Supplementary Information

for

Facile Fabrication of Multifunctional ZnO Urchins on Surfaces

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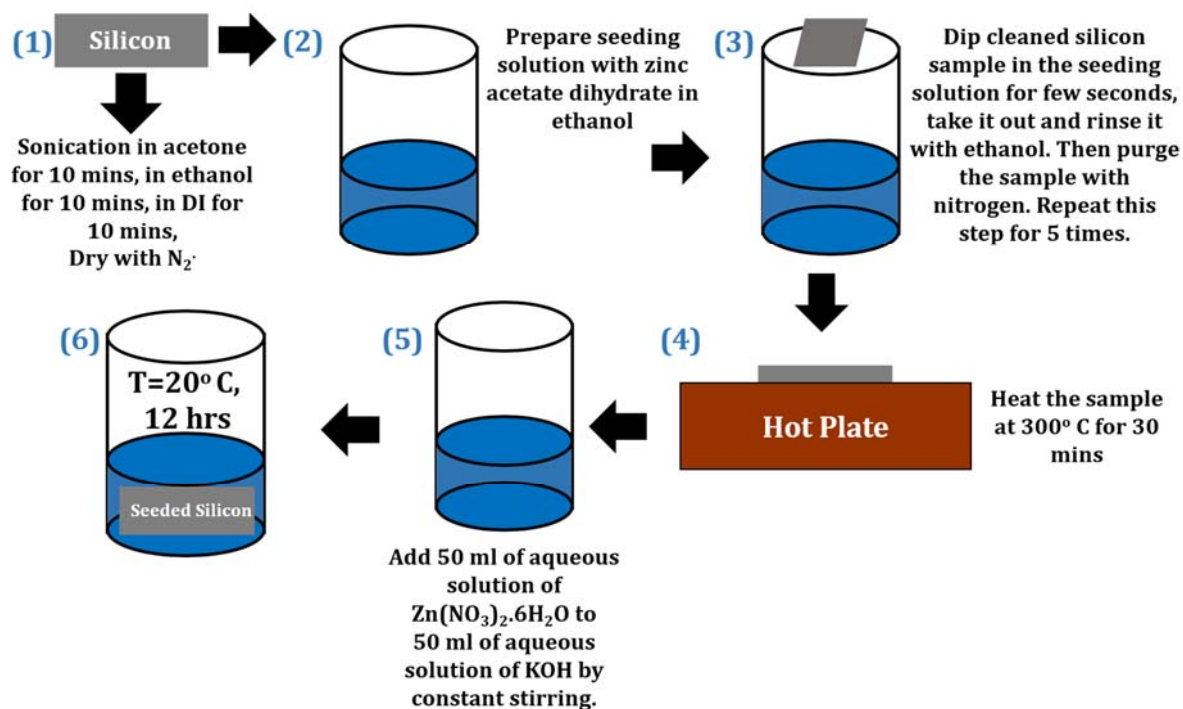


Figure S1: Process flow of the fabrication of ZnO nanostructures on seeded silicon substrates at near room temperature.

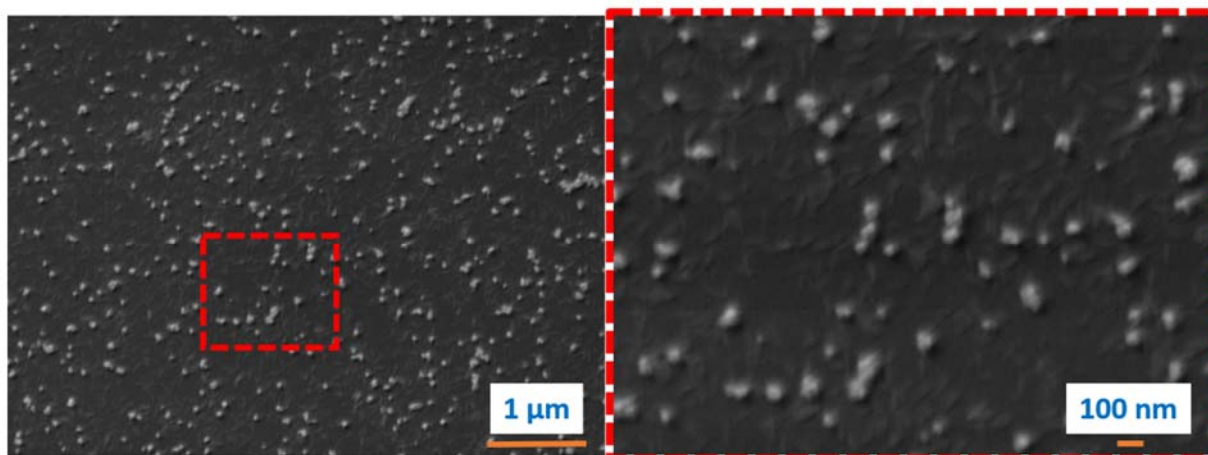



Figure S2: SEM images of a silicon substrate seeded with ZnO nanoislands in 5 mM zinc acetate dihydrate solution (dipping × 5 times and annealed at 300° C for 30 minutes).

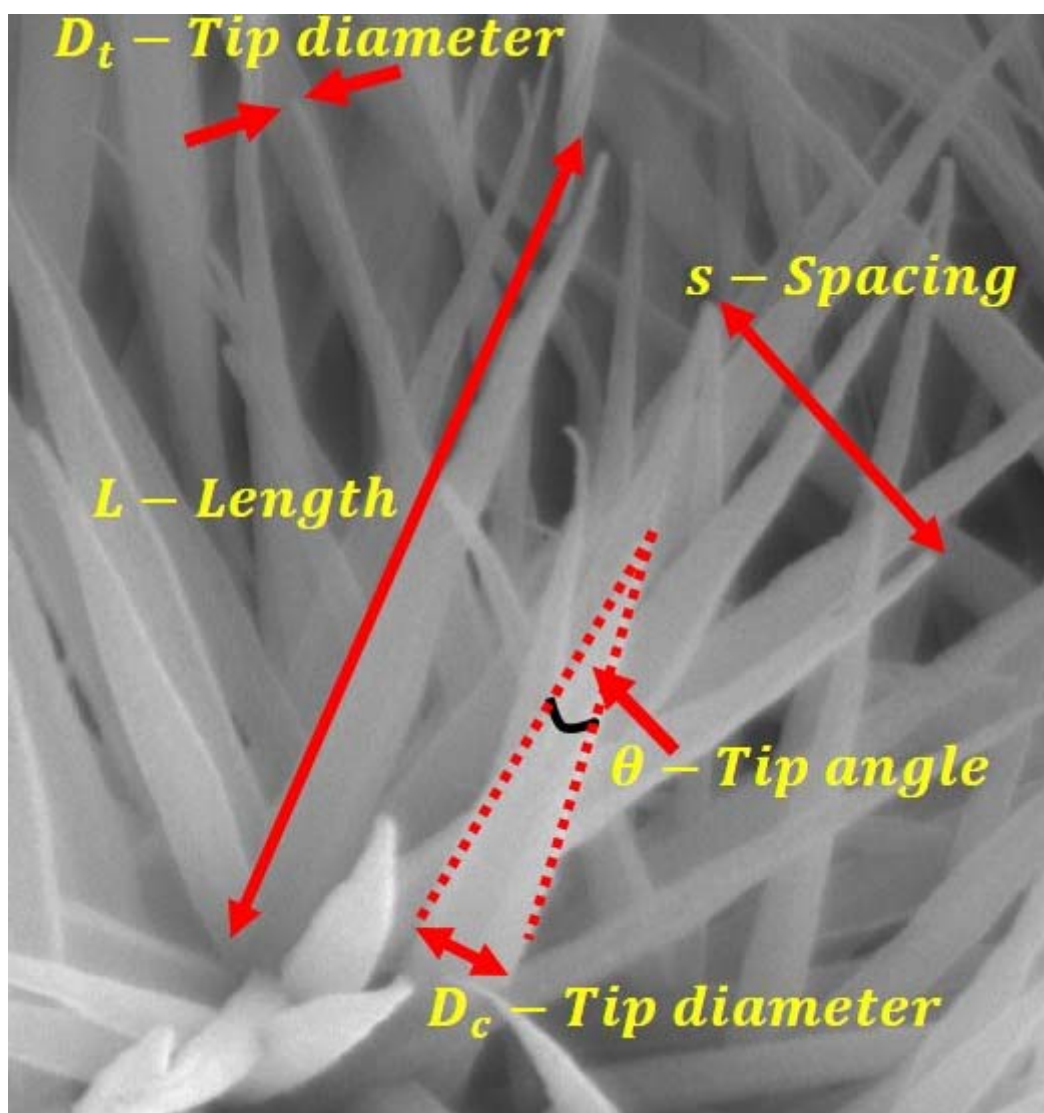



Figure S3: Nanoneedle dimension measurement using ImageJ software. The values in the main text were averaged from 50 different needles, with the measurements of different parameters at each single needle repeated 5 times.

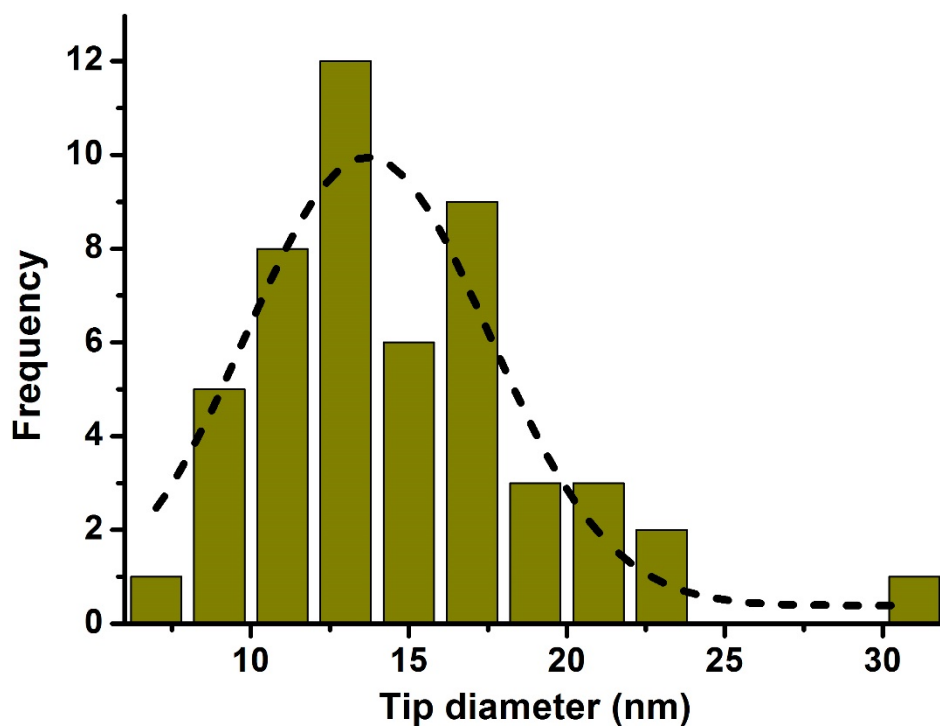



Figure S4: Size distribution from ImageJ analysis of the nanoneedle tip diameter at the top D_t urchins ranging from 7-30 nm with an average diameter of $D_t = 13\pm7$ nm.

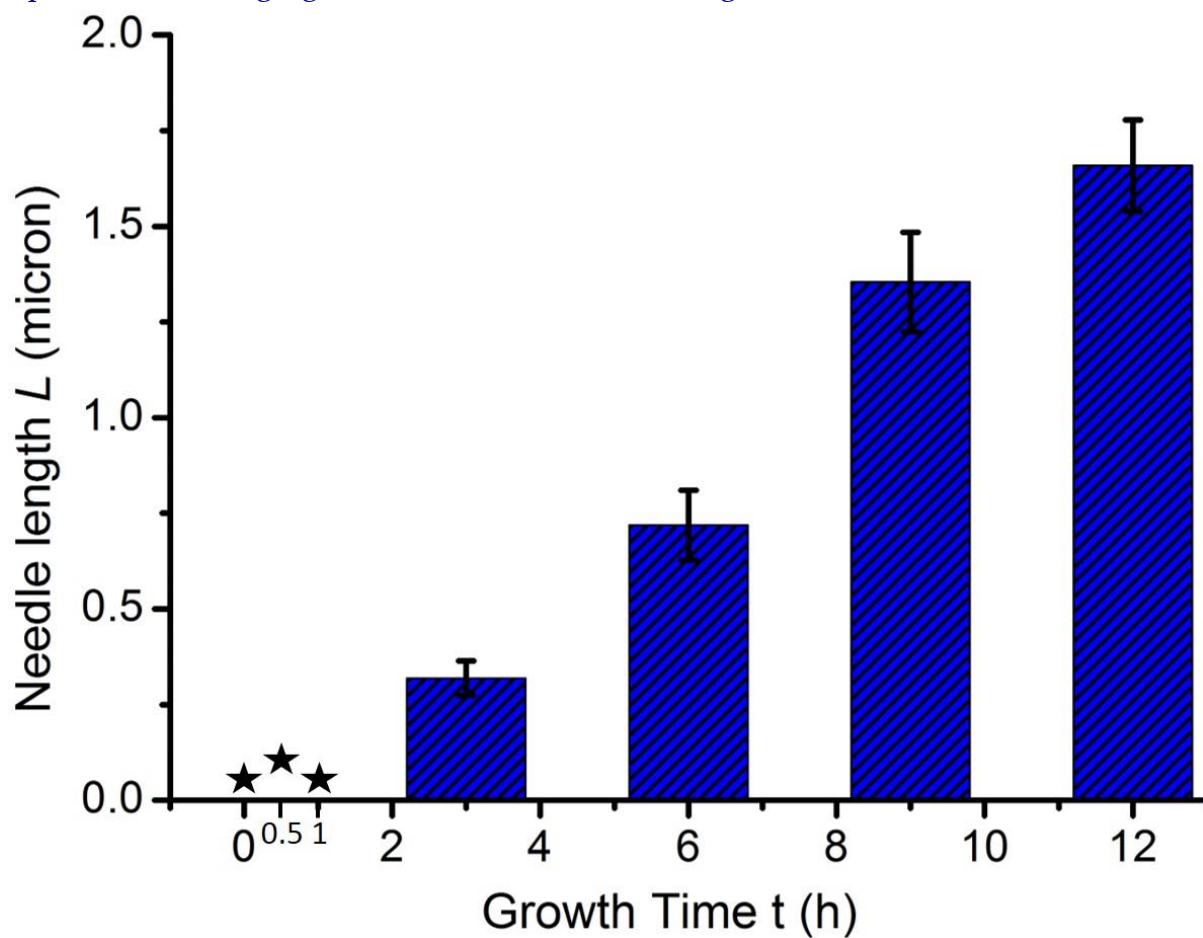



Figure S5: Length of the nanoneedles *L* in the urchin structure vs. growth time. Length of the nanoneedle was found to increase with respect to synthesis time. Stars in figure shows that for time points 0, 0.5 and 1 h there was no formation of urchin structures.

**Nanourchin growth
on top of nanoneedles**

**Nanoneedles growth
on silicon substrate**

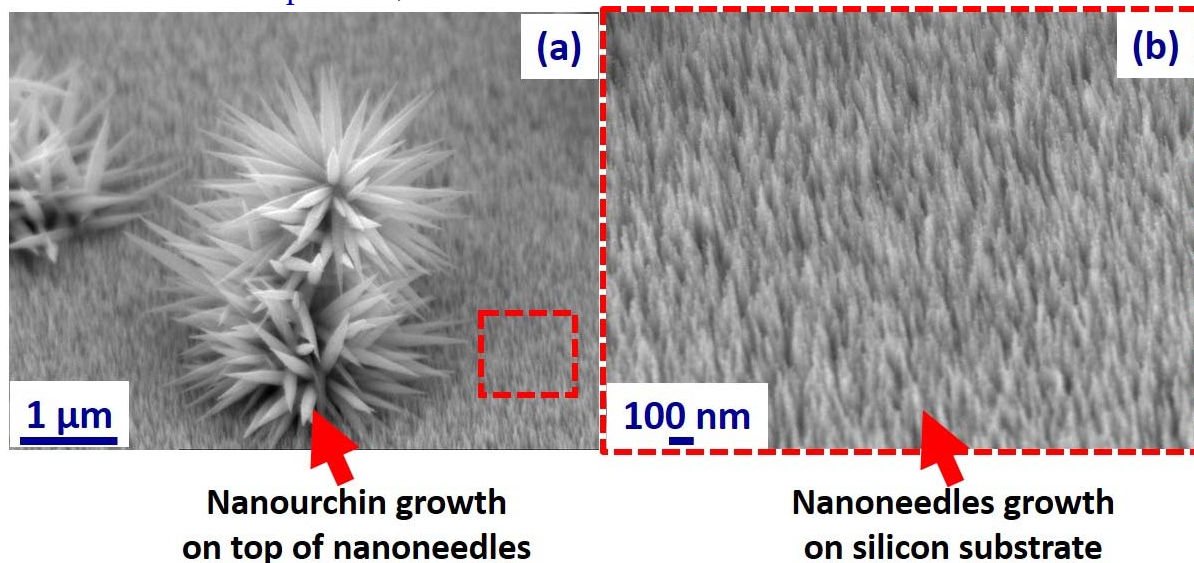



Figure S6: (a) the angled view after 9 h growth, showing ZnO urchins on the top of highly (b) oriented ZnO nanoneedles.

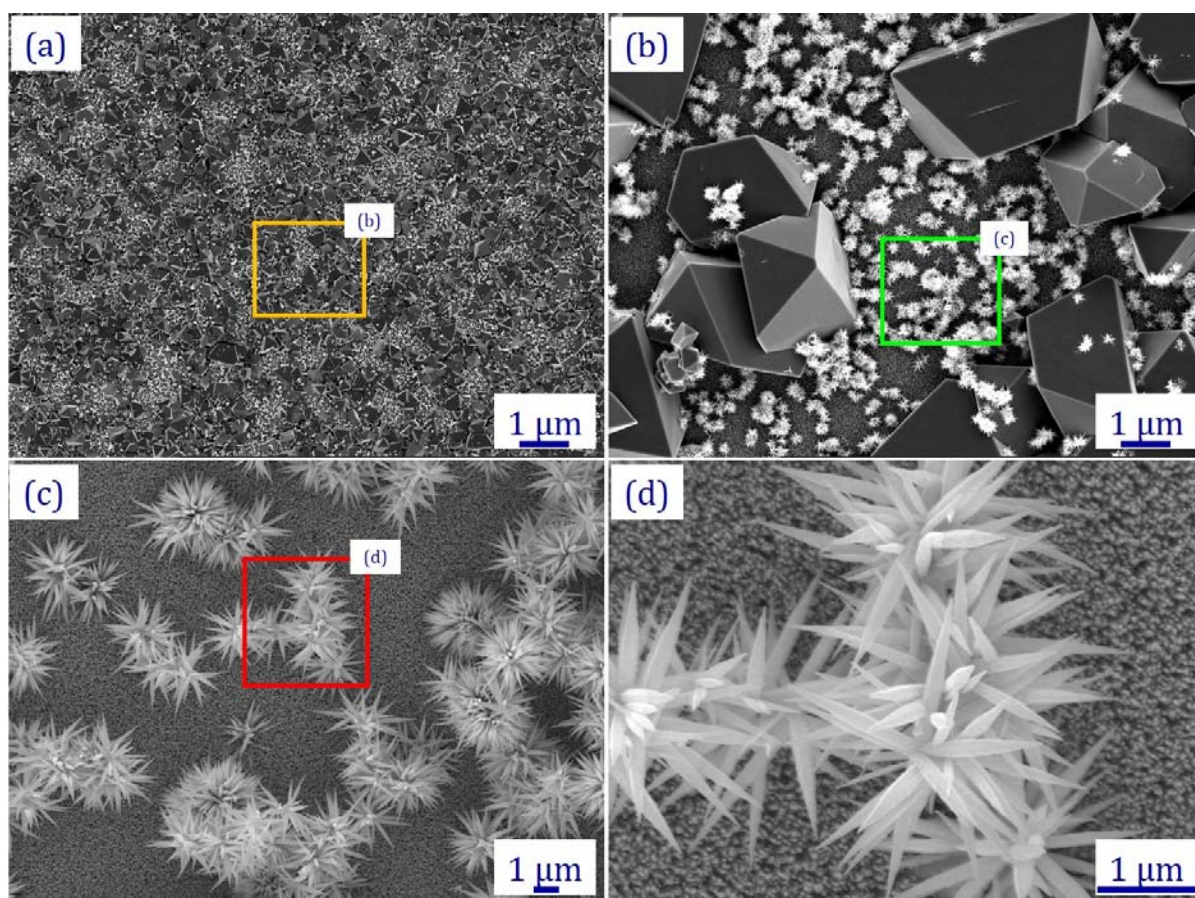



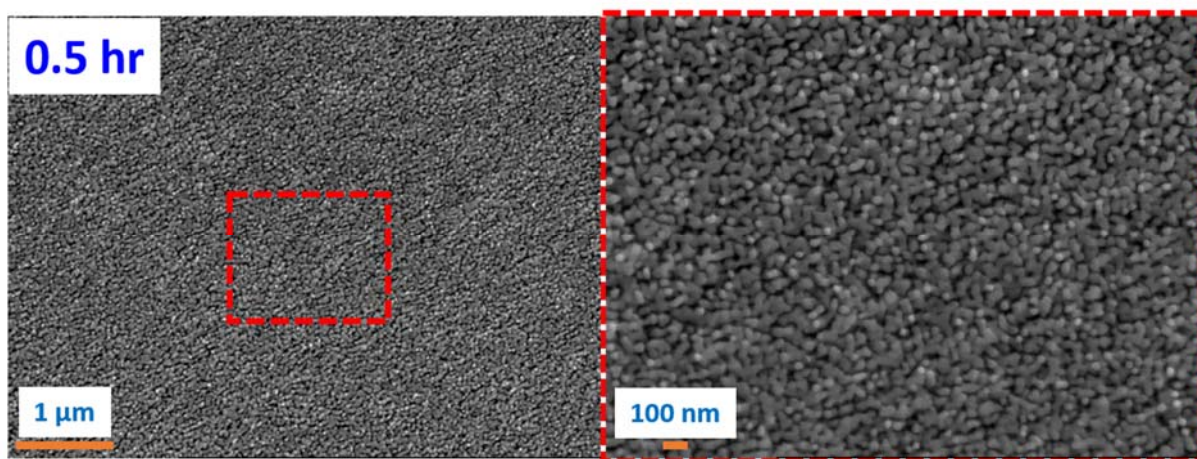
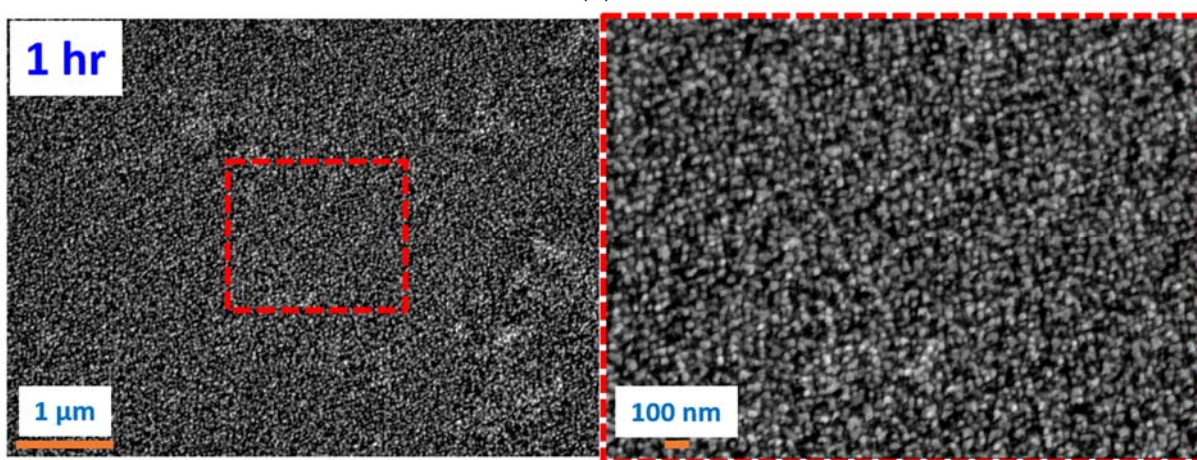
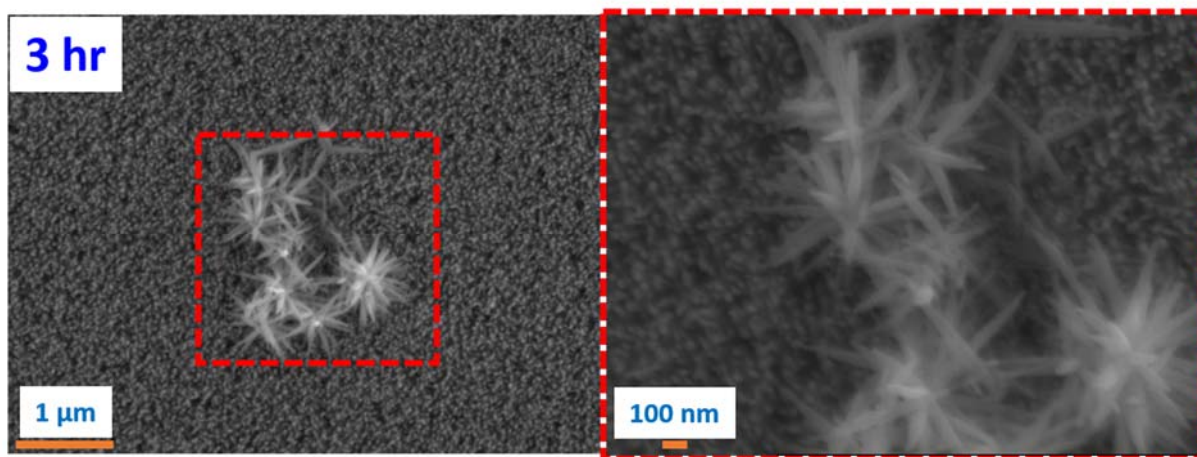
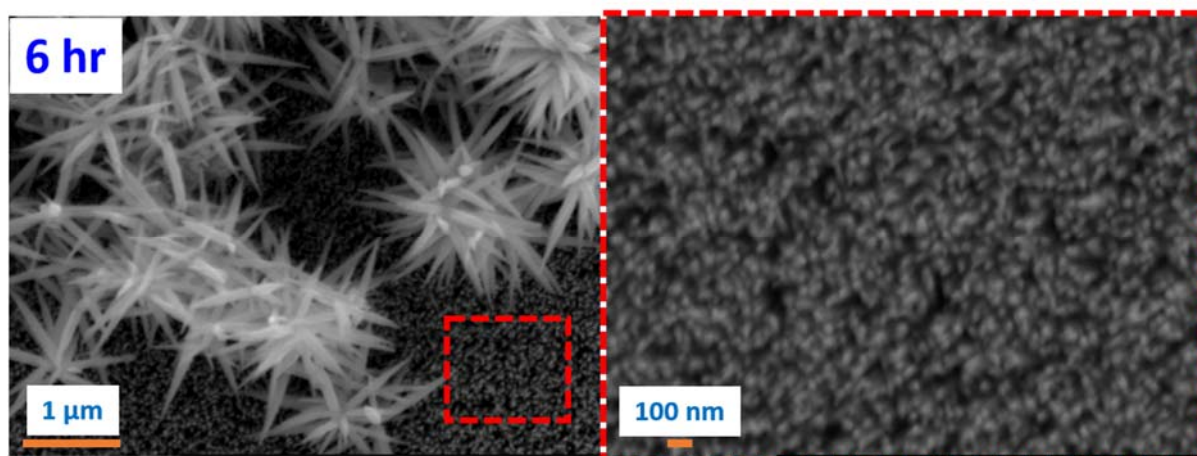
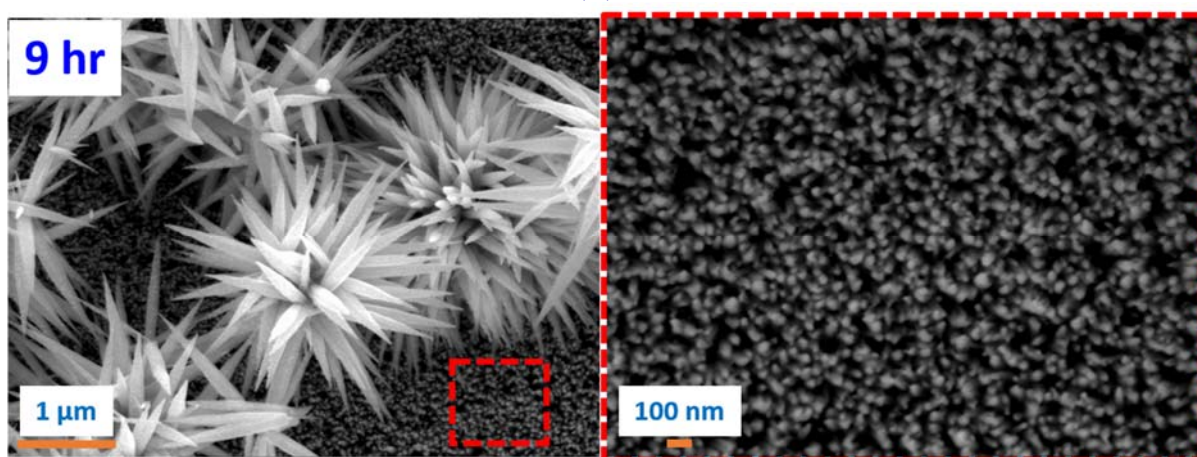
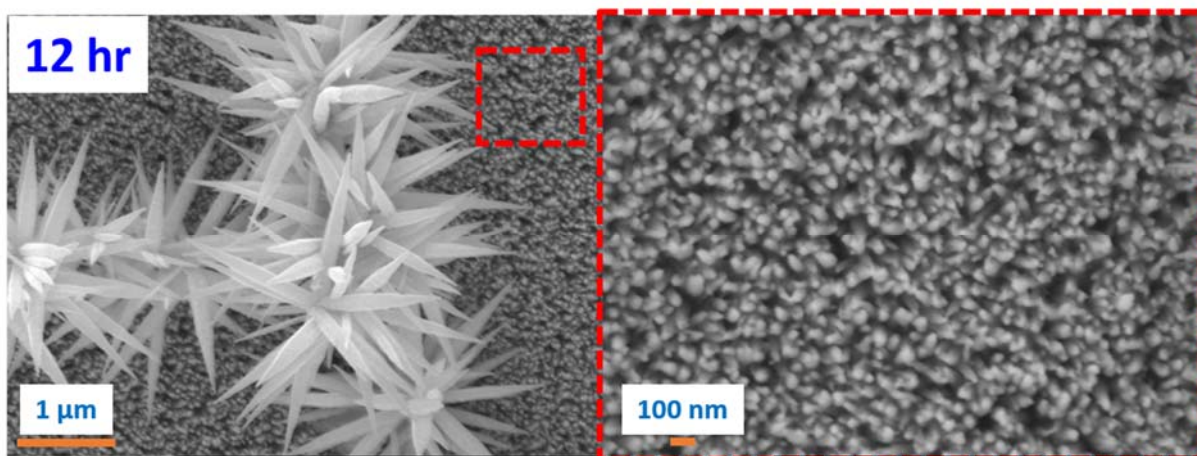
Figure S7: Representative FESEM images of the seeded silicon substrate post 12 h synthesis in the zincate solution.

(a)

(b)

(c)

(d)

(e)

(f)

Figure S8: SEM images of seeded silicon substrates after growth in zincate solution at different time intervals. Density of ZnO nano urchins was found to increase with the increase synthesis time.

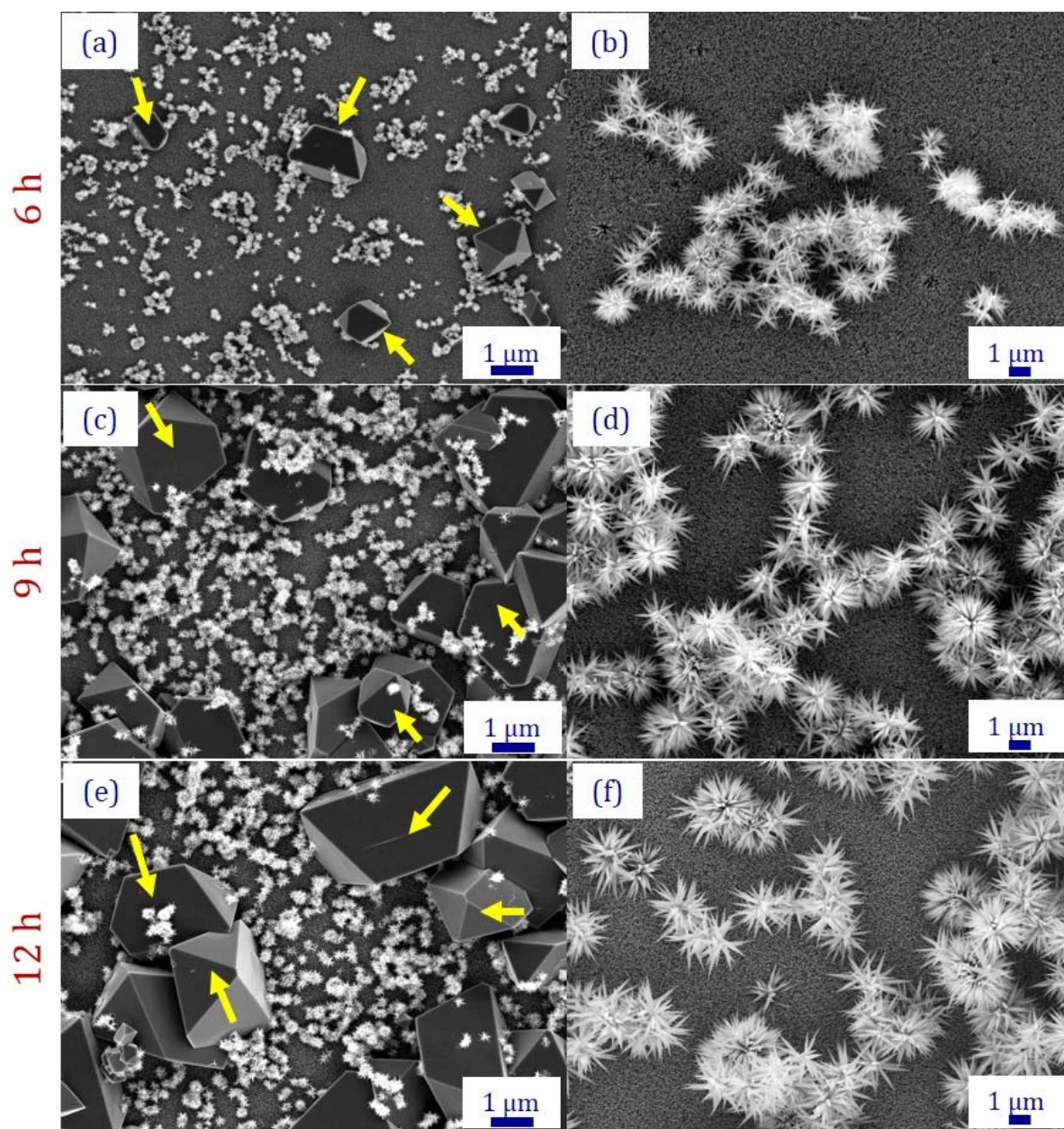



Figure S9: SEM images of seeded silicon substrates after growth in zincate solution at different time intervals. $Zn(OH)_2$ crystals were observed on the substrates for synthesis time t > 3 h.

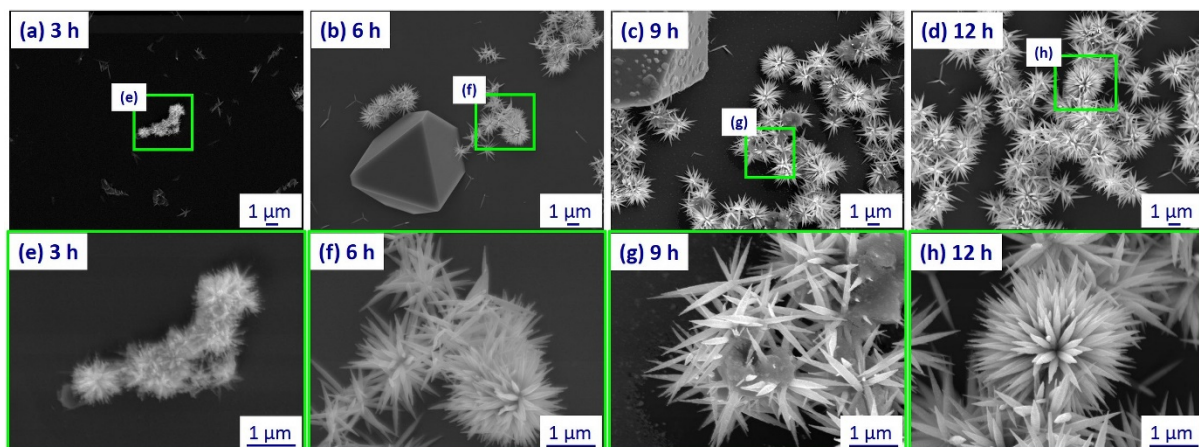



Figure S10: SEM images of ZnO urchins on a non-seeded silicon substrate, taken at different time intervals: (a) 3 h, (b) 6 h, (c) 9 h, and (d) 12 h. (e-h) show enlarged views of the square regions as labelled in (a-d), respectively.

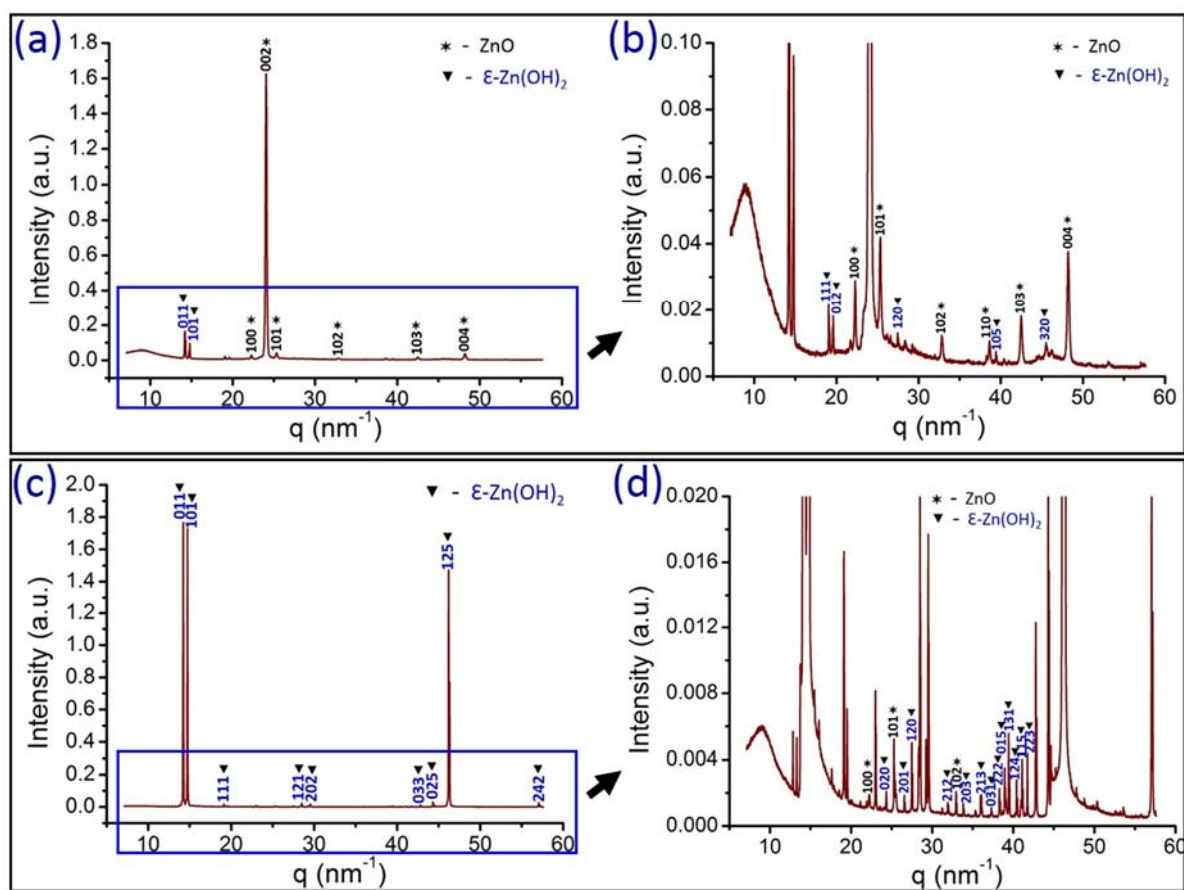



Figure S11: XRD of (a)&(b) seeded and (c)&(d) unseeded silicon substrates after growth in the zincate solution at 20° C for 12 h, with the ZnO and ε-Zn(OH)$_2$ peaks indicated by * and ▼, respectively, and the enlarged views shown on the right-hand side.

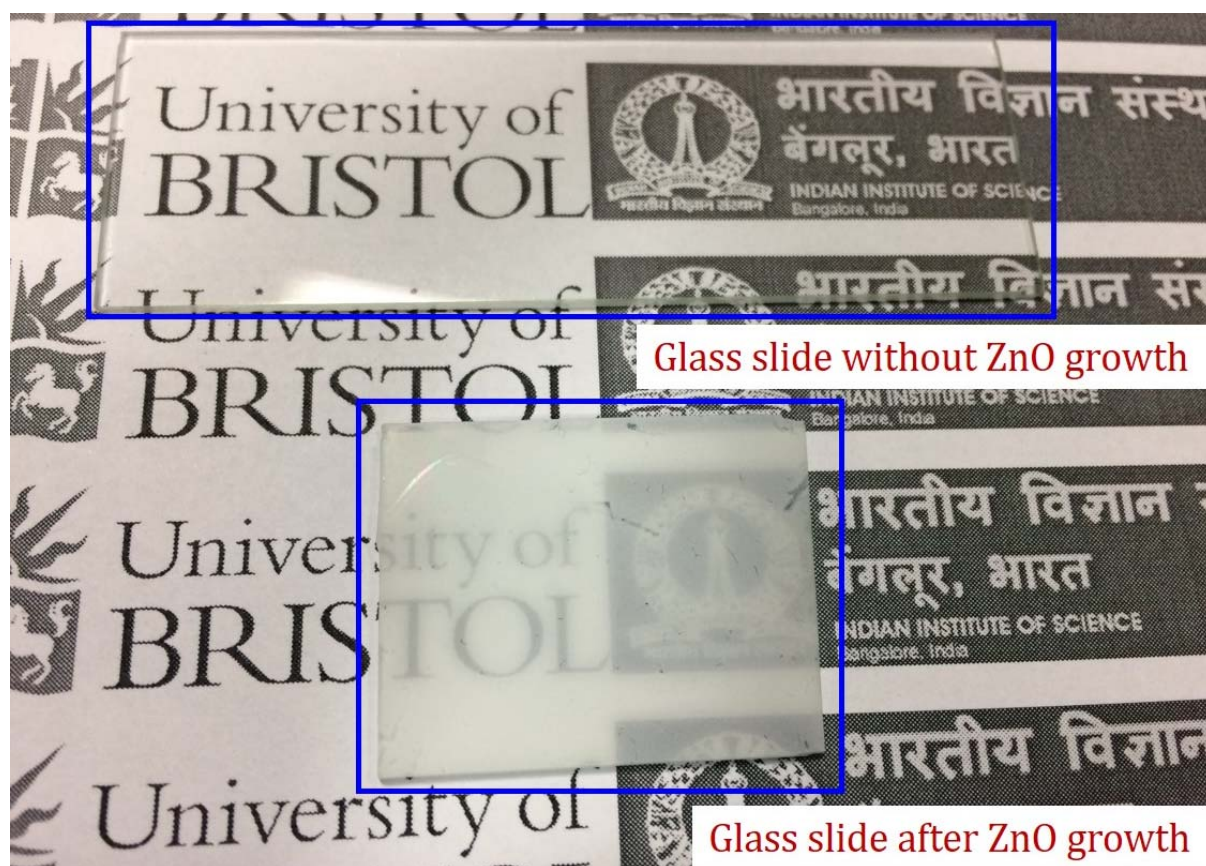



Figure S12: Optical image showing the loss in transparency after the formation of ZnO urchin/nanoneedles on the glass substrate.

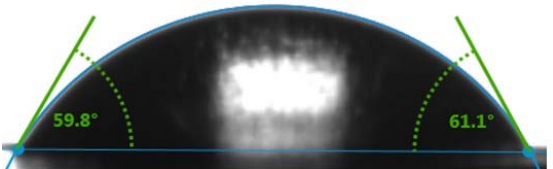
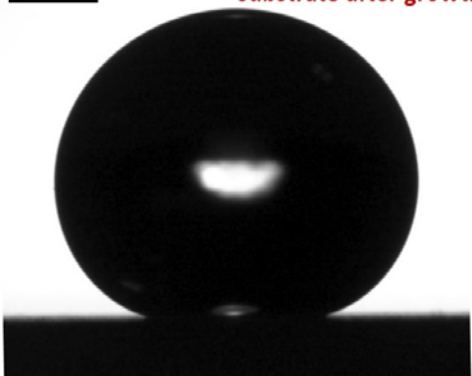
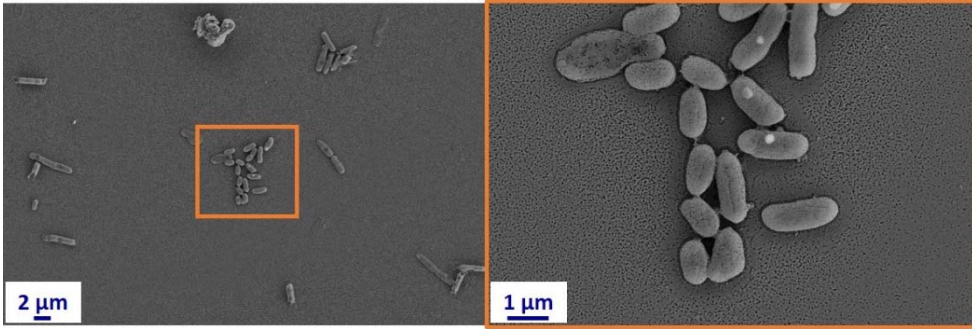
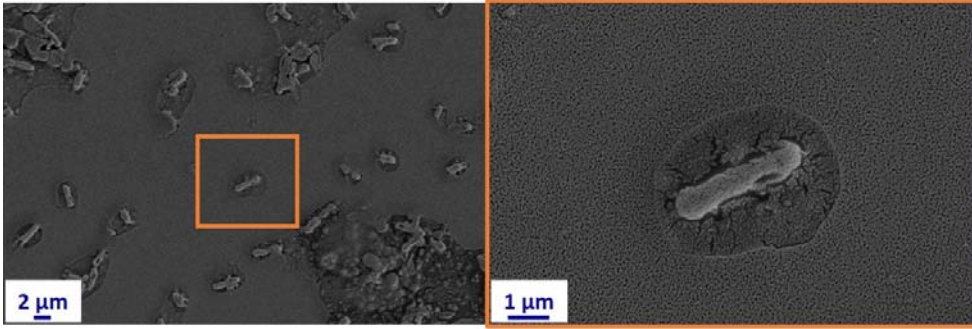
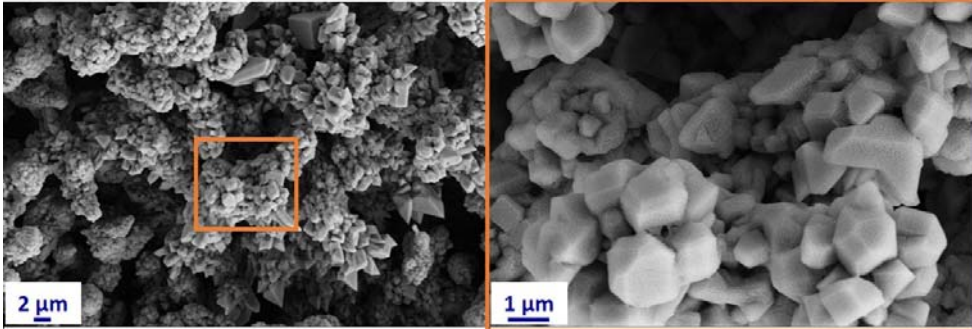
Table S1: Static contact angles of DI water droplet on different substrates

Bare, unmodified silicon *(Hydrophilic)* CA - 36.5°	
Silicon with 20 nm thin film of ZnO *(Hydrophilic)* CA - 59.8°	
Seeded silicon substrate with grown ZnO Urchins *(Superhydrophilic)* CA - 0°	
Non-seeded silicon substrate after growth *(Superhydrophilic)* CA - 0°	
Seeded silicon substrate with grown ZnO nanostructures with silanization *(Superhydrophobic)* CA - 159°	

Figure S13: 12 well culture plate for pouring the bacterial suspension on different samples.

Table S2: SEM of *E. coli* on different substrates

Bare, unmodified silicon *(bacteria observed on the surface)*

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| **Silicon with 20 nm thin film of ZnO** *(bacteria observed on the surface)* |

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| **ZnO Micro-urchin Surface** *(No bacteria colony was found on the surface. However, morphology of the ZnO nanowires was changed.)* |

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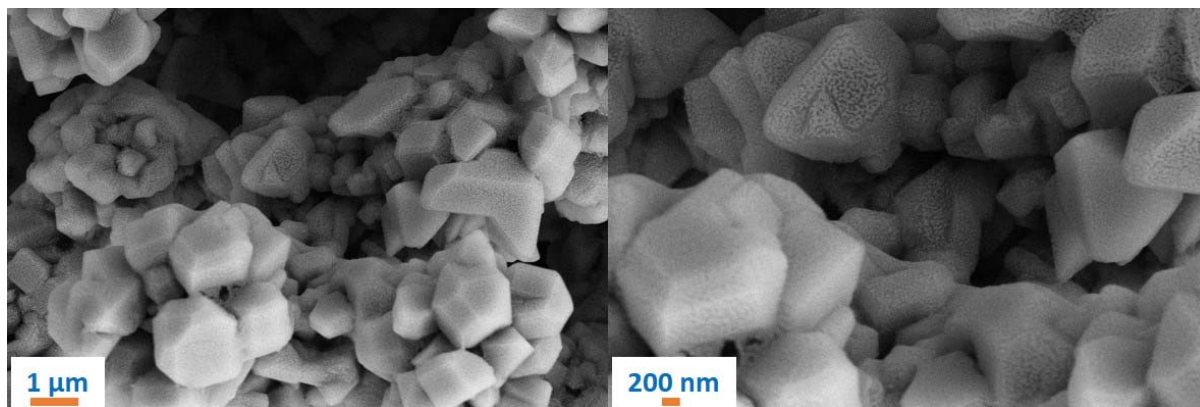
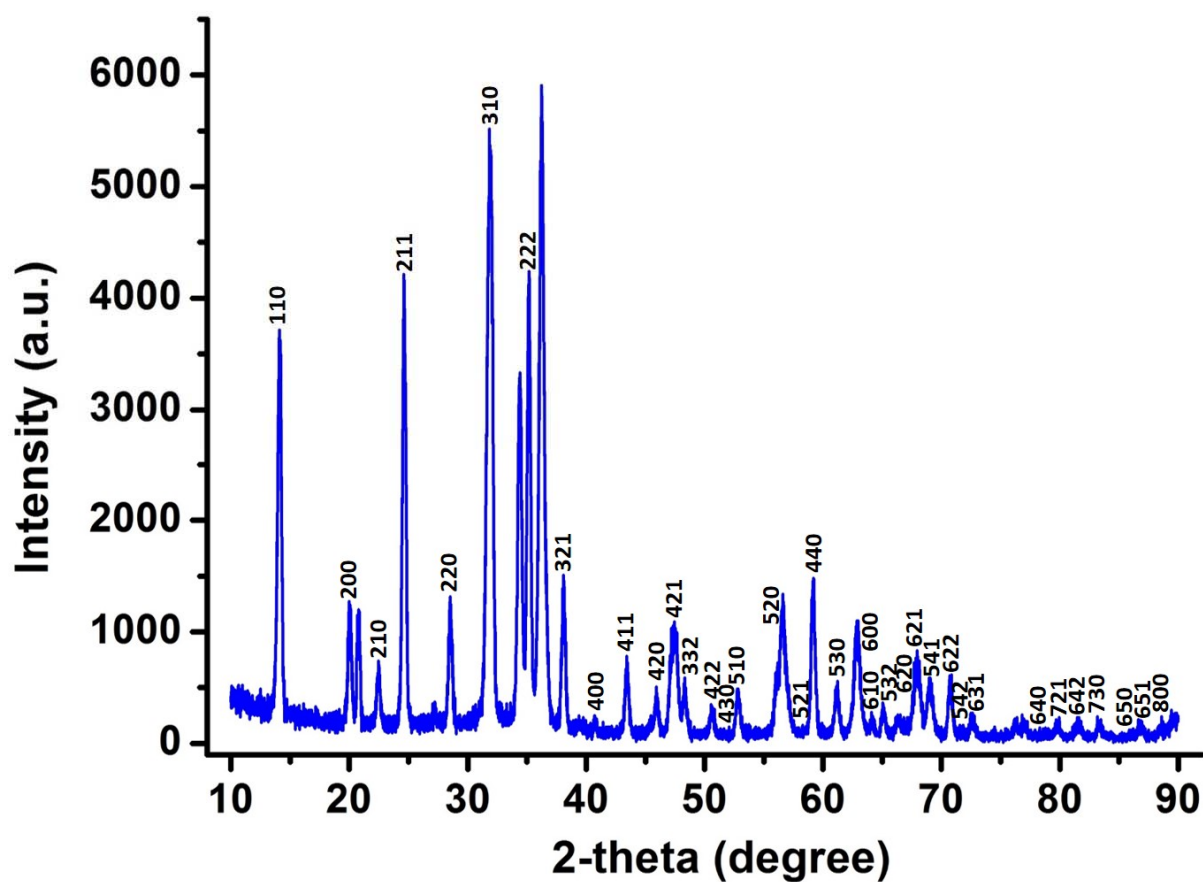

(a)

(b)

Figure S14: (a) SEM and (b) XRD of ZnO nanourchin surface after pouring the bacterial culture for 24 hours. Formation of sodium zinc phosphate hydrate (NaZn-PO$_4$.H$_2$O) was observed on the surface due to the reaction of ZnO with PBS leading to the change in morphology of the spiky ZnO nanowires.