Electronic Supplementary Information (ESI)

MoS_2 nanodots decorated In_2S_3 nanoplates: a novel heterojunction with enhanced photoelectrochemical performance

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Experimental Details

Synthesis of In_2S_3 nanoplates:

110.6 mg $InCl_3$ (99.9%, Aladdin), 24 mg S (AR, Sinopharm Chemical Reagent), and 10 mL oleylamine (C-18 content 80%-90%, Aladdin) were added into a three-neck flask (100 mL) connected to a Schlenk line (all chemicals were used as received). Then the temperature was raised up to around 110 °C with stirring, for degassing about an hour and purging with Ar for 3 times. All reaction conditions were kept inert to prevent the formation of the oxide. Then, the flask was heated to 215 °C and kept for 1 h. The final yellow precipitant was dispersed in approximately 20 mL toluene to form a stable ink solution.

Synthesis of MoS_2 nanodots：

163.1 mg $Mo(acac)_2$ [bis(acetylacetonato)dioxomolybdenum)] (97%, Aladdin), 32 mg S (AR, Sinopharm Chemical Reagent) powder and 10 mL oleylamine (C-18 content 80%-90%, Aladdin) were added into a three-neck flask (100 mL) connected to a Schlenk line. Then the temperature was raised up to around 110°C with stirring, for degassing about an hour and purging with Ar for 3 times. All reaction conditions were kept inert to prevent the formation of the oxide. Then, the flask was heated to 300 °C and kept for 1 h. The final black precipitant was dispersed in approximately 20 mL toluene to form a stable ink solution.

Preparation for In_2S_3, MoS_2 and In_2S_3/MoS_2 nanocomposite films：

In_2S_3, MoS_2 and In_2S_3/MoS_2 nanocomposite were dissolved in toluene solution. To prepare films for optical and photoelectrochemical tests, 0.2-0.3 mL solution of the materials was coated on soda-lime glass (SLG) and FTO glass, respectively. Then the samples were kept in the draught cupboard to naturally evaporate toluene.

Materials characterizations

TEM images were obtained on a JEM-2100F field-emission transmission electron microscope with a working voltage of 200 kV. Raman spectra were obtained on a Jobin-YvonLabRamHR800-Horiba spectrometer with the wavelength of 532 nm. The optical absorption spectra were collected using a Hitachi U-4100 spectrophotometer. X-ray photoelectron spectroscopy (XPS) analysis was performed with the Spectrometer of Thermo-VG Scientific ESCALAB 250Xi. The photoelectrochemical characterization and EIS tests of the film were carried out in 0.2 M Na_2S+Na_2SO_3 solution in a Pyrex electrolytic cell. A 300 W xenon lamp was used as the light source, and the light intensity was kept at 40 mW/cm^2. Mott-Schottky plots were obtained in 0.1 M Na_2SO_4 solution without irradiation. The ICP test was performed using the Thermo Scientific iCAP 7000 series ICP Spectrometer.

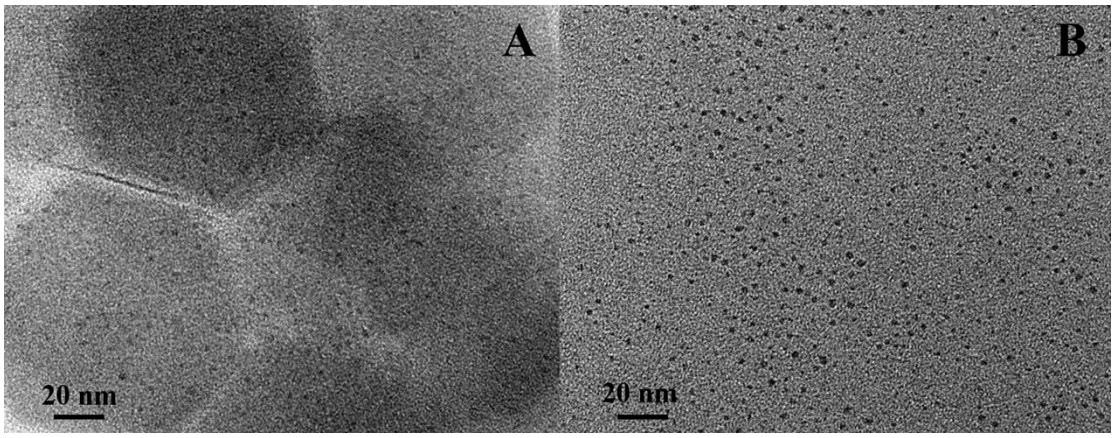

Fig. S1 Additional TEM images of the obtained In_2S_3/MoS_2 composite.

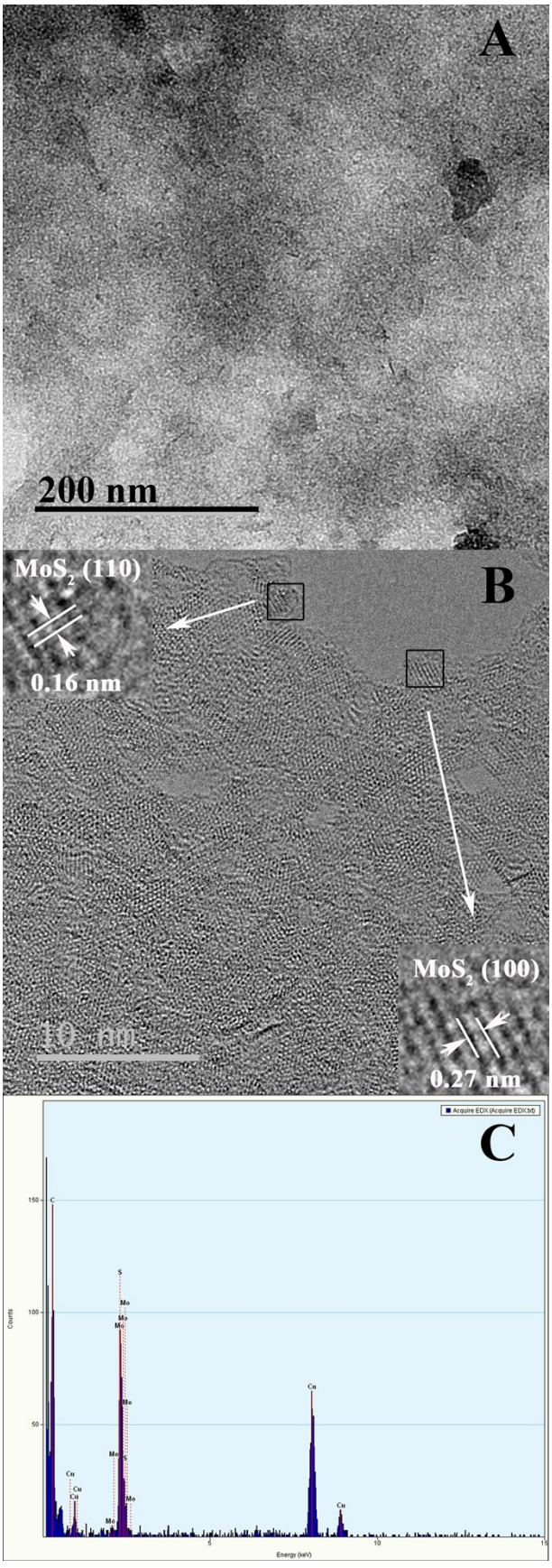

Fig. S2 (A) TEM, (B) HR-TEM images and (C) EDS spectrum of MoS_2 nanodots.

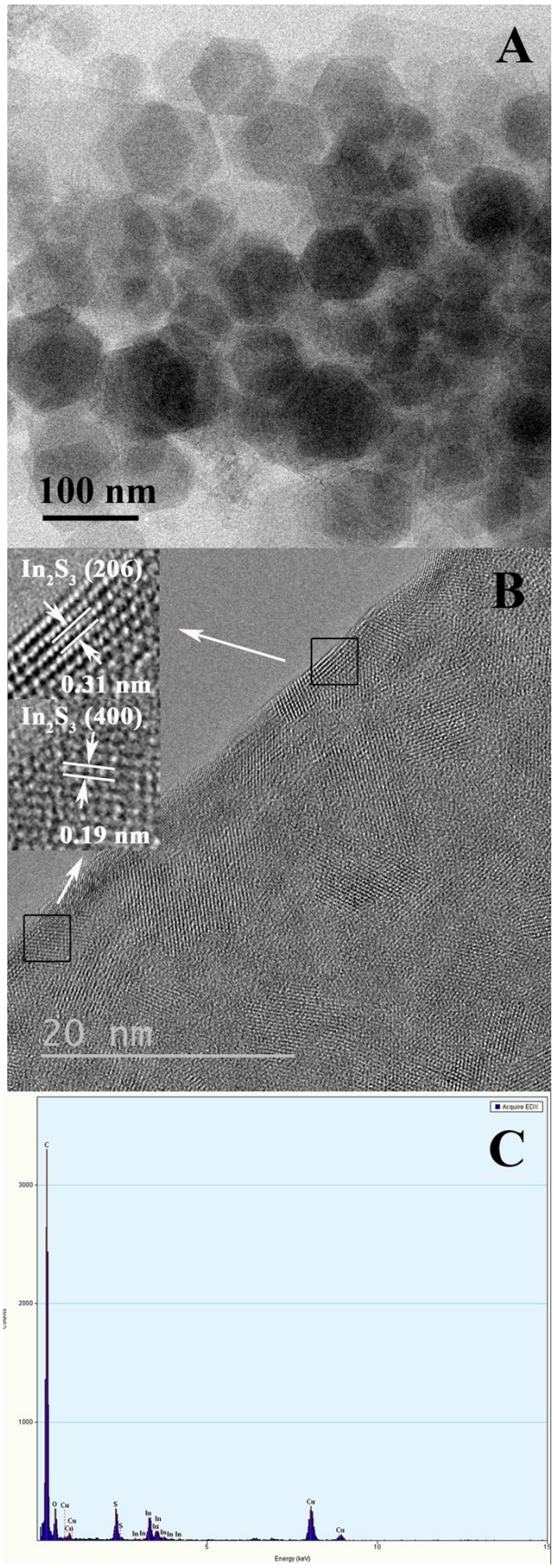

Fig. S3 (A) TEM, (B) HR-TEM images and (C) EDS spectrum of In_2S_3 nanoplates.

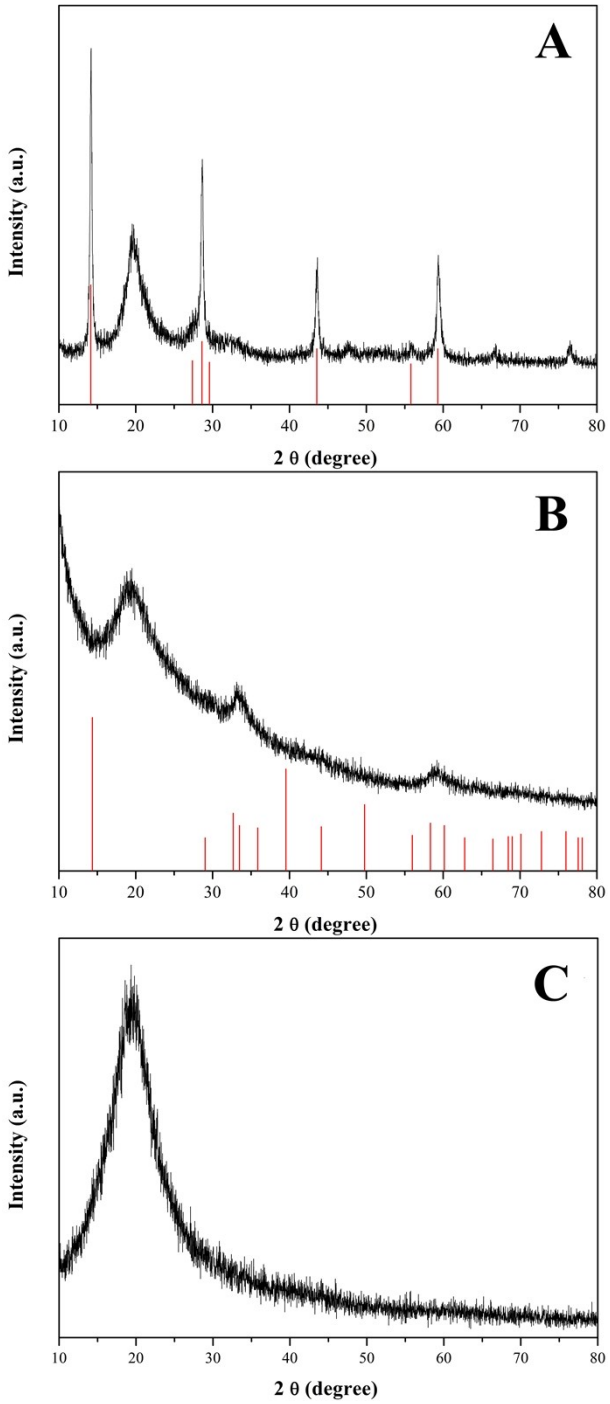

Fig. S4 XRD patterns of (A) In_2S_3, (B) MoS_2 and (C) Oleylamine.

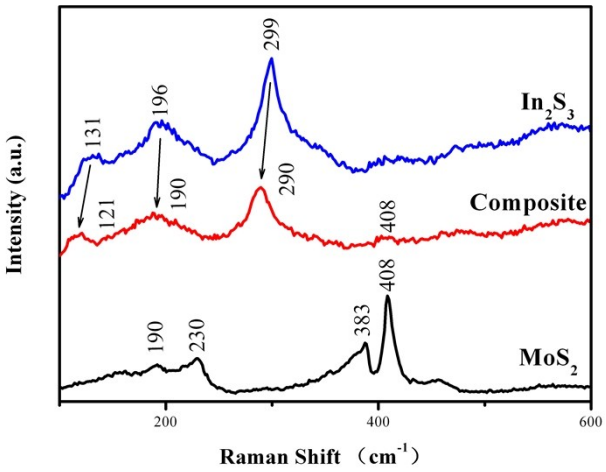

Fig. S5 Raman spectra of In_2S_3, MoS_2 and In_2S_3/MoS_2 nanocomposite.

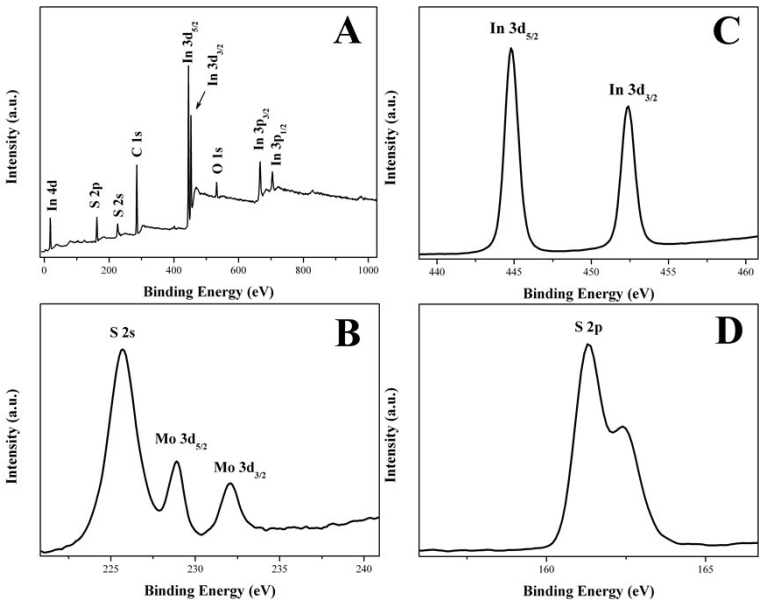

Fig.S6 The XPS spectra of the In_2S_3/MoS_2 nanocomposite:
(A) Survey , (B) Mo 3d, (C) In 3d and (D) S 2p.

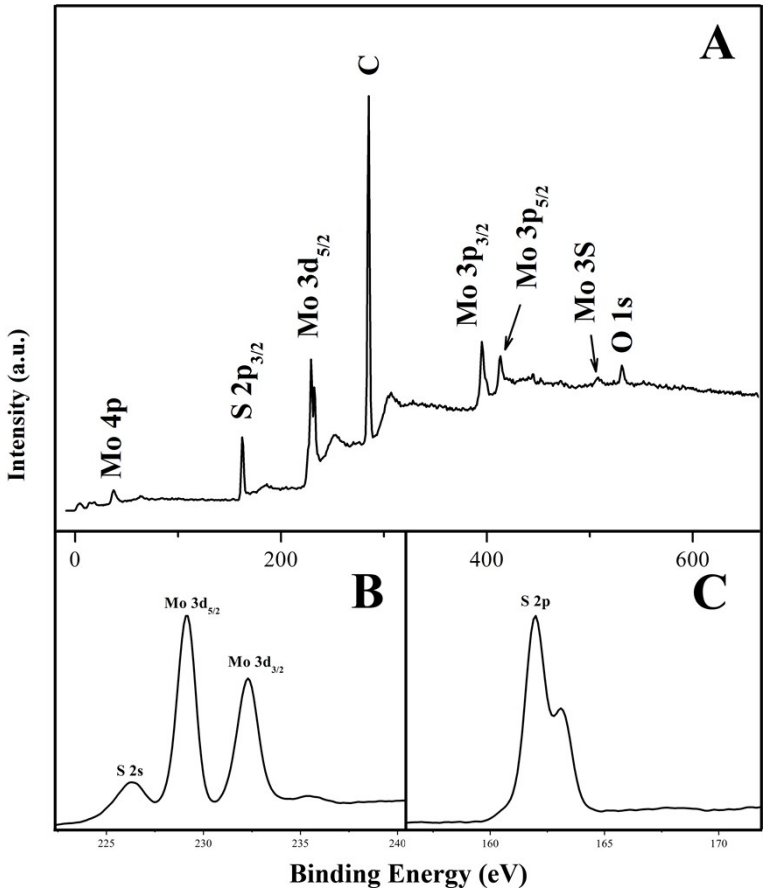

Fig. S7 The XPS spectra of MoS_2 nanodots: (A) Survey, (B) Mo 3d and (C) S 2p.

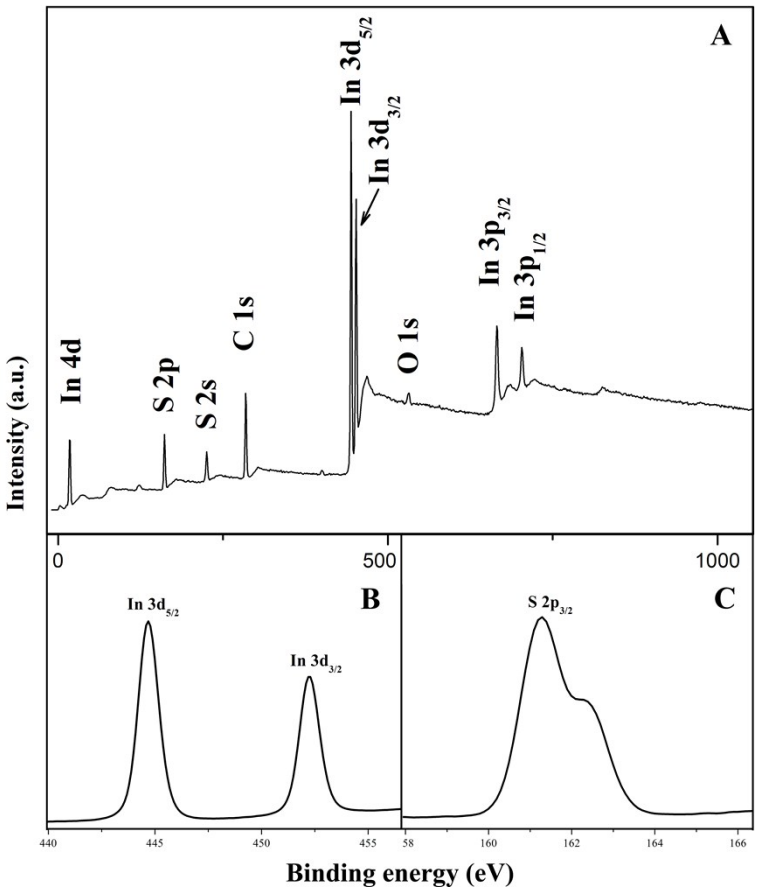

Fig. S8 The XPS spectra of In_2S_3 nanoplates: (A) Survey, (B) In 3d and (C) S 2p of In_2S_3

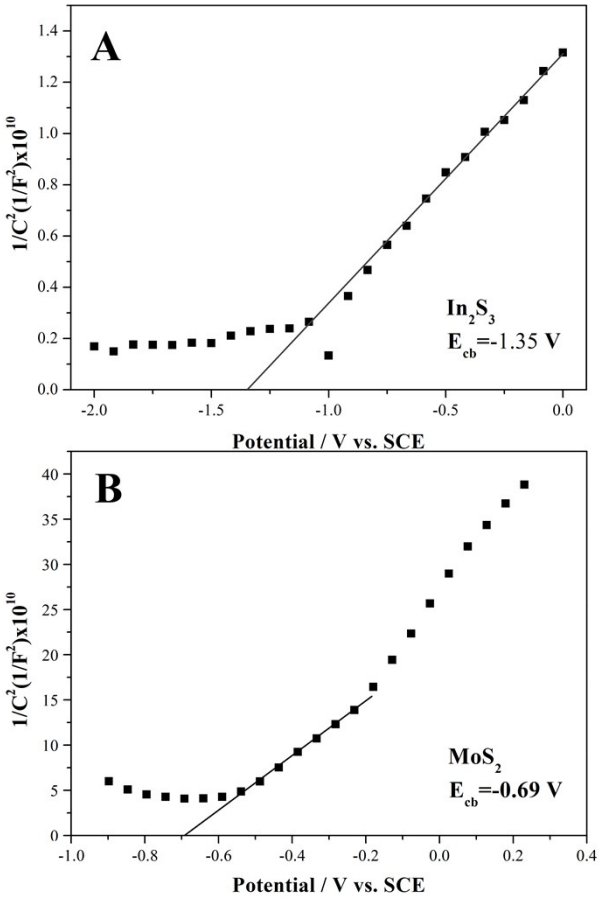

Fig. S9 Mott-Schottky plots of (A) In_2S_3 and (B) MoS_2 in 0.1 M Na_2SO_4 solution under the dark condition.

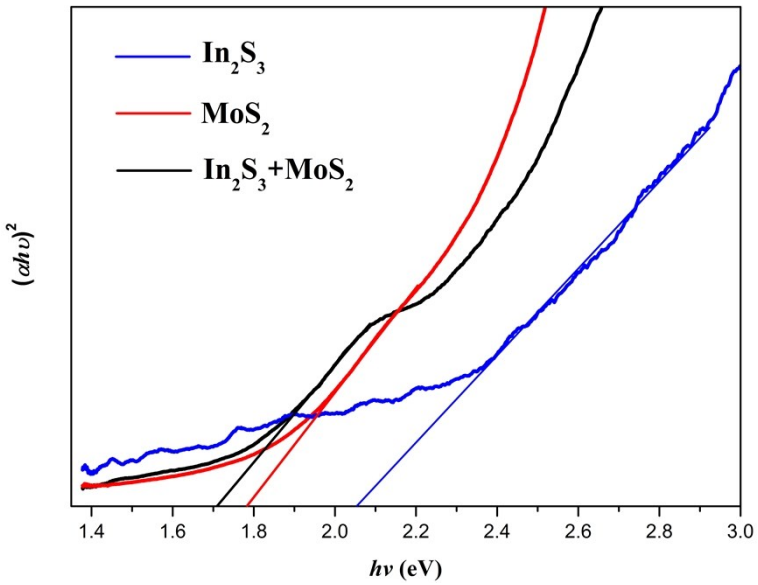

Fig. S10 Band gap values of In_2S_3, MoS_2 and In_2S_3/MoS_2 composite.