Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

Enhanced photodetection and a wider spectral range in In_2S_3-ZnO 2D-3D heterojunction: Combined optical absorption and enhanced carrier separation at the type-II heterojunction

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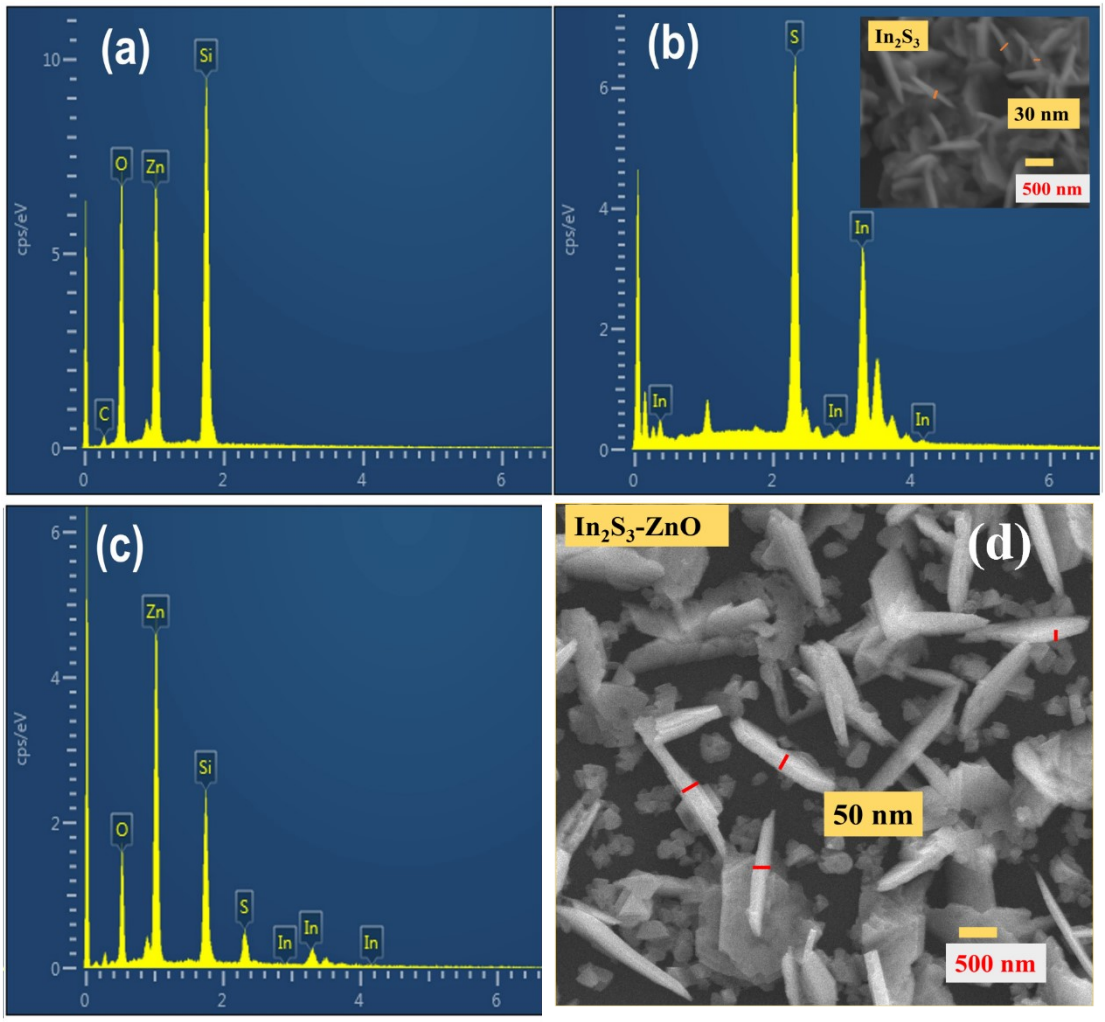


Figure S1 (a) EDX for ZnO, (b) EDX for In_2S_3 with cross-sectional image of In_2S_3 in the inset, (c) EDX for the In_2S_3/ZnO heterojunction (d) cross-sectional image of the heterojunction showing

The chemical composition of the samples is analyzed by EDX spectra which show the presence of Zn and O in the ZnO thin films with In and S elements present non continuously in the 2D-In_2S_3 and continuous presence of Zn, O, In, and S in the In_2S_3-ZnO heterojunction sample.

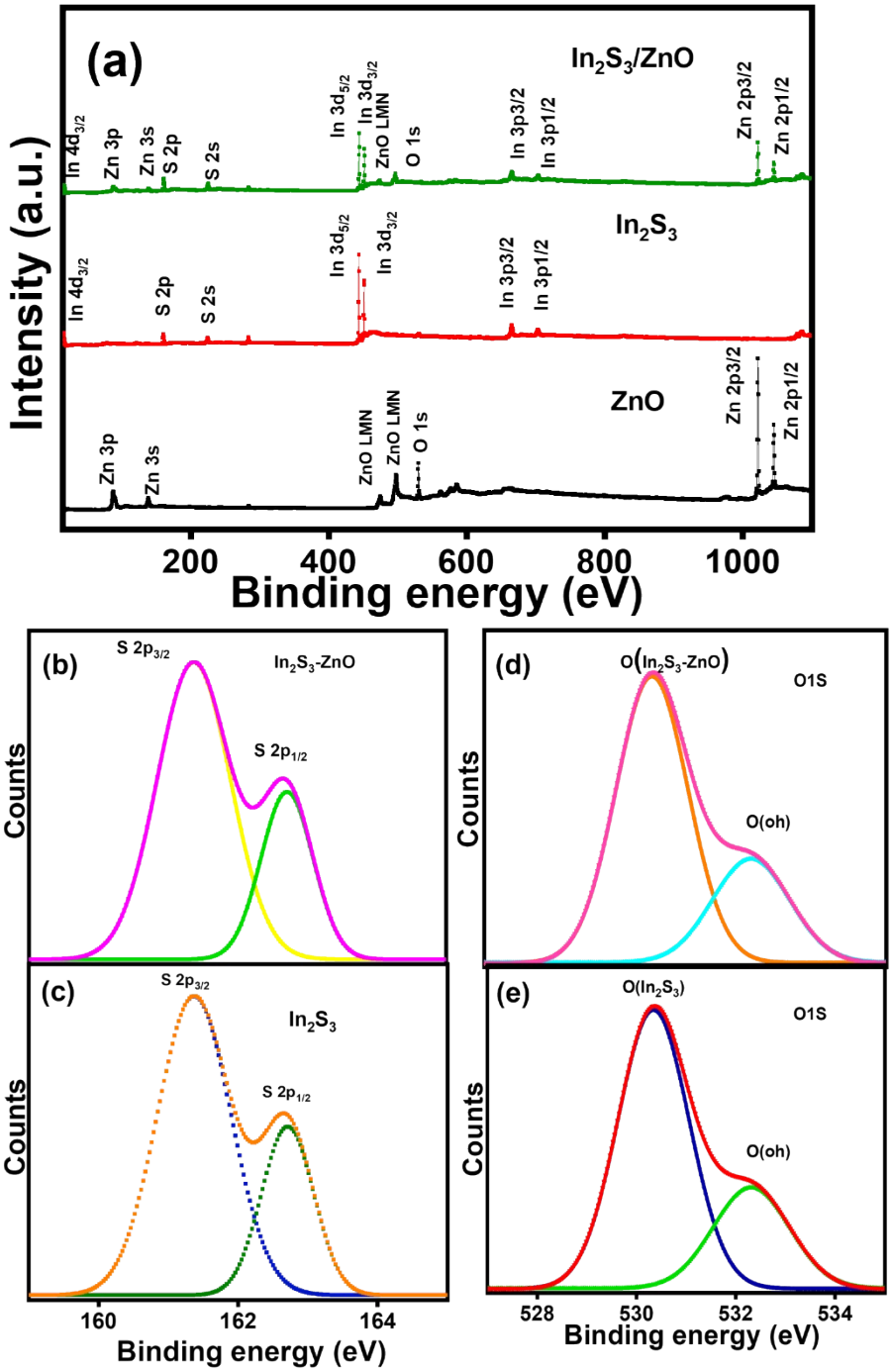
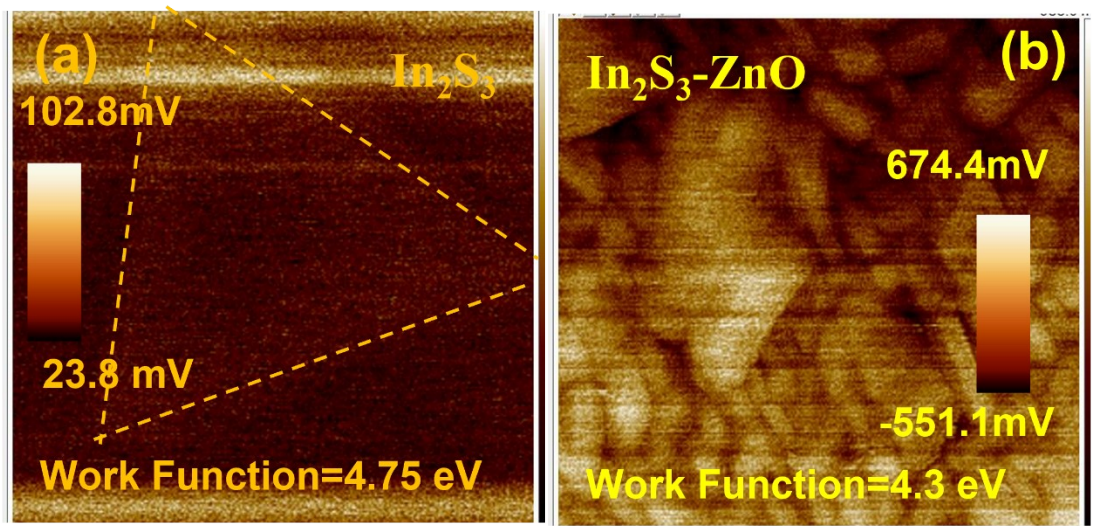


Figure S2(a) Survey spectra for the pristine In_2S_3, ZnO and In_2S_3-ZnO heterojunction sample, show the presence of In, S, Zn and O over the entire sample, these results are consistent with EDX spectra. (b) and (c) the deconvoluted spectra for sulfur present in both pristine In_2S_3 and the In_2S_3-ZnO heterojunction (d) and (e) the deconvoluted spectra for oxygen in both ZnO and the heterojunction In_2S_3-ZnO.

Figure S3 (a) and (b) have shown AFM potential images for the In_2S_3 and the In_2S_3-ZnO heterojunction with the thickness of nanoflakes around 30 nm for pristine In2S3 and 50 Nm for the In_2S_3-ZnO heterojunction. The work function value is 4.75 eV for the In_2S_3 and 4.3 eV



for the heterojunction which implies that both behave differently in the photoresponse.

For pristine ZnO, photocurrent values are of the order of 7×10^{-7} A and dark current 3.9×10^{-7} A. For In_2S_3, the current is the order of 4×10^{-5} A and dark current 1.4×10^{-5} A at +1 V, while in the In_2S_3-ZnO heterojunction sample, the current in light is of the order of 0.28×10^{-3} A which is 10^4 and 10^2 times higher than pristine ZnO and In_2S_3 respectively.

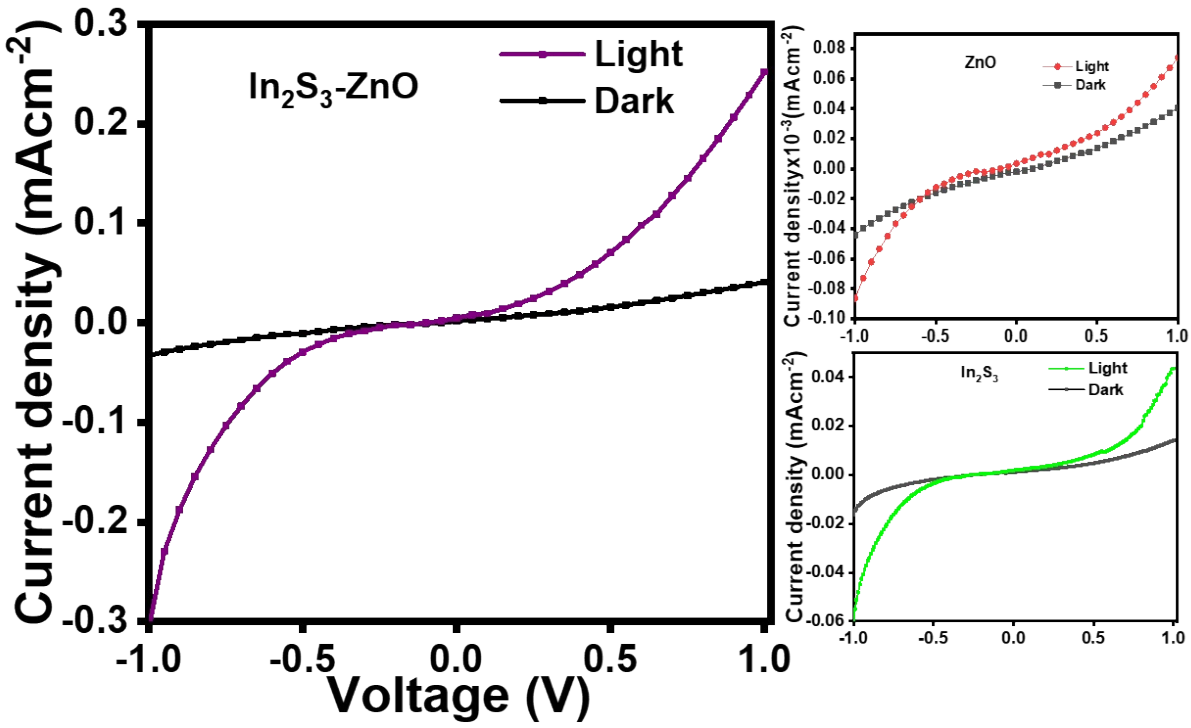


Figure S4 shows I-V characteristics (current density variation with voltage) under dark and white light illumination for In_2S_3-ZnO heterojunction, pristine In_2S_3, and ZnO thin film samples.

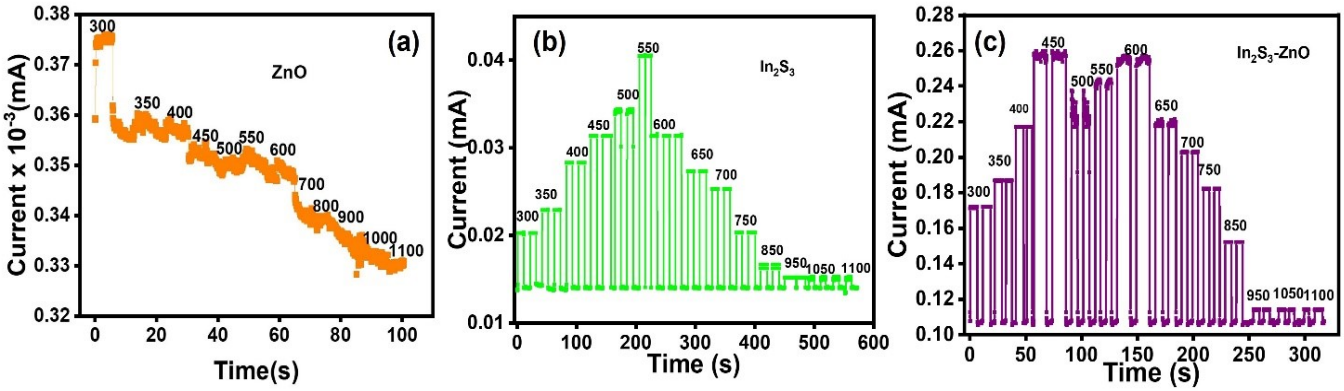


Figure S5 (a) ZnO thin films of the thickness of 100 nm exhibit a high response of 3.2 × 10^{-4} $mAcm^{-2}$ at wavelength 300 nm in the UV region and a minimal 2.5 × 10^{-5} $mAcm^{-2}$ response for the visible wavelength range 400-700 nm, because of its wide bandgap (3.2 eV) value. (b) Nanoflakes of In_2S_3 show photoresponse in the visible region of 400-800 nm, which includes a maximum current of 0.05 $mAcm^{-2}$ for the 550 nm wavelength close to the bandgap (2.2 eV) of In_2S_3 and a current of 0.02 $mAcm^{-2}$ for wavelength 800 nm. (c) In_2S_3-ZnO heterojunction exhibits higher photoresponse and current density within the entire UV-Visible wavelength range of 300-800 nm with a maximum photocurrent value of 0.3 $mAcm^{-2}$ at the wavelength 450 nm. The measurements also revealed that the heterojunction shows more photocurrent than the ZnO and In_2S_3 samples for the entire UV-Vis range.

References

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