

# Revealing component synergy of Ni–Fe/black phosphorous composites synthesized by self-designed electrochemical method for enhancing photoelectrocatalytic oxygen evolution reaction

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## Supplementary material

The turnover frequency (TOF, unit: s<sup>-1</sup>) value of the studied OER catalyst was calculated according to the following equation:

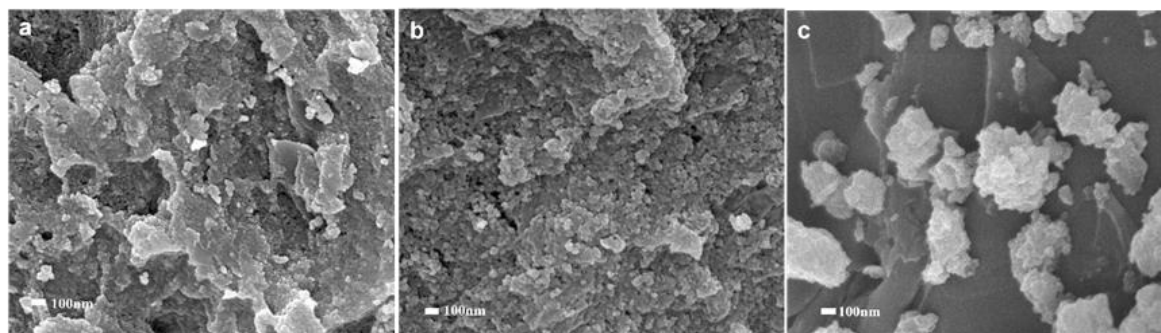
$$\text{TOF} = \frac{jN_{\text{A}}}{nFT} \quad (\text{S1})$$

where  $j$  stands for the current density (A·cm<sup>-2</sup>),  $N_{\text{A}}$  is the Avogadro number,  $n$  is the number of electrons transferred to evolve a molecule of product (for O<sub>2</sub>,  $n = 4$ ),  $F$  is the Faraday constant (= 96 485 C·mol<sup>-1</sup>), and  $\Gamma$  is the surface concentration of active sites or the number of participating atoms in a catalyst. The calculated TOF values of all the catalysts are listed in Table S1.

**Table S1** The calculated TOF values of different catalysts

Catalyst	$f(\text{Ni})/\text{wt.}\%$ <sup>a)</sup>	$f(\text{Fe})/\text{wt.}\%$ <sup>a)</sup>	TOF/s <sup>-1</sup>
Ni/BP	19.53	–	0.448
Fe/BP	–	22.54	0.0667
Ni–Fe/BP	12.08	12.68	0.4699

a) The values were determined from the ICP-OES analysis.



**Fig. S1** SEM images of (a) Ni/BP, (b) Fe/BP, and (c) Ni–Fe/BP catalysts.

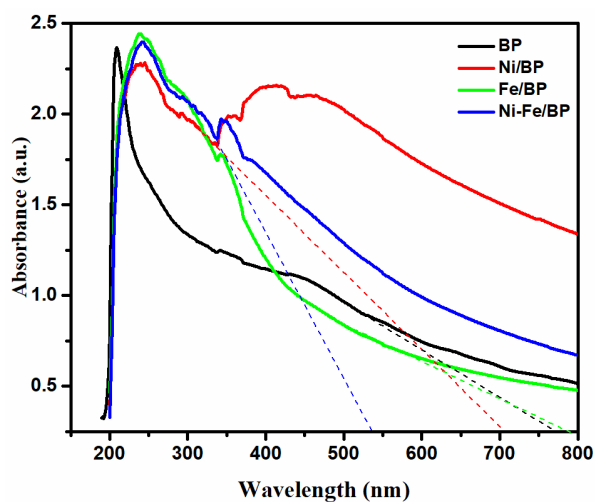


Fig. S2 UV-vis spectra of as-prepared catalysts.

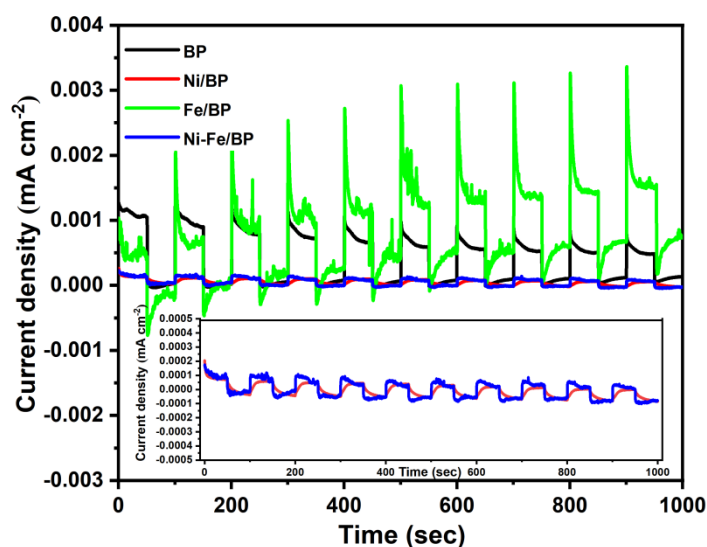


Fig. S3 Transient photocurrents of BP nanosheets as well as Ni/BP, Fe/BP, and Ni-Fe/BP catalysts in  $1 \text{ mol}\cdot\text{L}^{-1}$  KOH solution under illumination on a normal timescale.

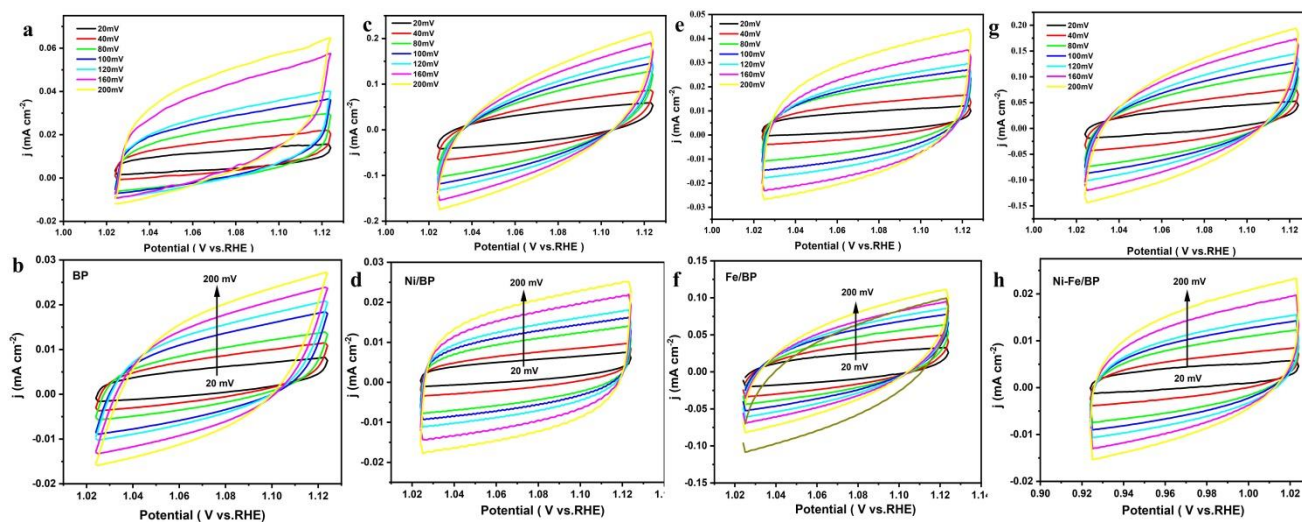


Fig. S4 Cyclic voltammograms of (a) BP nanosheets, (b) BP nanosheets under illumination, (c) Ni/BP, (d) Ni/BP under illumination, (e) Fe/BP, (f) Fe/BP under illumination, (g) Ni-Fe/BP, and (h) Ni-Fe/BP under illumination in  $1 \text{ mol}\cdot\text{L}^{-1}$  KOH at different scan rates.