Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

ZnO/ITO core/shell nanostructure electrodes for future prototype solar cell devices

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SI-1: Few details about the future prototype PV device using hierarchical hetero nanostructures.

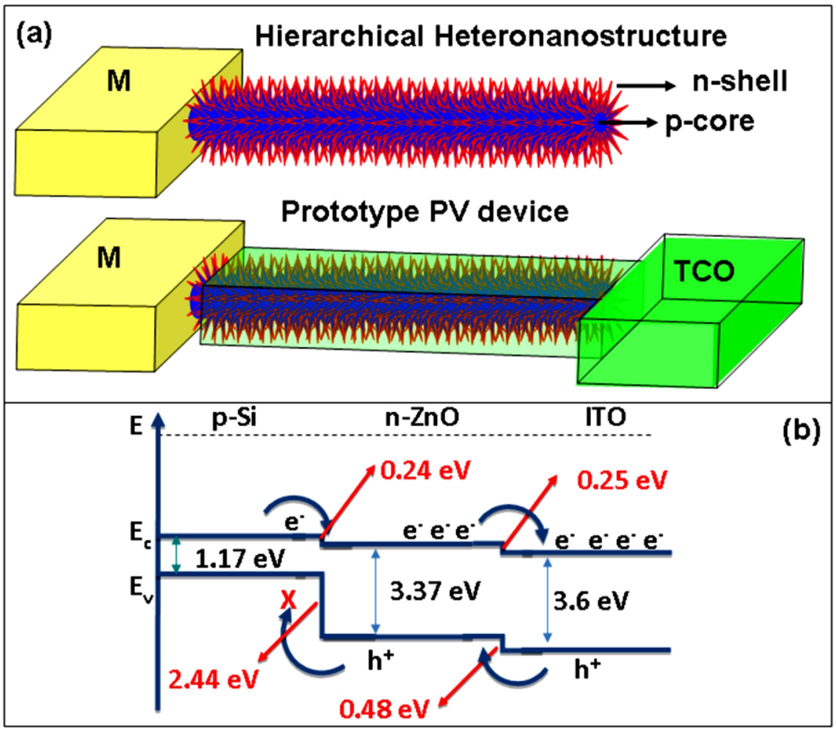


Figure S1: (a) Schematic representation of future prototype photovoltaic device will be fabricated using a single hierarchical heteronanostructure. (b) Energy band diagram of hierarchical heteronanostructure with TCOE (For example, ZnO-branches with ITO-TCO layers on p-Si NW).

SI-2: Fabrication of ZnO/ITO NRs based device.

ZnO/ITO NRs annealed at 500 °C was used for the fabrication of diode. Here the device was fabricated in two steps using a bilayer photolithographic mask, explained below:

Step-1: i) ZnO/ITO core/shell nanostructures dispersed in ethanol solution was doped on SiO2/Si substrate and then dried with nitrogen gas.
ii) Spin coated the photo resist (AZ1512) and baked at 110 °C for 1 min 30 s.
iii) Pattern of mask 1 was exposed and then developed by immersing in MIF 500 solution for 25 s then cleaned with deionized water. Then, the structures were dipped for a few seconds in ITO etchant (mixture of HCl+HNO3+H2O) to etch 50 nm ITO layer and followed by DIW.
iv) Ni/Au layers (100/50 nm) were deposited at room temperature by e-beam evaporation and then, photo resist was lifted off.

Step-2: Similar steps were followed for second contacts (Au~200 nm) using mask 2.

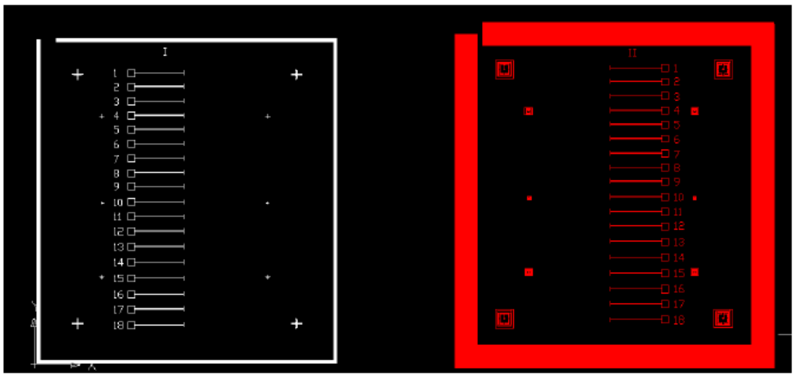


Figure S2: Images of bilayer photolithography mask 1 (left) and mask 2 (right)

SI-3: Elaborated XRD plots (between 49 and 53°) of as-grown and annealed ZnO/ITO core/shell structures.

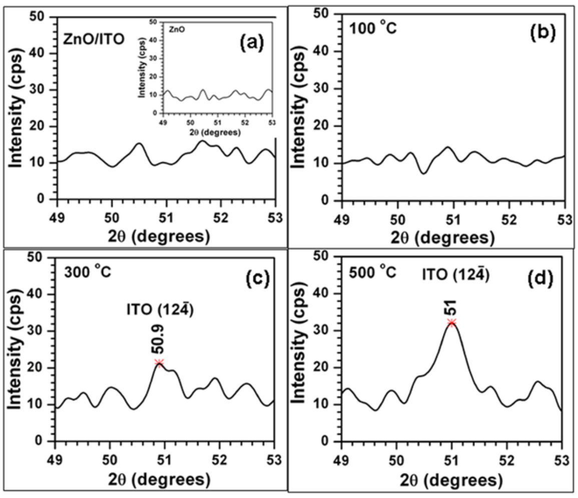


Figure S3: The elaborated XRD plots of (a) as-grown ZnO/ITO (inset shows the XRD plot of as-grown ZnO NRs), and (b-d) annealed at 100, 300, and 500 °C, respectively.

SI-4: FWHM and lattice constant 'c' values of ZnO, and ZnO/ITO structures.

Structures	**Peak position (2θ°)**	**FWHM (2θ°)**	**Lattice constant 'c nm'**
ZnO	34.34	0.250	0.522
ZnO/ITO	34.33	0.545	0.522
100 °C	**34.31**	**0.598**	**0.521**
300 °C	34.32	0.474	0.522
700 °C	34.34	0.419	0.522

SI-5: HRTEM images of as-grown ZnO/ITO core/shell structures.

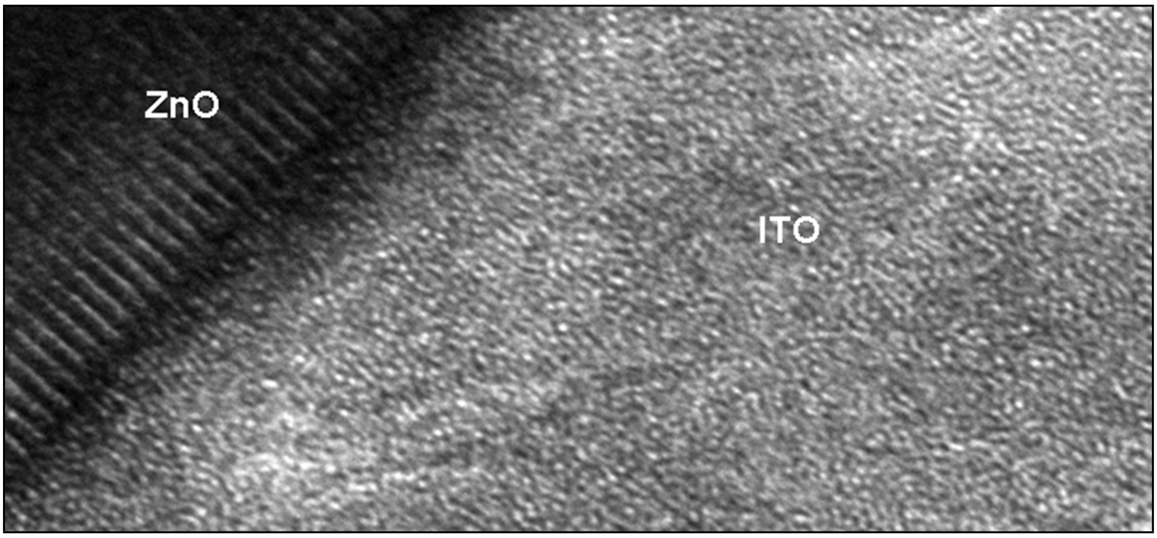
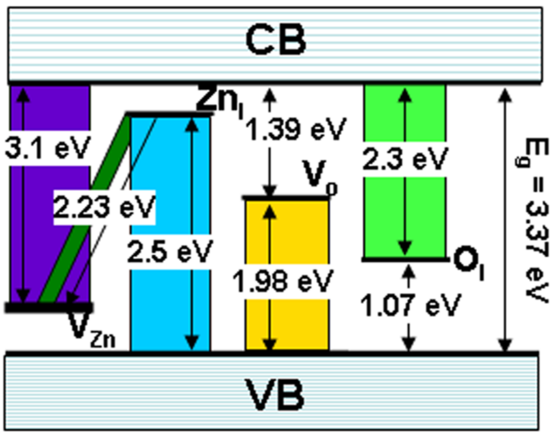


Figure shows the well-crystallized ZnO NR and amorphous ITO nanostructures.

SI-6: Schematic representation of energy level band diagram of ZnO with its impurity levels [x, y].



[x] A. Urbieta, P. Fernandez, and J. Piqueras, J. Appl. Phys., Vol. 96, 2004, 2210.
[y] A. Urbieta, P. Fernandez, and J. Piqueras, Appl. Phys. Lett., Vol. 85, 59687, 2004.

SI-7: (a) Elaborated PL spectra of ZnO/ITO core/shell nanostructures, the elaborated PL peak exhibited at 593 nm is shown in (b).