Supporting Information

Photocurrent measurements

All photocurrent measurements were conducted with sodium sulphite, a sacrificial hole scavenger commonly used in photoelectrochemistry. The reaction mechanism for the oxidation of sulphite is detailed below:

$$SO_3^{2-} + 2hole + H_2O \rightarrow 2H^+ + SO_4^{2-}$$

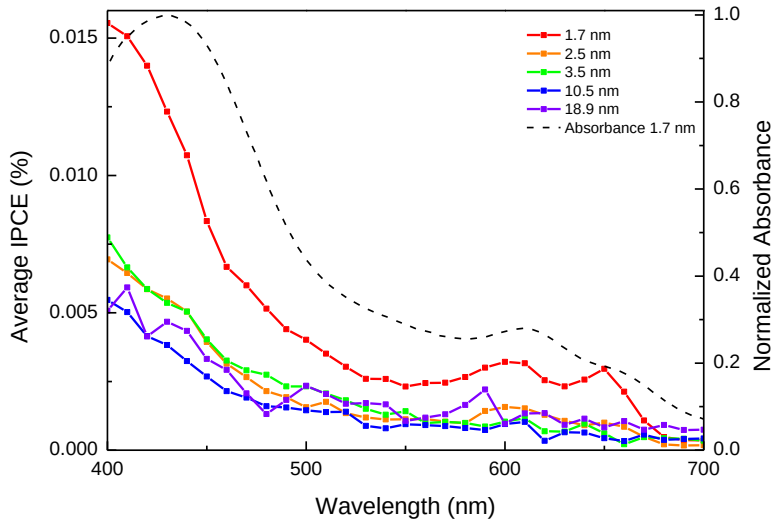

Figure S1.IPCE spectra for the different thicknesses for the MoS_2 only films.

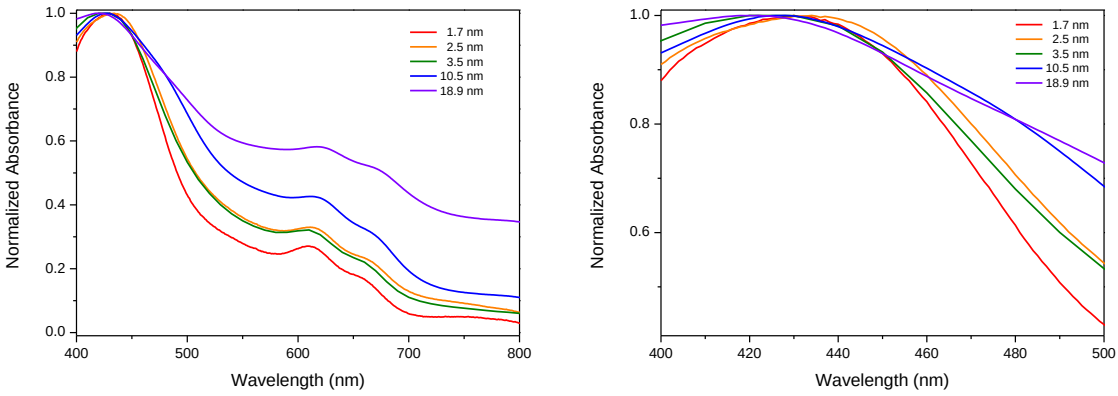

Figure S2. Normalized absorbance spectra (a) entire spectra, (b) 400 – 500 nm only, highlighting the red shift in absorbance peak for the thinnest films.

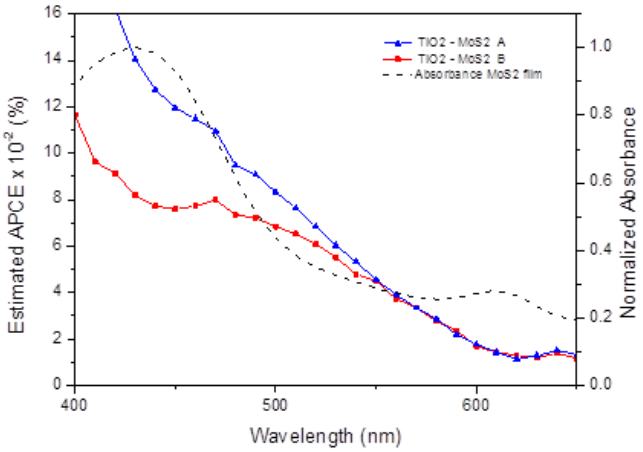

Figure S3. Estimated APCE for the composite films A and B (estimatedby calculation of the known concentrations of MoS_2 dispersed into each film).

Photocurrent measurements of the MoS_2-TiO_2 hybrid photoanodes was also measured utilizing iodine/triiodide electrolyte. The results are presented in Figure S4. Analogous to Figure 4 a photocurrent corresponding to excitons A/B is suppressed relative to the absorbance spectrum for the thin films. We therefore verify the assertion that conduction band is approximately -0.13 V ±0.05V (against SHE reference).

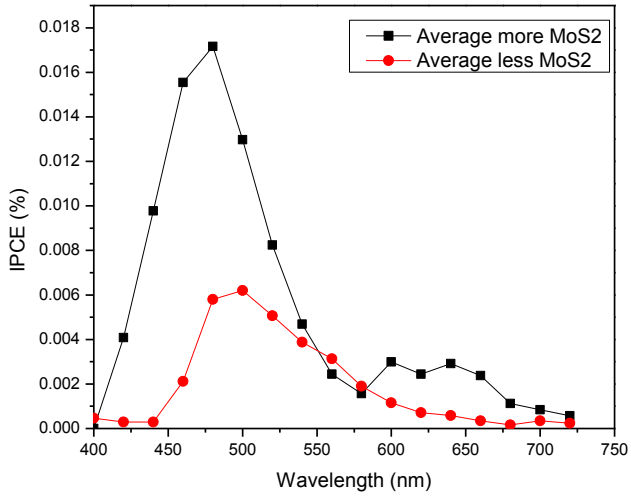

Figure S4. Average photocurrent for two ratios of MoS_2/TiO_2 samples. Averages are calculated for 2 samples for each ratio and 3 measurements for each sample. Photocurrent was measured with Iodide/tri-iodide electrolyte.

To monitor the photoanodes for stability repeat runs of the same electrodes was completed. Figure S5 shows an example of three consecutive runs of a MoS_2 only photoanode.

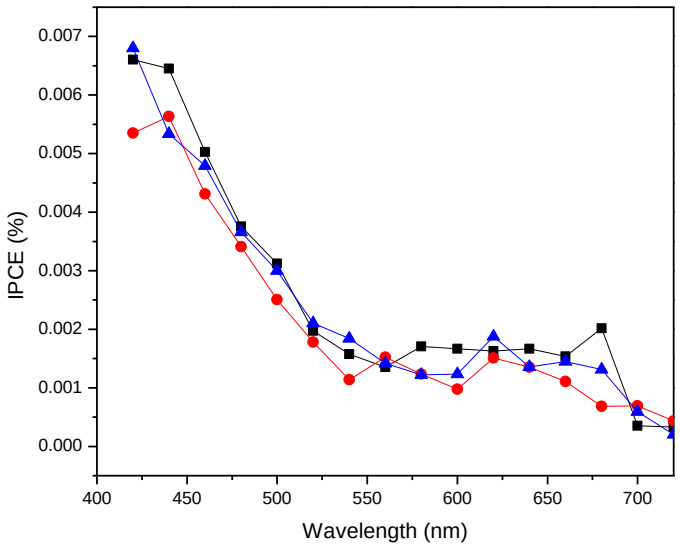

Figure S5. Three consecutive photocurrent measurements of the same photoanode.

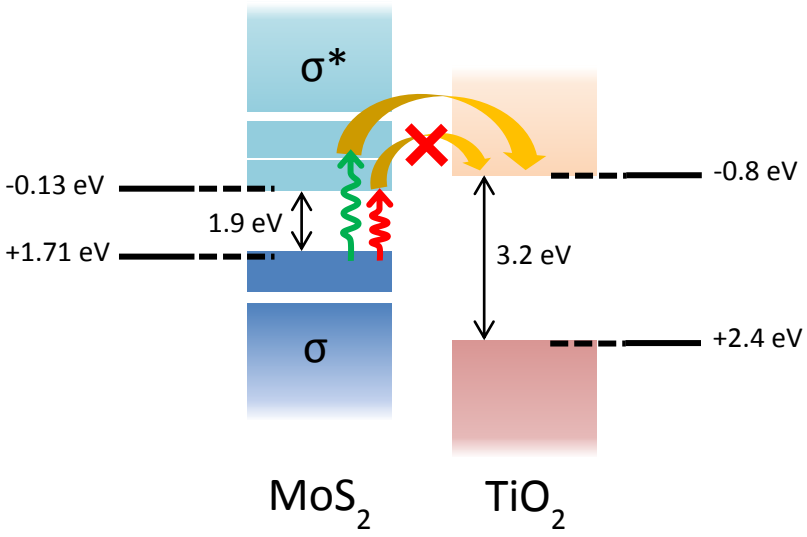

Figure S6. Approximate band structure of MoS2 and TiO2. Details of the conduction band maxima and valance band minima are given (against NHE).