = -7.5	a_4 = -9.6	a_7 = 8.3
a_2 = 13	a_5 = -10	a_8 = -22

Supplementary Table S4: Parameters values for PET model

Parameters b_i		
b_0 = 94	b_4 = 83	b_8 = 35
b_1 = 23	b_5 = 14	b_9 = -91
b_2 = -14	b_6 = 85	b_{10} = -20
b_3 = -45	b_7 = -78	

Supplementary equations: normalization

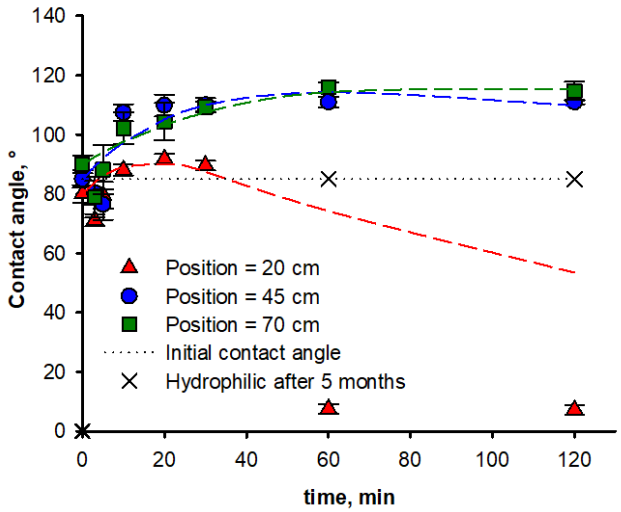
$$t = \frac{time-75}{45} \quad (1)$$

$$Pr = \frac{pressure}{10} \quad (2)$$

$$r = \frac{ratio-2.06}{1.94} \quad (2)$$

$$H_2O_2 = \frac{peroxide-0.5}{0.5} \quad (3)$$

$$Po = \frac{position-45}{25} \quad (4)$$



Supplementary Figure S3: Contact angle as a function of time for three different positions (PET model)

Supplementary Table S5: Quantitative results for AFM

	Untreated HDPE	Treated HDPE	Untreated PET	Treated PET
Surface area (μm^2)	26.3	25.3	25.5	25.9
Projected surface area (μm^2)	25.0	25.0	25.0	25.0
Surface area difference (%)	5.03	1.07	2.17	3.16
R_q (nm)	17.7	17.4	10.8	17.8
R_a (nm)	10.9	13.0	7.10	14.8

Supplementary Video S1: Rain simulator proof of concept