Supporting Information

Enhancing the Bactericidal Efficacy of Nanostructured Multifunctional Surface using an Ultra-Thin Metal Coating

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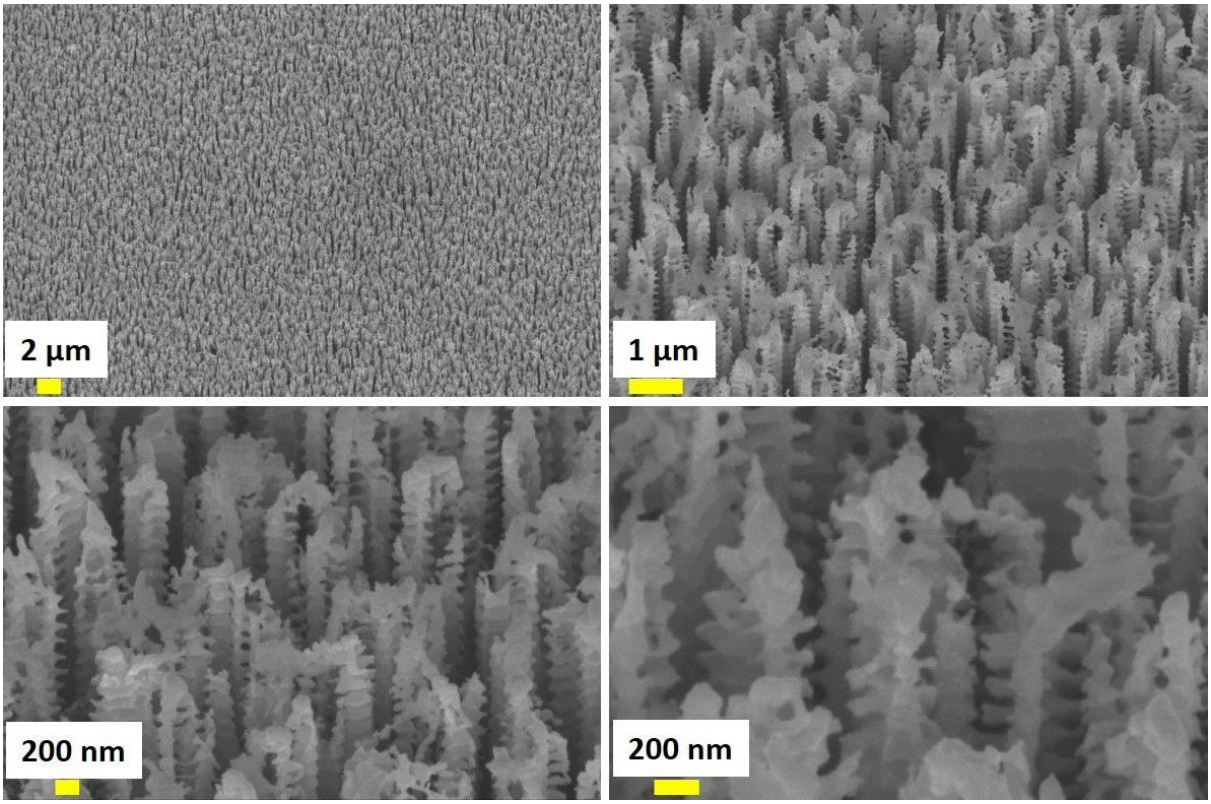


Figure S1: Representative FESEM images of nanostructured surface (45° tilt view) at different magnifications. SEM images show random size and spatial distribution of the nanostructures.

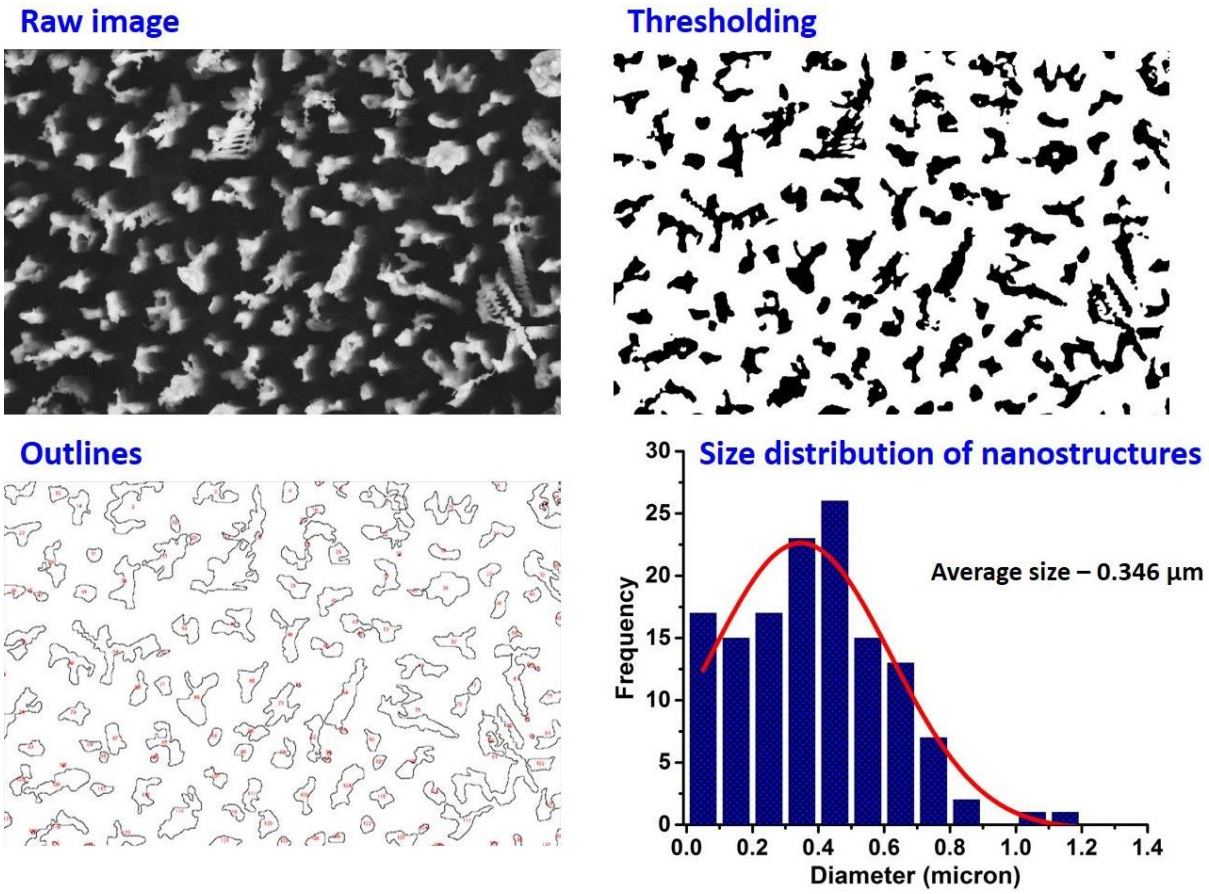
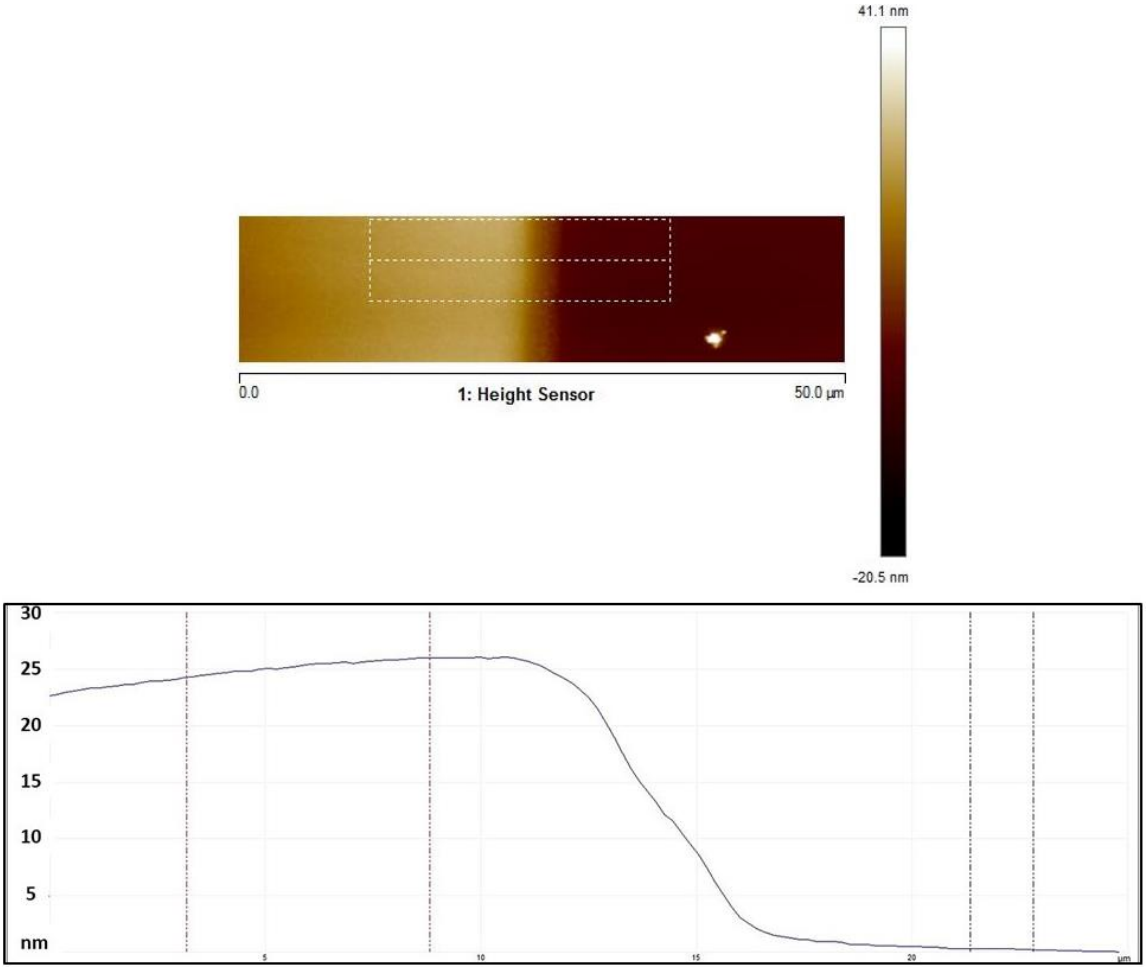
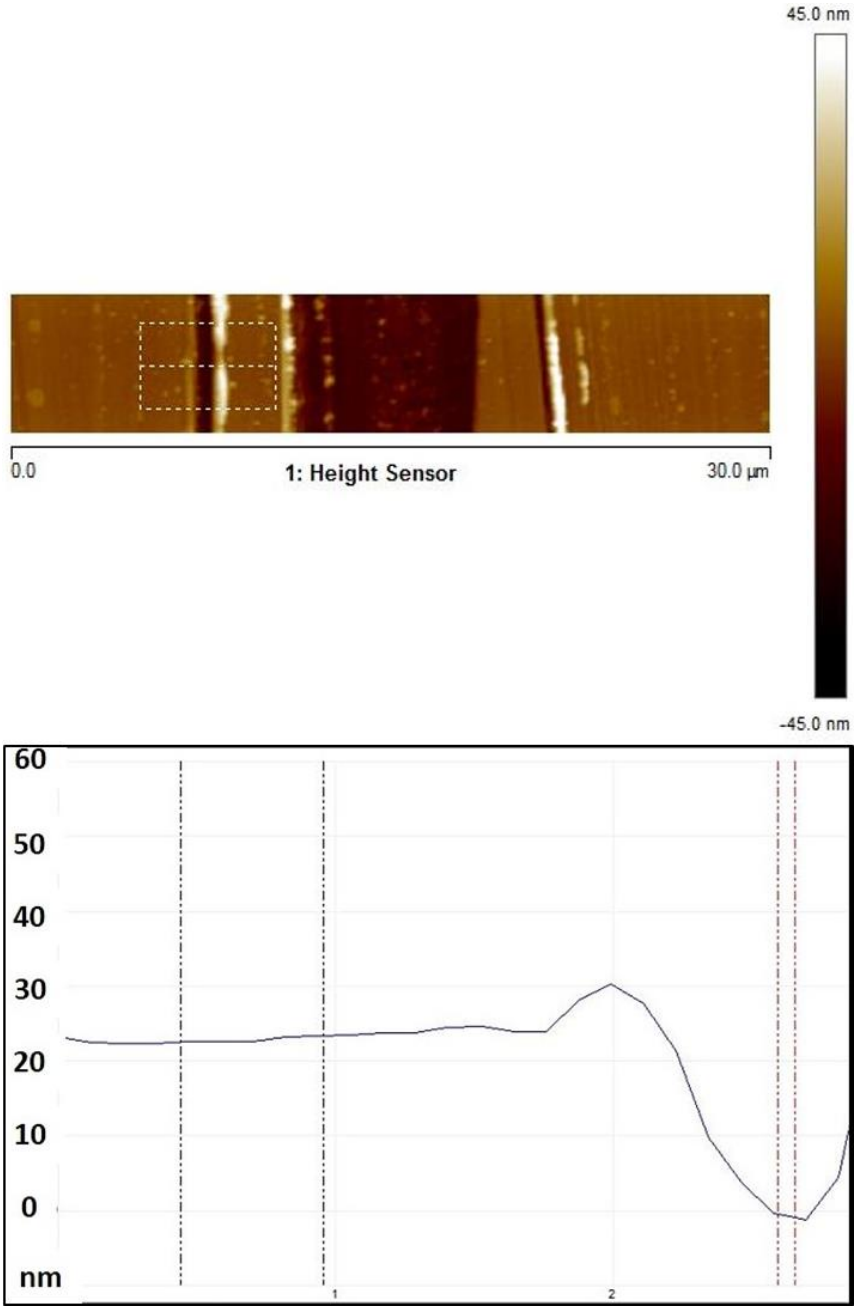


Figure S2: Image J analysis to find the size distribution of the nanostructure base diameter present on the surface. Nanostructures size ranging from 50-1200 µm was observed on the surface with an average diameter of 346 nm.


41.1 nm
0.0
1: Height Sensor
50.0 µm
-20.5 nm
30
25
20
15
10
5
nm
5
10
15
20
µm

(a)



(b)

Figure S3: Thickness measurement of thin layer of (a) silver and (b) copper layer using atomic force microscopy.

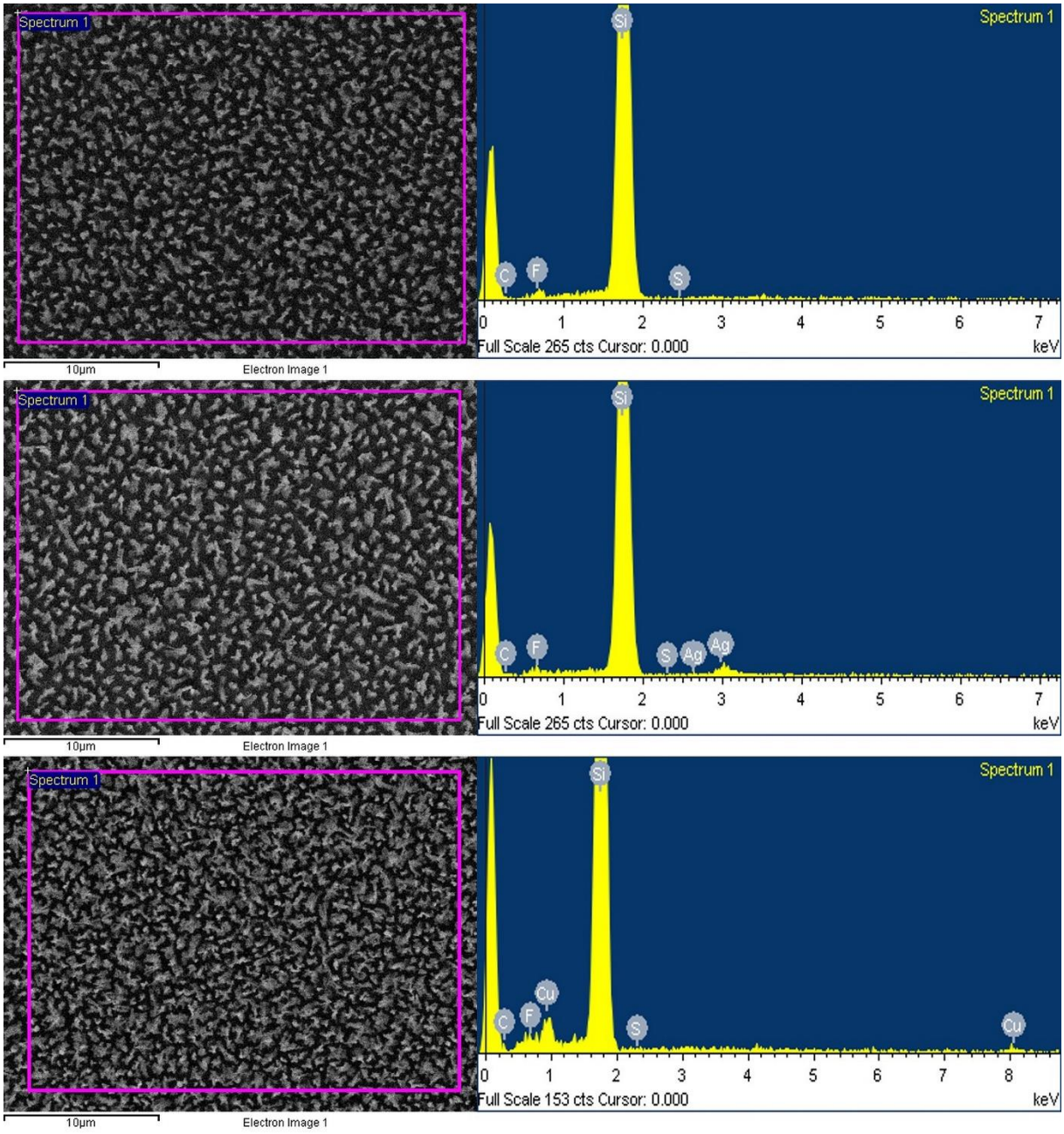


Figure S4: EDAX spectra of NSS, NSS_Ag and NSS_Cu surfaces.

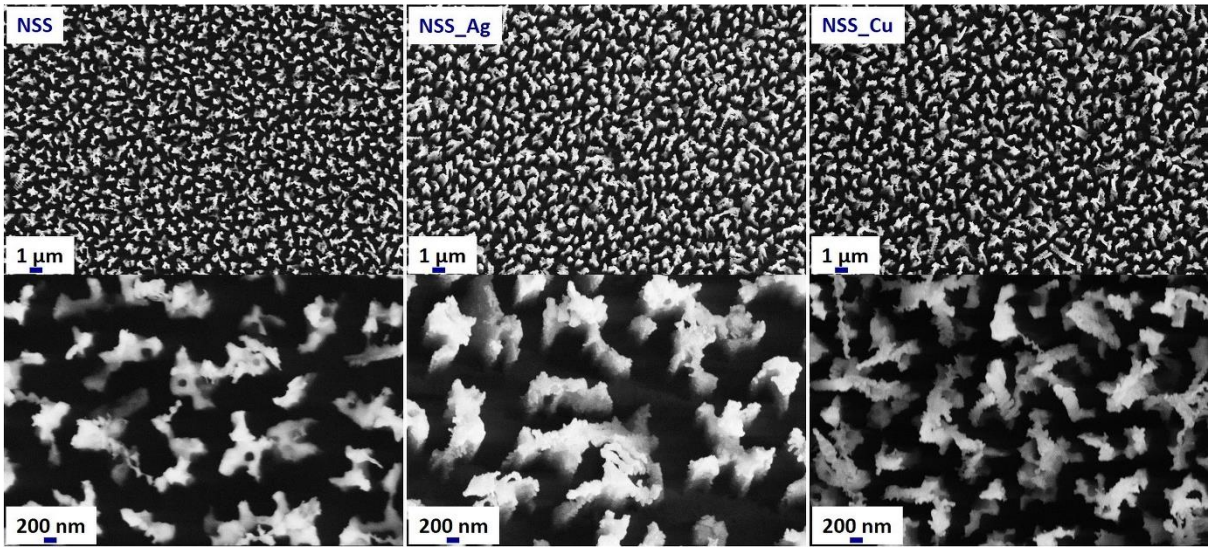


Figure S5: Representative FESEM images of nanostructured surface before and after silver/copper coating.

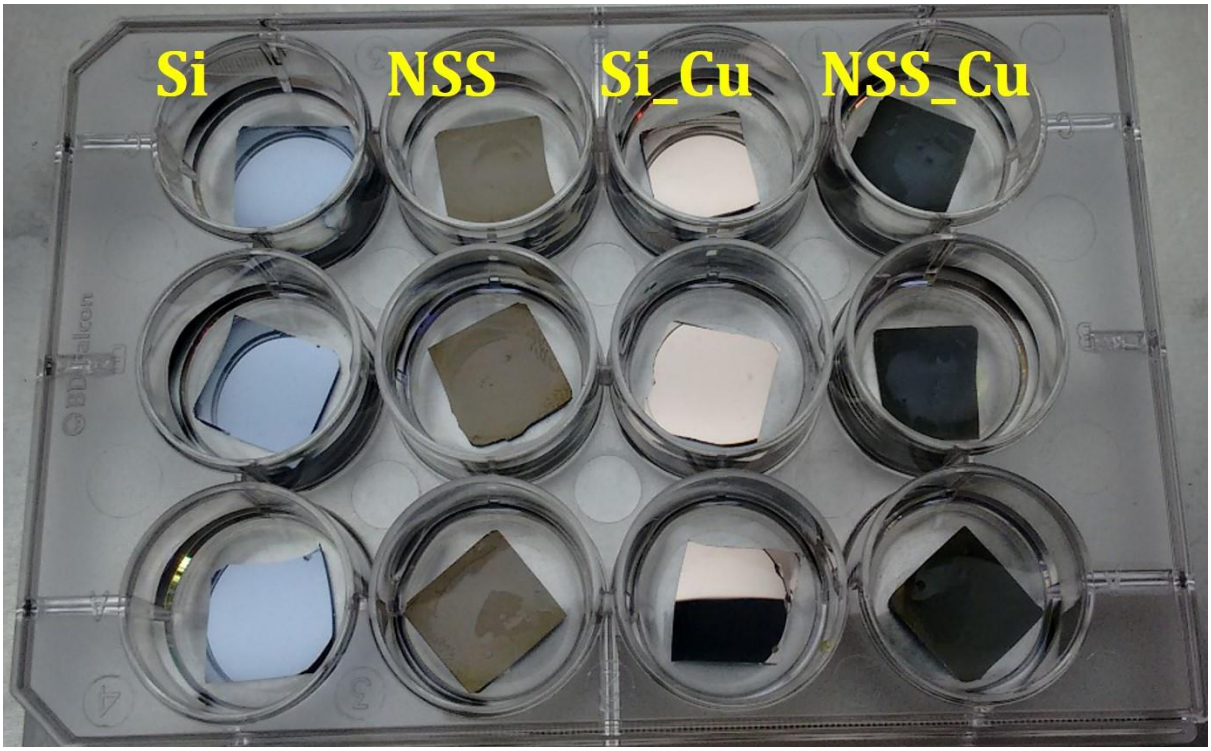
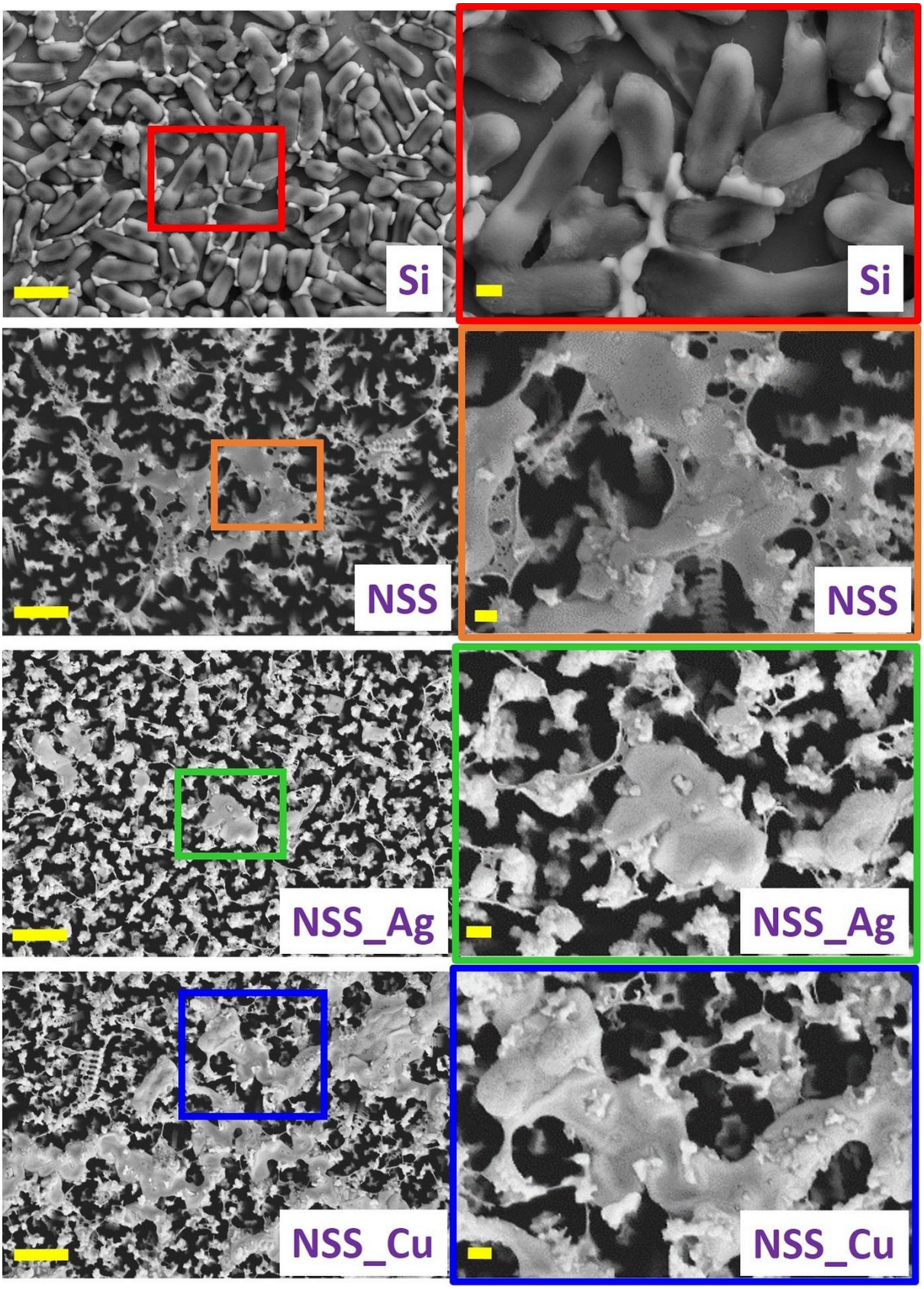
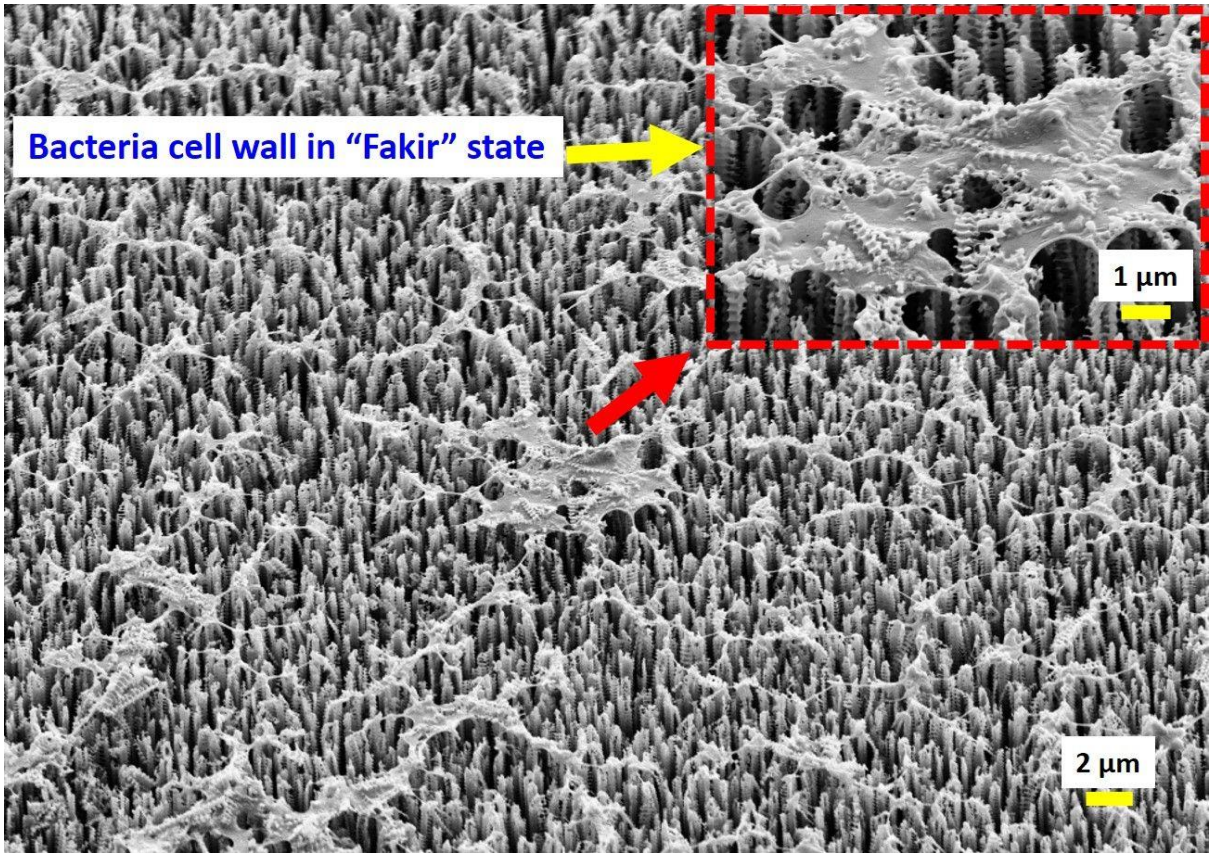


Figure S6: Bacteria culture plate for carrying out the CFU measurement experiments. 2 ml of *E. coli* culture was poured on each sample. At different time points 100 µL bacteria culture was taken and plating was done on the agar plates.



(a)



(b)

Figure S7: (a) FESEM of *E. coli* on different surfaces: Silicon control, NSS, NSS_Ag, and NSS_Cu (Scale bar left: 2µm, scale bar right: 200nm). Disruption of the *E. coli* cell wall on the nanostructured surfaces is clearly evident from the scanning electron microscopy images and *E. coli* cells look healthy on the flat silicon surface. (b) FESEM image of ruptured *E. coli* cell wall (45^{o} tilt view) in “Fakir” state (cell wall hanging on top of the nanostructures) on top of the nanostructures.

Table S1: Surface area of *E. coli* on flat silicon and nanostructured surfaces.

Number of measurements	Projected area of *E. coli* on flat surface (µm²)	Projected area of *E. coli* on nanostructured silicon surfaces (µm²)
1	0.728 (Si)	2.545 (NSS)
2	0.733 (Si)	4.694 (NSS)
3	0.905 (Si)	5.8 (NSS)
4	0.748 (Si)	3.7 (NSS)
5	0.77 (Si)	
6	1.256 (Si)	
7	1.35 (Si_Ag)	2.98 (NSS_Ag)
8	1.57 (Si_Ag)	2.754 (NSS_Ag)
9	1.7 (Si_Ag)	3.12 (NSS_Ag)
10	1.525 (Si_Cu)	1.93 (NSS_Cu)
11	2.144 (Si_Cu)	2.86 (NSS_Cu)
12	2.25 (Si_Cu)	1.7(NSS_Cu)

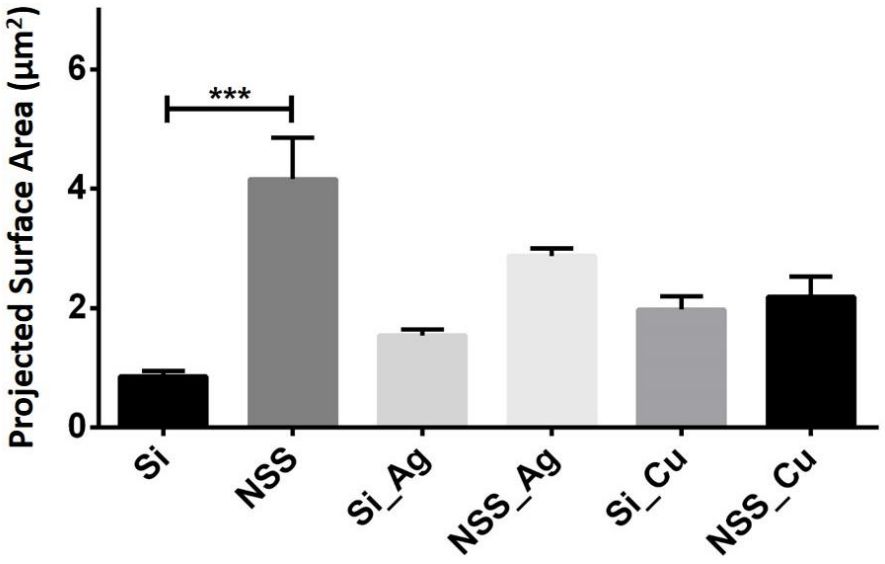
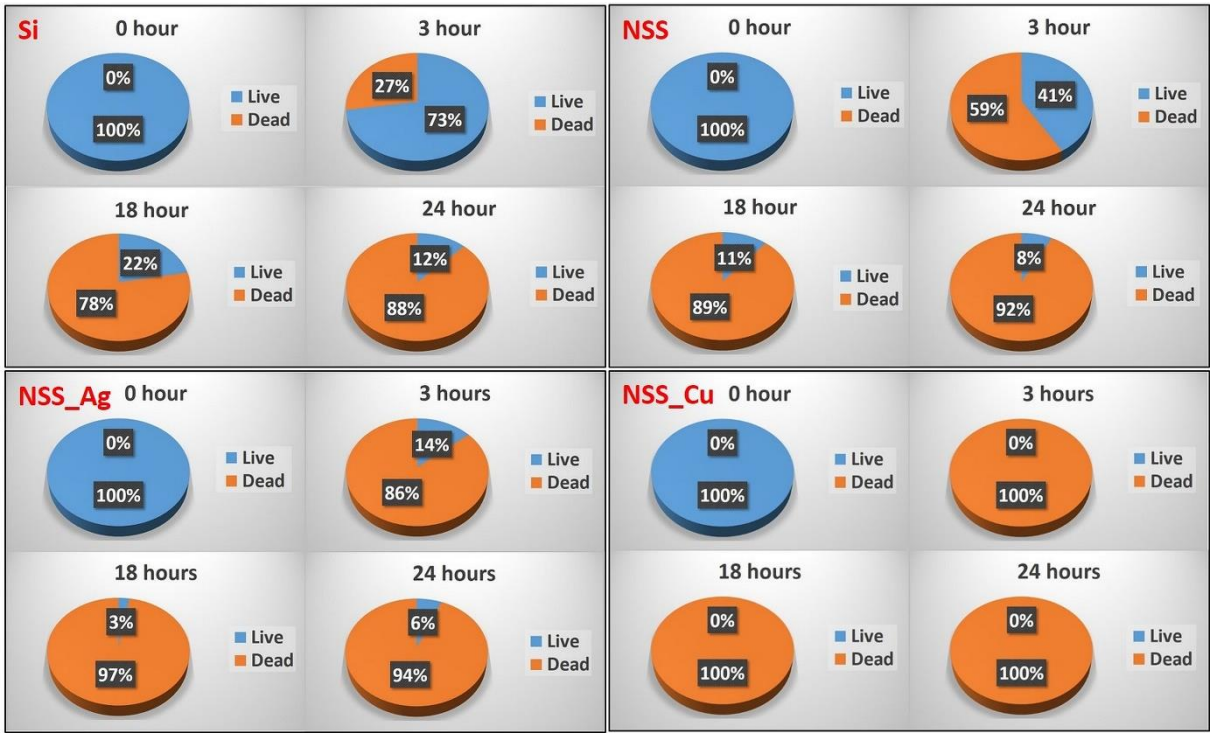
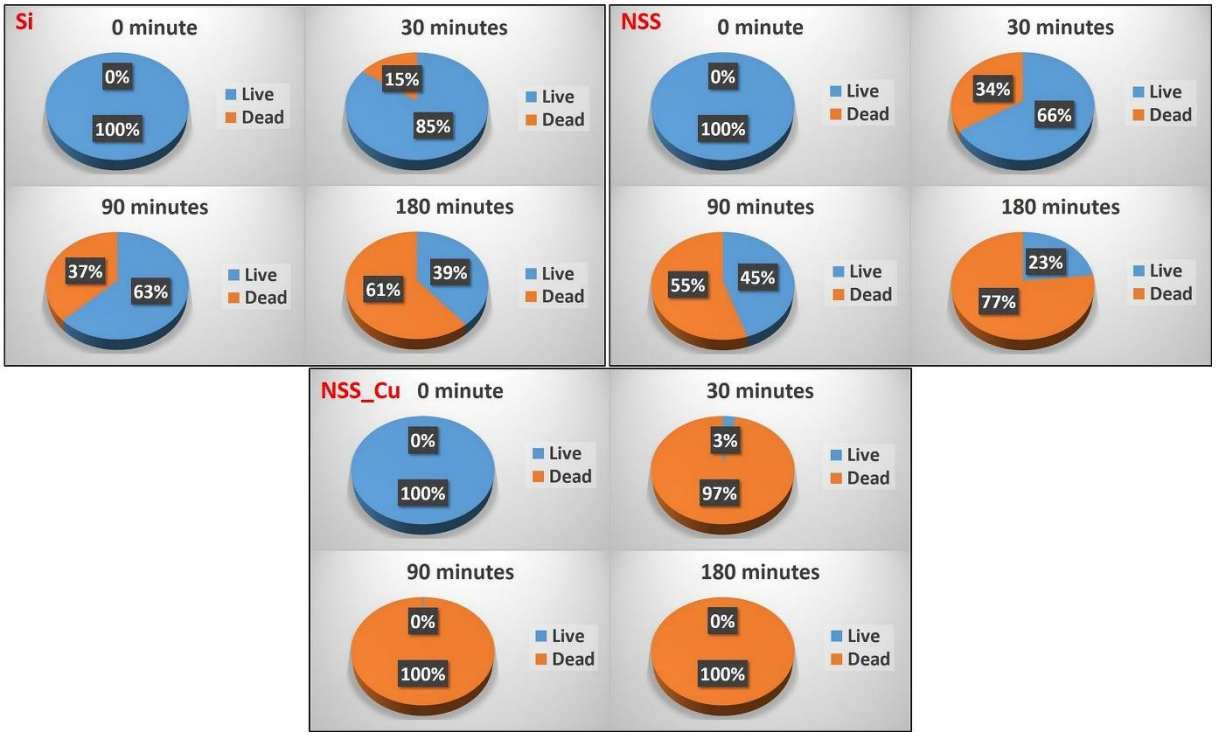


Figure S8: Projected Surface area Surface area of *E. coli* on flat and nanostructured surfaces. There is a significant difference between the projected surface area of *E. Coli* on the flat silicon and NSS [***$p \leq 0.001$, Student's t-test].



(a)



(b)

Figure S9: % of viable cells of *E. coli* left on different surfaces over an incubation period of (a) 24 hours and (b) 3 hours. It shows clearly that within 3 hours NSS_Cu surface killed all the bacteria present. Numbers on the charts show the % of live and dead *E. coli* left on the flat Silicon and the nanostructured surfaces.

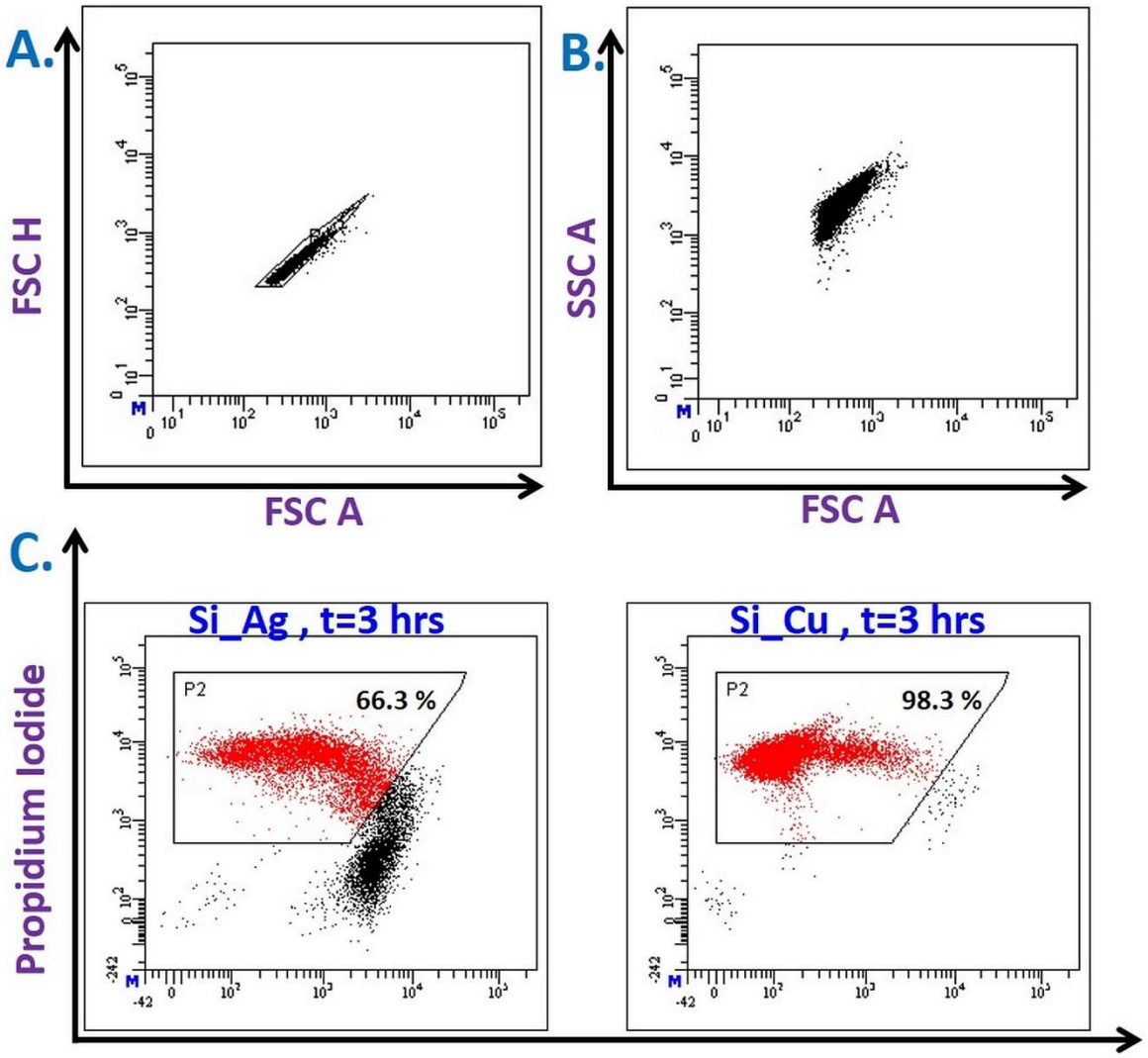


Figure S10: (A) Single events were selected in the P1 region, while the (B) P2 region comprised of debris-free cells. (C) Quantification of the PI positive cells for Si_Ag and Si_Cu surfaces.

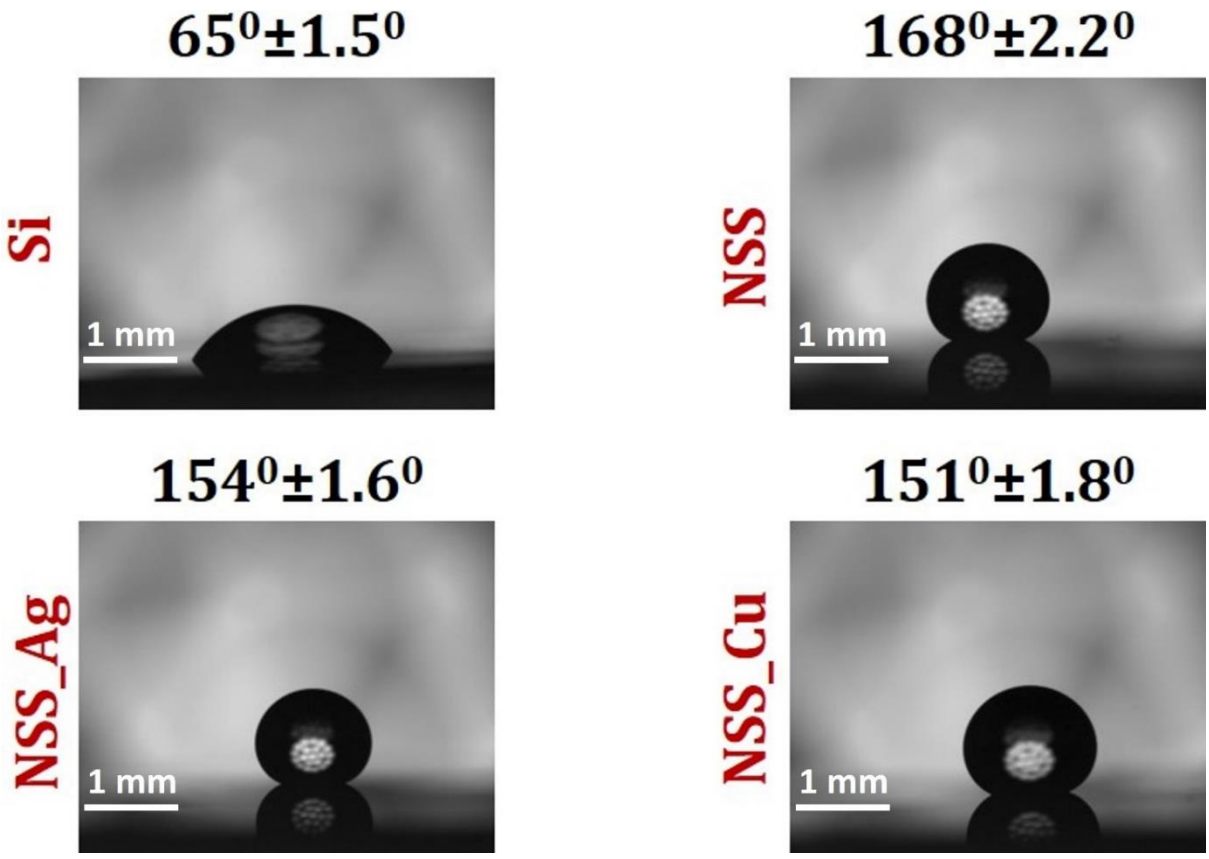
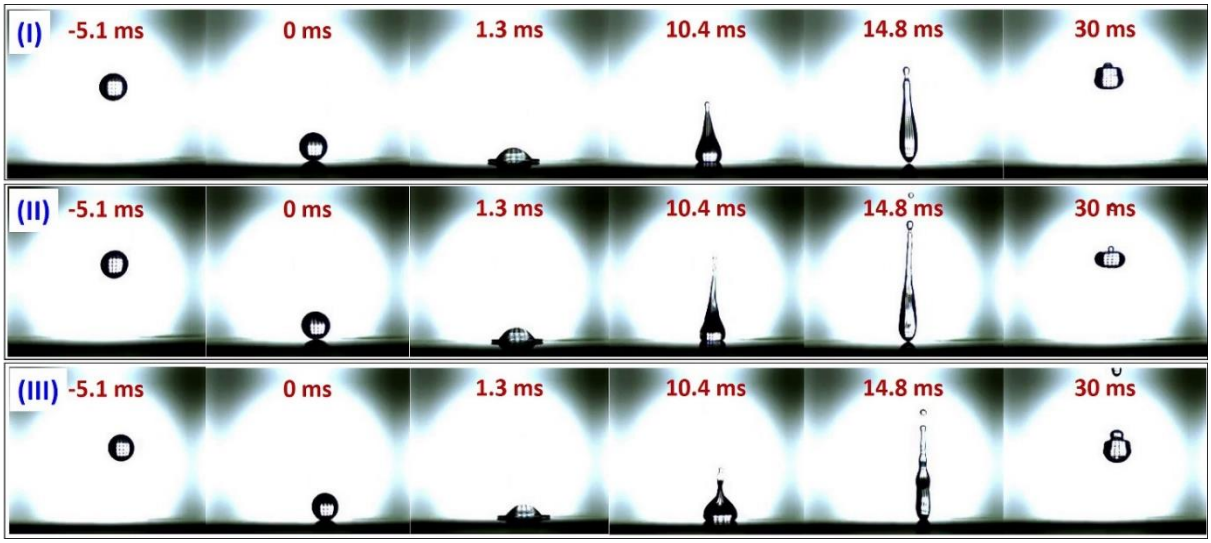
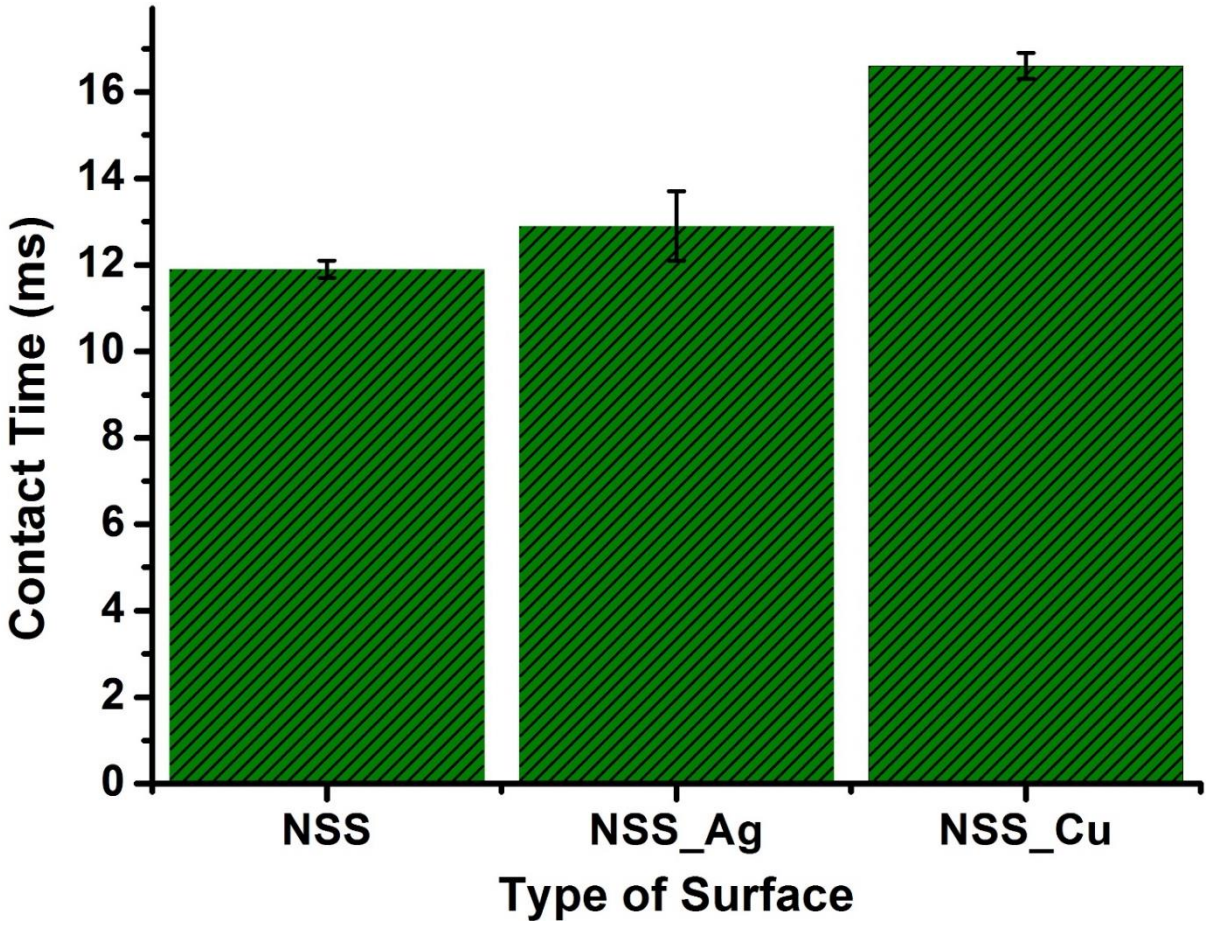


Figure S11: Wettability of all the engineered surfaces: 8 µL droplet was used to measure the static contact angle. NSS, NSS_Ag and NSS_Cu exhibited excellent superhydrophobicity with contact angle higher than 150^0 and contact angle hysteresis of less than 10^0 (see Table S2).



(a)



(b)

Figure S12: (a) Snap shot of drop impact dynamics of water droplet on the nanostructured superhydrophobic surfaces (I) NSS, (II) NSS_Ag and (III) NSS_Cu. (b) Contact time of water droplet on different nanostructured surfaces.

Table S2: Contact angle and contact angle hysteresis of nanostructured surfaces

Sample	Contact Angle (degree)	Contact Angle Hysteresis (degree)	Contact Time (ms)
Si	65±1.5	-	-
NSS	168±2.2	1.9±0.1	11.9±0.2
NSS_Ag	154±1.6	6.4±0.5	12.9±0.8
NSS_Cu	151±1.8	8±0.2	16.6±0.3

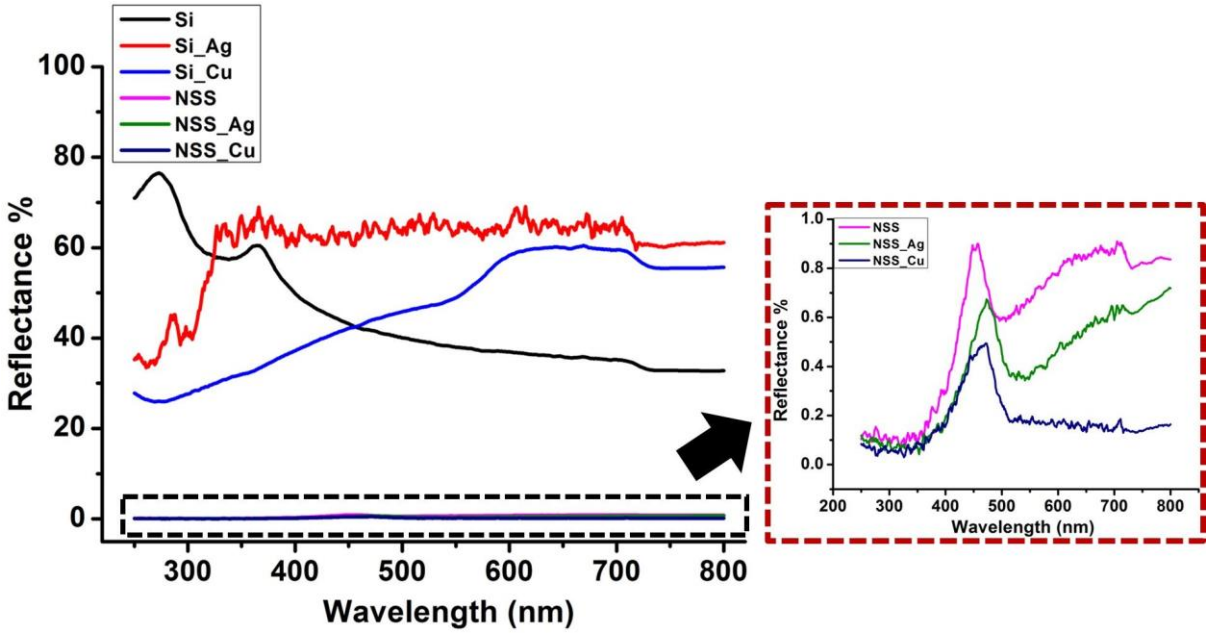


Figure S13: Reflectance Data for all the engineered surfaces with varied wavelength from 250 nm to 800 nm. Inset showing magnified view of reflectance data for only nanostructured surfaces. Reflectance of less than 1% was achieved for the nanostructured surfaces.

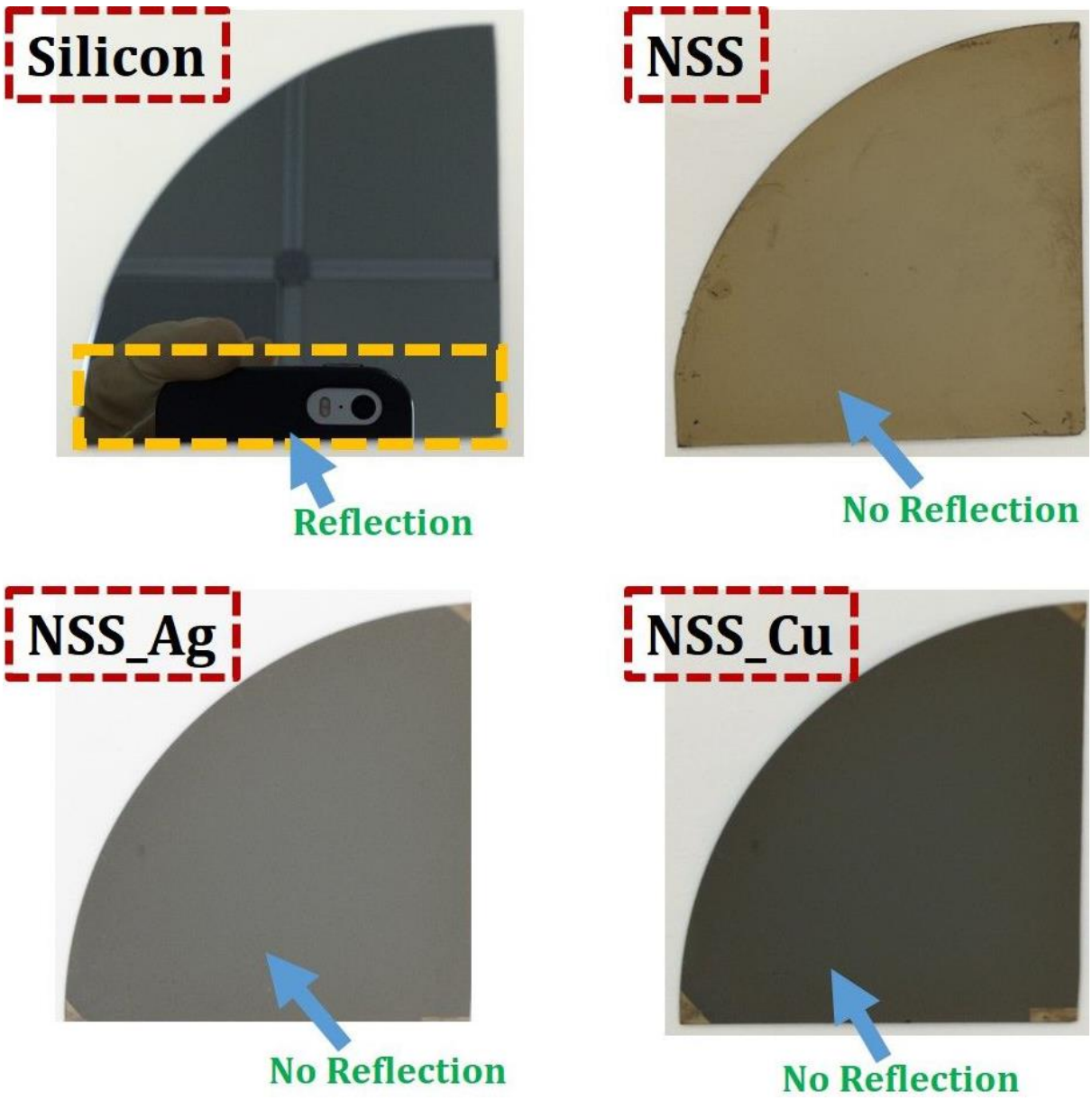


Figure S14: Quarter pieces of silicon and nanostructured surfaces showing reflective and antireflective behaviour respectively. Reflection image of the cell phone is quite clearly seen on the flat silicon surface, whereas no reflection is observed on the nanostructured surfaces.

Table S3: Silver Sputtering Condition (E-beam Evaporator)

Material	Ag
Base Pressure (mbar)	2.7×10^{-6}
Deposition Pressure (mbar)	3.1×10^{-6}
Thickness (nm)	20
Primary Current (A)	10
Secondary Current (A)	100
Voltage (V)	35

Table S4: Copper Sputtering Condition (Techport Sputtering Unit)

Material	Cu
Substrate Temperature	Room Temperature
Target to substrate distance	6 cm
Deposition Pressure (mbar)	0.08
Incident Power (W)	110
Reflected Power (W)	15
Plate Current (mA)	120
Plate Voltage (kV)	1.5
Thickness (nm)	20