Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Fractal Pattern Mediated Superhydrophobic Glass and Metallic Surfaces using PTFE Particles: A Generalized Simple Approach

(Supporting Information)

Nainsi Saxena, Santanu Paria*

Interfaces and Nanomaterials Laboratory, Department of Chemical Engineering, National Institute of Technology, Rourkela 769008, Orissa, India.

*Corresponding author. E–mail addresses: sparia@nitrkl.ac.in, or. santanuparia@yahoo.com; Fax: +91 661 246 2999

Coating of Different wt % on Glass Surface before Heating (Single coating)

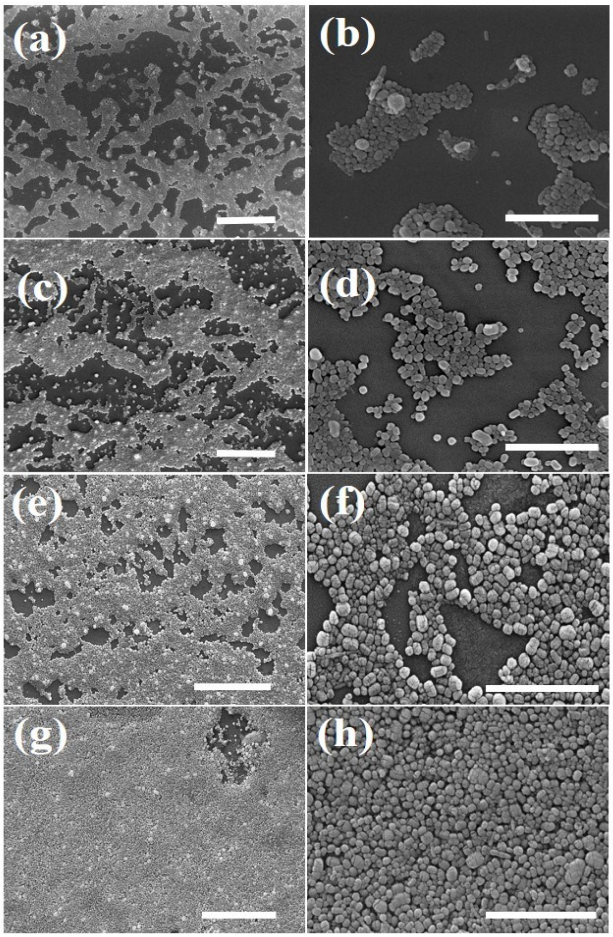


Figure S1: FE-SEM images of the coated glass surface with different wt% of PTFE before heating (a, b) 2 wt%, (c, d) 3wt%, (e, f) 4 wt%, (g, h) 5 wt%. Scale bar (a, c, e, g) = 10 μm and (b, d, f, h) = 3 μm.

Coating of Different wt % on Glass Surface after Heating at 250 °C for 2 hrs (single coating)

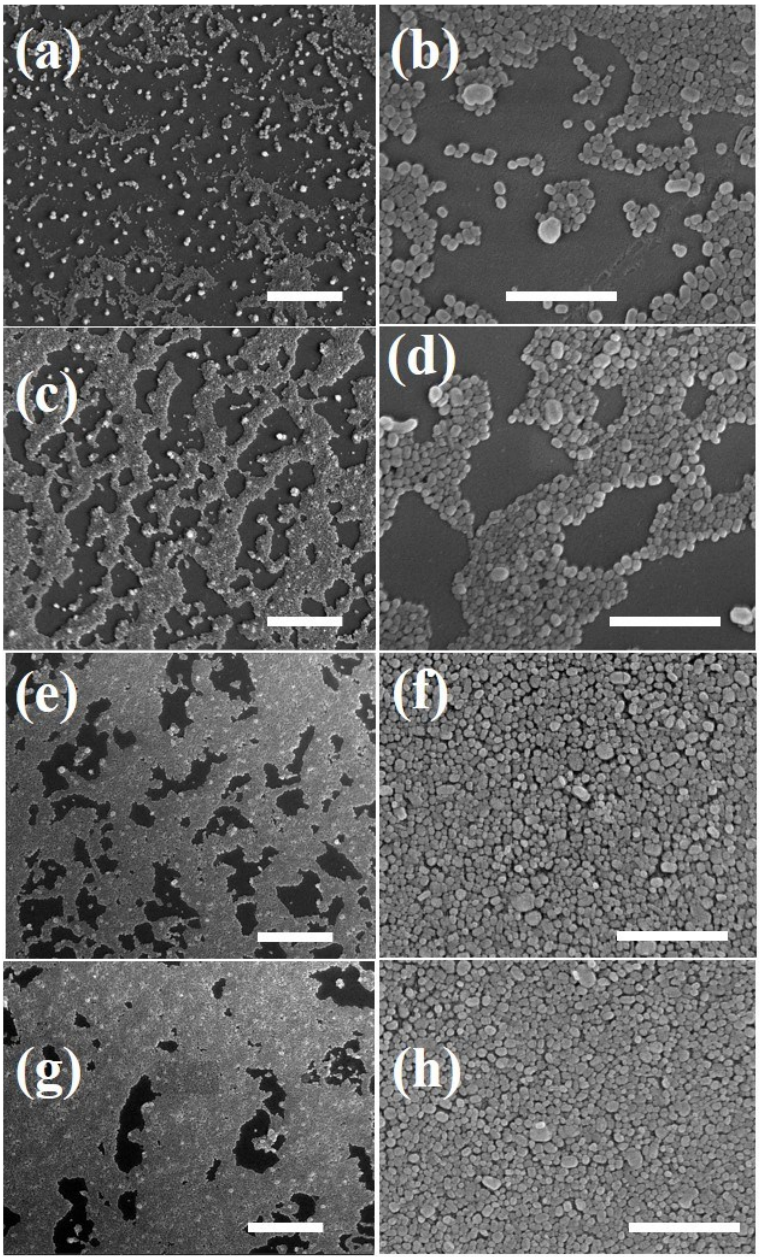


Figure S2: FE-SEM images of the coated glass surface with different wt% of PTFE after heating at 250 ° C for 2 hrs (a, b) 2 wt%, (c, d) 3wt%, (e, f) 4 wt%, (g, h) 5 wt%. Scale bar (a, c, e, g) = 10 µm and (b, d, f, h) = 3 µm.

Droplet Evaporation Study

A 10 µl droplet of same 5 wt% of PTFE dispersion was dropped and kept for drying at 40 ºC inside a dry block heater for 1 hr. It was found when the droplet containing 5 wt% was showing an empty area, and the NPs were unable to give a uniform deposition after drying as shown in figure S3(a). A similar observation was found for 5 wt% after 3 times coating on the same droplet shown in figure S3 (b). Later we have done the multiple coating with successively heating after each coating at 250 °C for 2 hrs and analyzed microscopically. The results figure S3(c, f) shows that when the coatings were increased up to 5 times on the same droplet, the whole droplet area was covered by PTFE NPs with a uniform coating. We have also used 60 wt% PTFE suspension for droplet evaporation and found that at higher concentration the droplet was giving non-uniform coating and showing big lumps after evaporation along with the crack formation figure S3 (h, i).

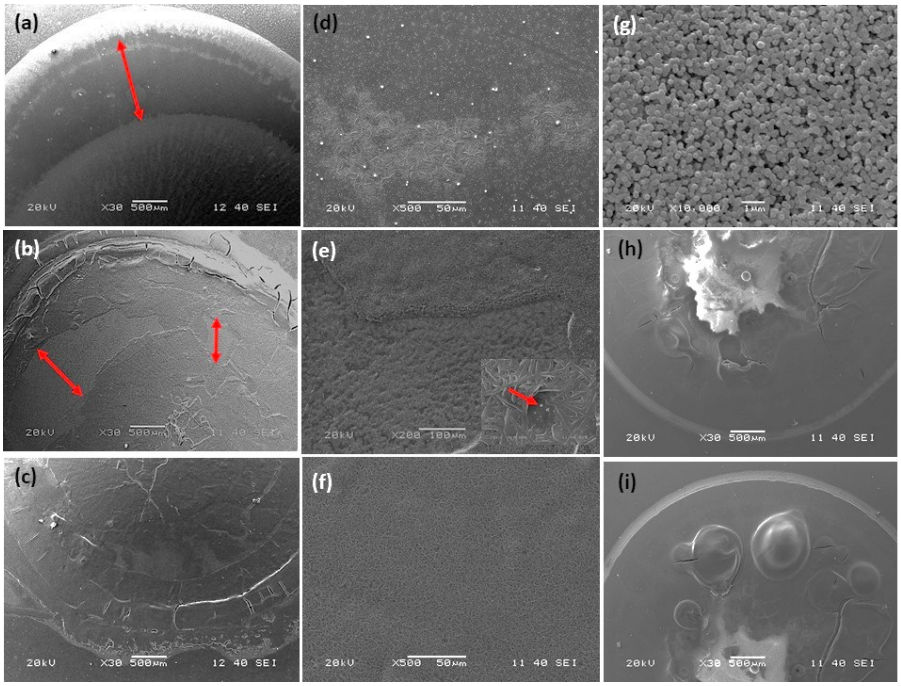


Figure S3: Droplet evaporation study with various wt% of PTFE dispersion (a,d) 5 wt%, after single coating, (b,e) 5 wt%, after triple coating, (c,f) 5 wt%, after 5 coating, (g) magnified view

of PTFE NPs 5 wt% drop after drying. (h,i) droplet evaporation of 60 wt% PTFE suspension showing cracked and lumps formation.

FT-IR spectroscopy

To see the effect of sintering temperature on PTFE coating, FT-IR analysis of PTFE coated surfaces before and after sintering (250 °C) were done and presented in figure S4. The peak at 1656 cm^{-1} for PTFE coating before curing is due to the presence of moisture signifies H–O–H scissors-bending[1], and that at 3400 cm^{-1} is for H-O-H stretching. These peaks were observed when the coating was dried at 25 °C, however absent at 80 °C because of removal of water molecules. The characteristic peaks at 1210 and 1148 cm^{-1} are correspond to $–CF_2–$ asymmetric and symmetric stretching, which are consistent for all samples.[2–4] From the spectra, it is clear the PTFE layer remains intact after sintering at 250°C temperature and water removes at ~ 80 °C.

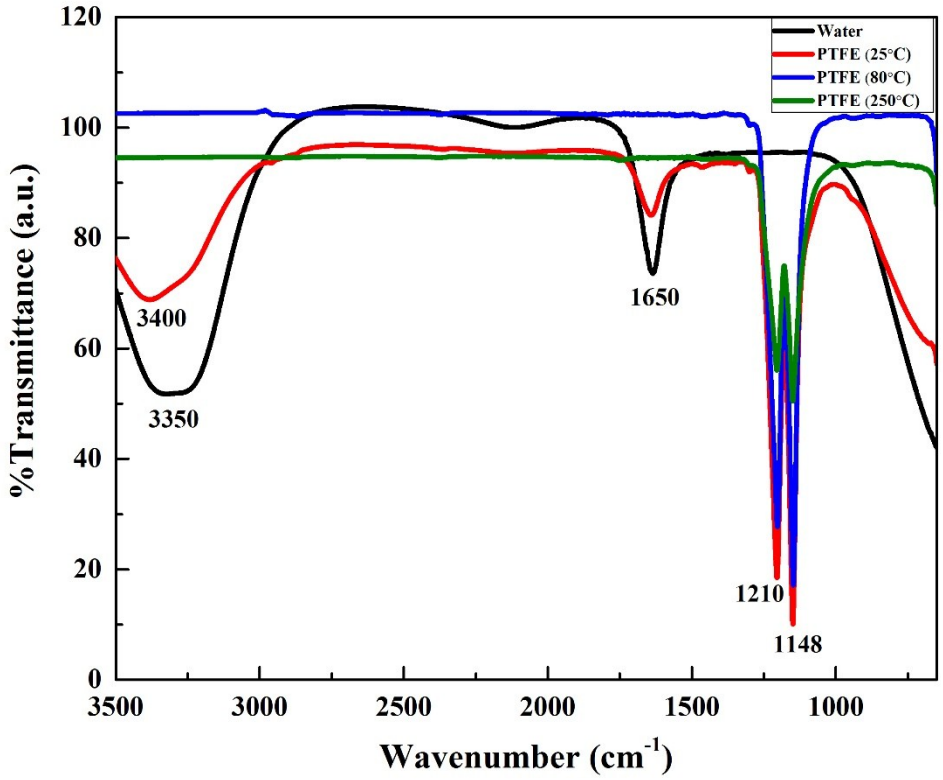


Figure S4: FT-IR spectra of pure water and PTFE coatings dried at 25°C, 80 °C, and sintered at 250°C for 2 h.

Table-ST1: Water contact angle on 2,3,4 and 5 wt% PTFE dispersion coated glass surfaces with respective number of coatings at curing temperature 250 °C.

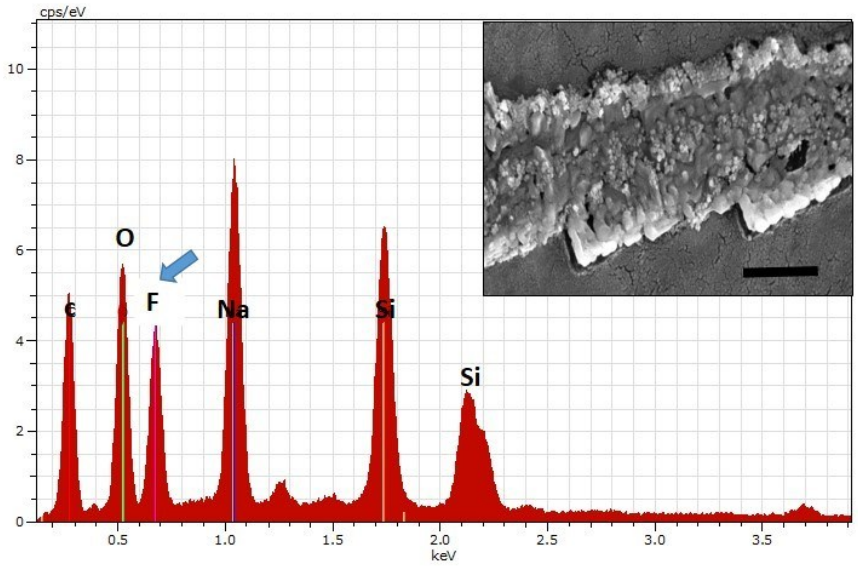
Number of coatings	Contact angle			
	2%	3%	4%	5%
1	127.5±9	129.1±8.5	130.2±9.2	133.5±3.78
2	128.2±4.5	130.5±5	131.4±5	134.5±3
3	133.18±3.1	137.6±1.7	138±1.4	138±0.80
4	137.7±0.9	137.25±0.69	139.1±1	139.3±0.69
5	137.9±0.72	137.4±0.58	138.3±0.69	139±0.35

Table ST2: Average roughness of coated samples measured by profilometer are given below after single coating.

The single coating on glass surface (PTFE wt%)	**Before heating (nm)**	**After heating at 250 °C (nm)**
Blank	15	-
2 wt%	85	118
3 wt%	112	142
4 wt%	138	190
5 wt%	180	220
Patterns (5 wt %)	266	378

EDS analysis

The eds spectra of a small area of fabricated fractal patterns on glass surface analyzed and given below.



El	AN	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error (1 Sigma) [wt.%]
C	6	K-series	14.27	29.03	40.82	1.94
O	8	K-series	10.79	21.95	23.17	1.43
F	9	K-series	7.68	15.62	13.89	1.06
Na	11	K-series	7.56	15.37	11.29	0.48
Si	14	K-series	8.86	18.02	10.83	0.39
		Total:	49.15	100.00	100.00	

Figure S5: EDS analysis patterns, inset view of the selected area elemental analysis.

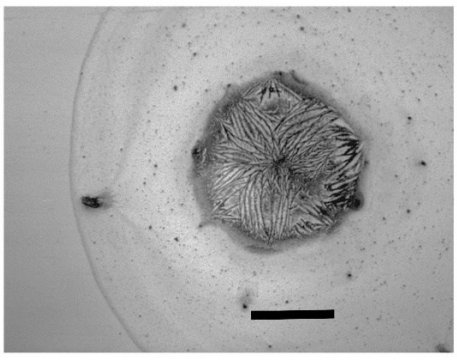


Figure S6. Optical microscopic image of the formed pattern after droplet evaporation of CMCNa and oxalic acid (D). Scale bar 500 µm. Patterns formed under the influence of the ICRD effect.

Effect of CMCNa Concentration on Pattern Formation

We performed an experiment to study the effect of CMCNa on the fractal pattern formation with PTFE NPs mixture with D (CMCNa and oxalic acid). Herein, we took an increased CMCNa concentration from 0.4 to 0.6 wt% remaining things we kept same like other experiments. The FE-SEM (figure S7) shows that branched patterns are mostly vanished and organized into strips like patterns along with PTFE NPs.

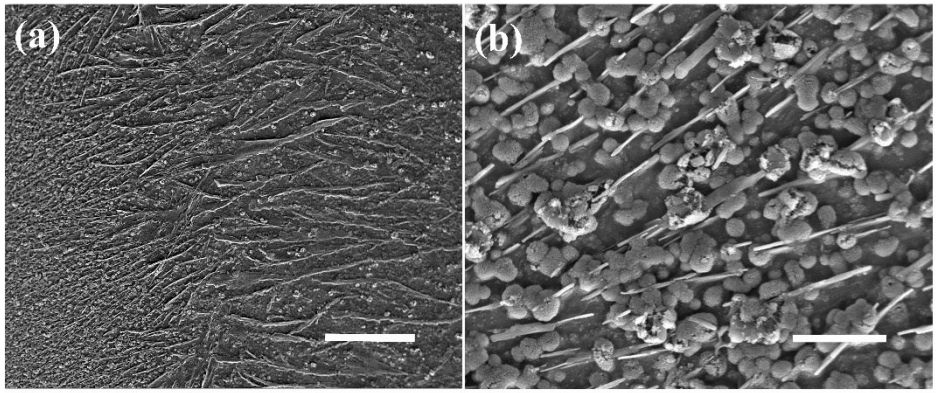


Figure S7: Organized PTFE NPs using 0.6 wt% of CMCNa and 40 mM oxalic acid. Scale bar 100 µm and 10 µm.

References:

(1) Mojet, B. L.; Ebbesen, S. D.; Lefferts, L. *Chem. Soc. Rev.* **2010**, *39* (12), 4643–4655.

(2) Chen, X.; Gong, Y.; Suo, X.; Huang, J.; Liu, Y.; Li, H. *Appl. Surf. Sci.* **2015**, *356*, 639–644.

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(4) Lappan, U.; Geißler, U.; Lunkwitz, K. *J. Appl. Polym.* **1999**, *74*, 1571–1576.