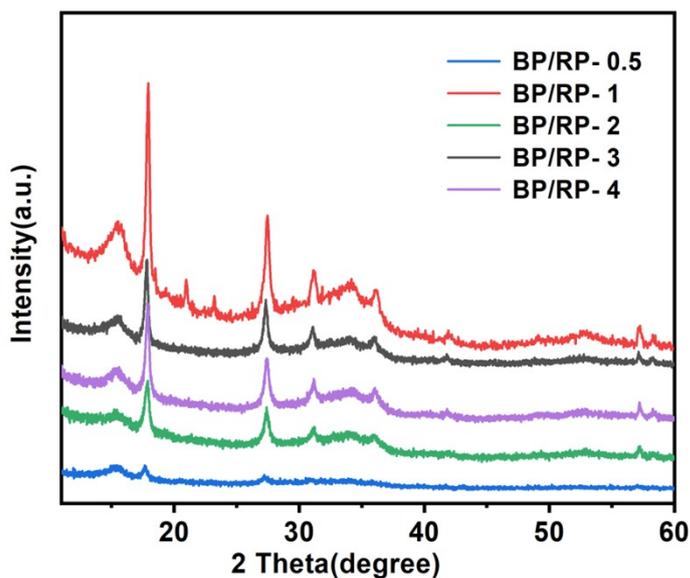


## Supporting Information

### In situ growth of metal free 1D/2D phosphorus Z-scheme heterostructure for photocatalytic overall pure-water splitting



**Figure S1.** XRD patterns of different samples prepared from red phosphorus under various ratios of red phosphorus to ethylenediamine.

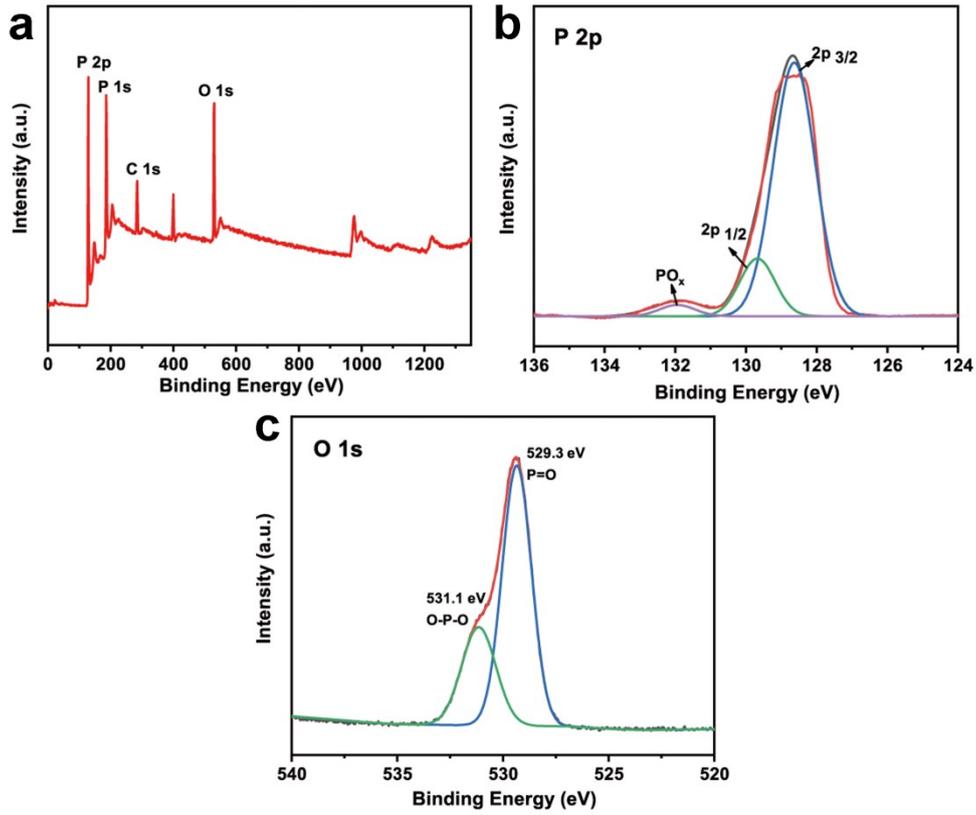


Figure S2. a) survey; b) P 2p and c) O 1s XPS spectrum of the BP/RP heterostructure.

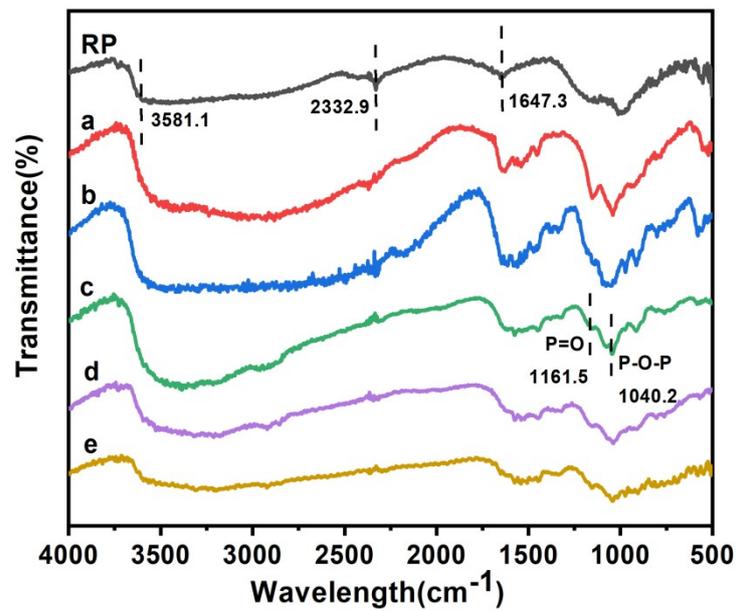
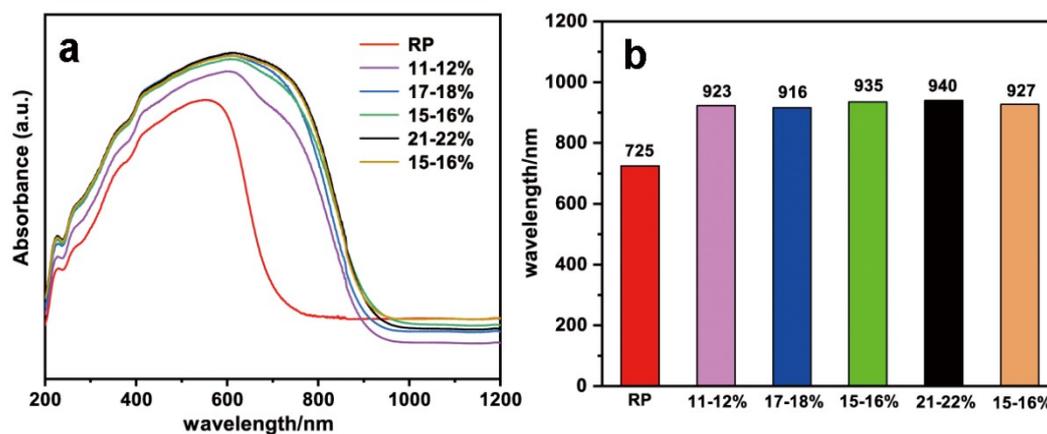
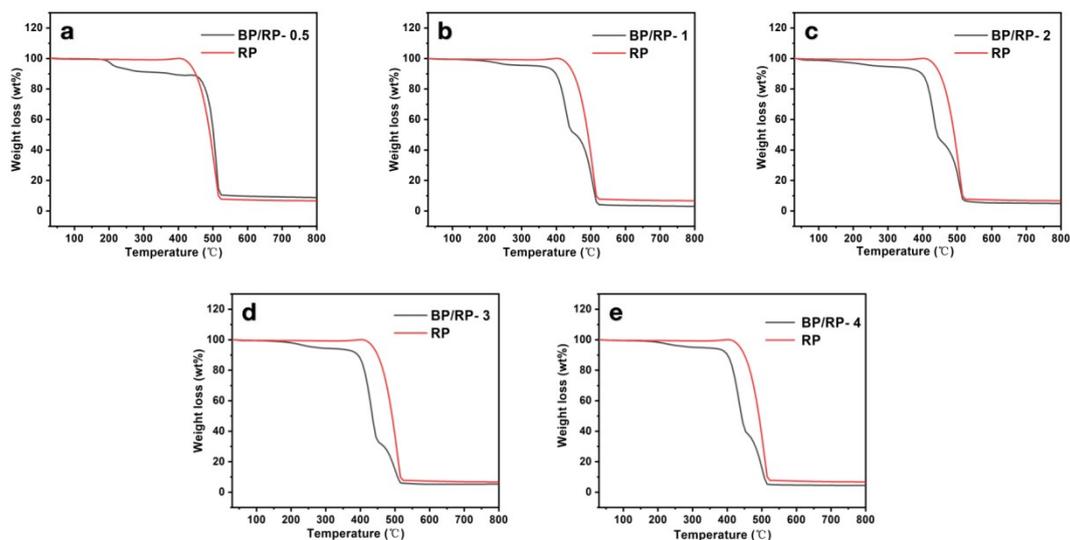


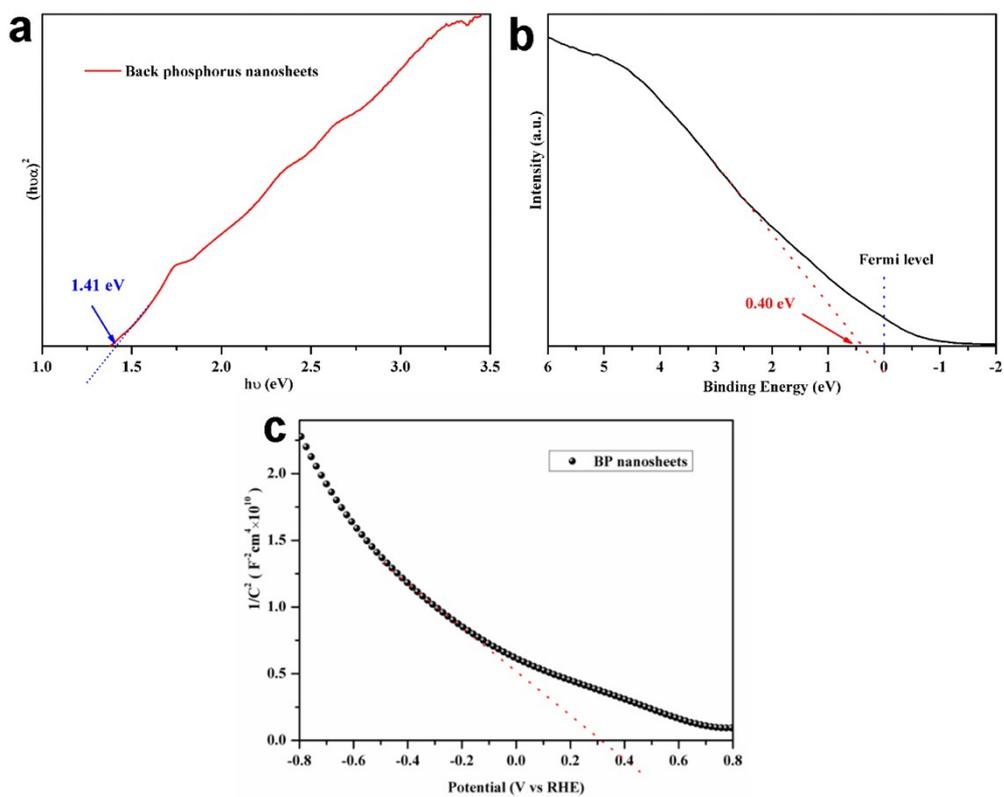
Figure S3. FT-IR spectra of RP and BP/RP (curve a-e: BP/RP - 0.5, 1, 2, 3, 4 ).



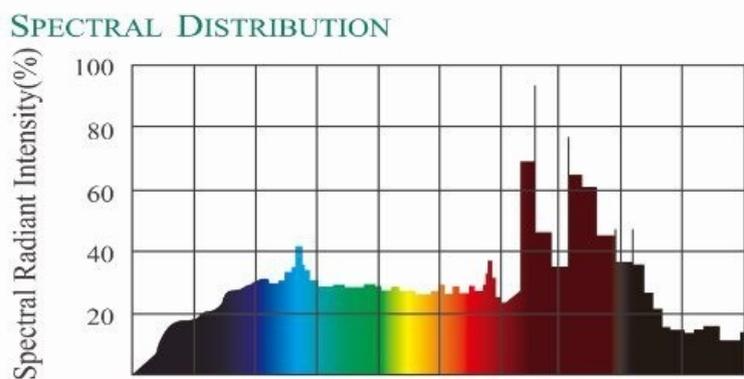
**Figure S4.** a) UV-Vis DRS spectra of RP and different BP/RP samples; b) The absorption edge of RP and different BP/RP samples. (11-12%, 17-18%, 15-16%, 21-22%, 15-16% : BP/RP - 0.5, 1, 2, 3, 4)



**Figure S5a-e.** Thermogravimetric analysis (TGA) curves of RP and different BP/RP samples under N<sub>2</sub> atmosphere with a heating rate of 10 °C · min<sup>-1</sup>.



**Figure S6.** a)  $(ah\nu)^2$  and  $h\nu$  curves of prepared black phosphorus nanosheets; b) XPS valence band energy spectra of black phosphorus nanosheets; c) Mott-schottky analysis of black phosphorus nanosheets.



**Figure S7.** The spectrum of 300 W xenon lamp.