Enhanced electron field emission properties of high aspect ratio silicon nanowire-zinc oxide core-shell arrays

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Supporting Information:

Energy Dispersive X-ray Spectorscopy (EDS):

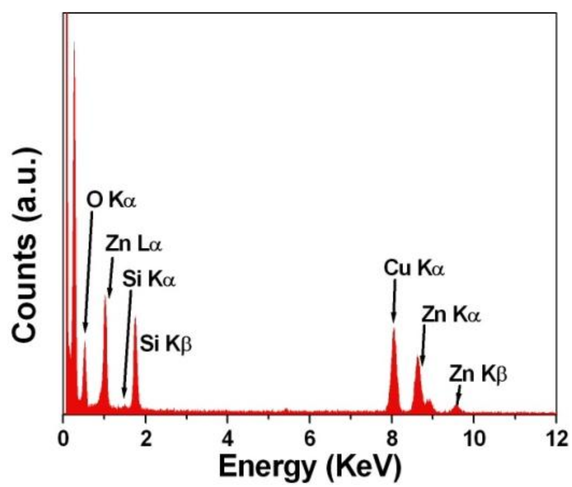

Fig. S1 Energy Dispersive X-ray Spectroscopy (EDS) analysis of SiNW-ZnO core-shell arrays.

EDS anaysis confirms the elements Si, Zn and O of the SiNW-ZnO arrays. Fig S1 shows the silicon has emission X-ray signals at K_α at 1.740 eV and K_β at 1.829 eV while Zn has L_α at

1.022 eV , K_α at 8.637 eV and K_β at 9.570 eV.Oxygen has K_α signals at 0.523 eV.The signal K_α at 8.040 eV is assigned for copper from the TEM grid.

AFM imaging:

The surface roughness changes effected after the ZnO coating are also studied by tapping mode atomic force microscopy (AFM) technique; accordingly the height profile AFM image in Fig. S2 a of blank SiNWs of 10 × 10 μm^2 area shows that the nanowires occur in bundles. Fig. S2 b is the linear section height profile of marked line in Fig. S2 a which shows that the surface roughness of the bundles of nanowires is ~ 350 nm which acts as the core arrays for the growth of ZnO. Similarly, Fig. S2 c is the height profile AFM image of SiNW-ZnO arrays of 10 × 10 μm^2 area shows that, after ZnO layer formation, there is no any change the orientation of SiNW arrays. Fig. S2 d is the linear section height profile of marked line in Fig. S2 c which shows that the surface roughness of ZnO layer on SiNW arrays is upto 120 nm. The significant change of surface roughness from 350 nm of blank SiNWs to 120 nm of SiNW-ZnO arrays is due to the uniform ZnO formation on SiNW arrays.

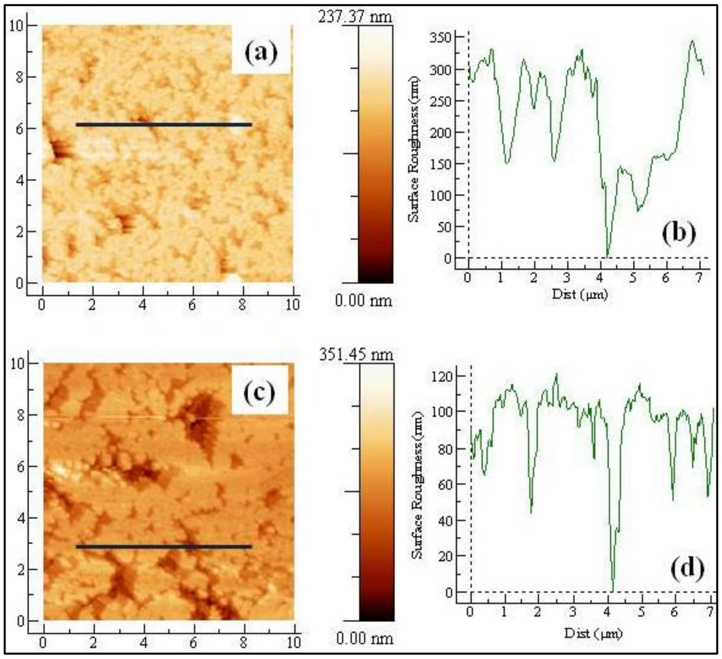

Fig. S2 (a) top surface AFM image of blank SiNWs and (b) cross sectional analysis of the marked line in Fig. S2 (a); similarly (c) top surface AFM image of SiNW-ZnO arrays and (d) cross sectional analysis of the marked line in Fig S2 (c).

Field Emission Stability data:

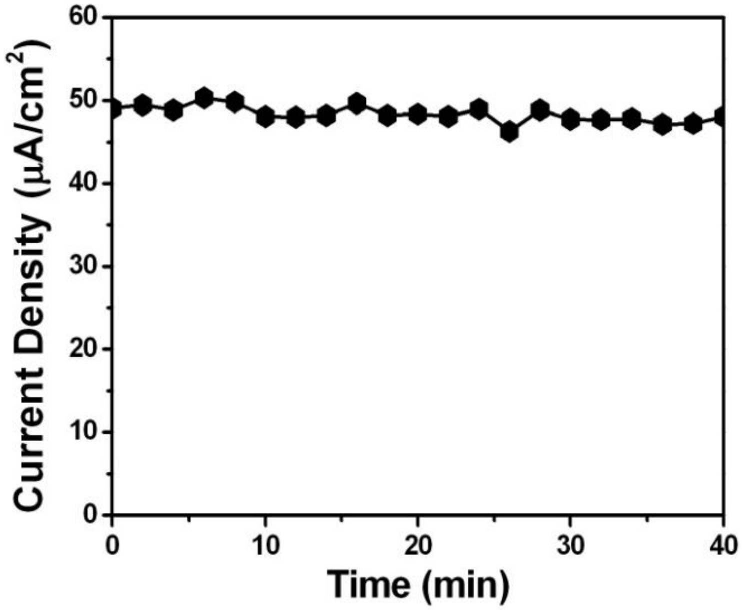

Fig. S3 Field Emission stability data of SiNW-ZnO core-shell arrays at 11 V μm^{-1} .

Field Emission stability data for SiNW-ZnO arrays shown in Fig. S3 confirms that the core-shell arrays are stable for 40 minutes at the applied potential of 11 V μm^{-1}. It is also notable that their no current degradation during the measurement.

FESEM images after FE measurements:

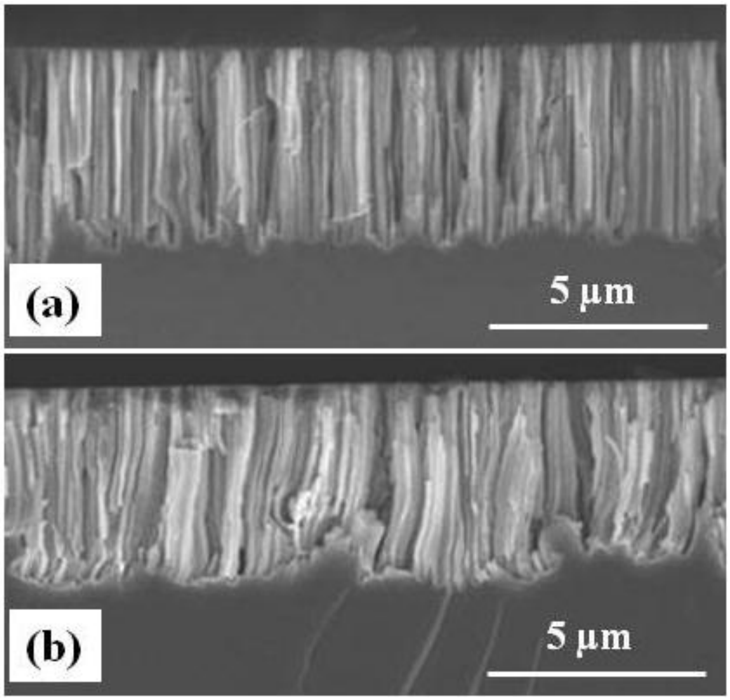

Fig. S4 (a) and (b) are vertical section FESEM images of blank SiNW and SiNW-ZnO arrays after field emission (FE) measurements respectively.

Fig. S4 (a) and (b) shows a FESEM images after the field emission measurements of blank SiNW and SiNW-ZnO arrays respectively. There is no obvious deterioration even after a typical long-term operation indicating the excellent mechanical stability of these core-shell arrays with no field induced mechanical stresses. This excellent current stability would be an asset for sustained performance of the emitters.