Electronic Supplementary Material (ESI) for CrystEngComm.

The PEC performance of $BiVO_4$ was enhanced by preparing the $CoFeB_i/BiVO_4$ photoanode using an ultrafast photoassisted electrodeposition method

[a] College of Chemistry and Chemical Engineering, Northwest Normal University, Lanzhou 730070, China

[b] School of Geography and Environment Science, Northwest Normal University, Lanzhou 730070, China

[c] Qinghai Provincial Key Laboratory of Nanomaterials and Nanotechnology, Qinghai Minzu University, Qinghai 810007, China

[d] School of Environment Science and Engineering, Chang'an University, Xi'an 710060, China

*Corresponding author. Tel: +86 931 7972677; Fax: +86 931 7972677.

*Corresponding author. E-mail: baiyan226@163.com(Y.Bai); pjhhj@sohu.com (J. Peng); wangqizhao@163.com, qizhaosjtu@gmail.com (Q. Wang)

Preparation of $BiVO_4$

To prepare the $BiVO_4$ film, a typical three-electrode setup was used. The working electrode was made of FTO conductive glass, the opposite electrode was a platinum sheet and the reference electrode was an Ag/AgCl electrode. First, in a clean beaker, 3.32 g of potassium iodide (KI) was weighed and mixed with 50 mL of distilled water at room temperature. Then, 1 M nitric acid (HNO_3) solution was gradually added to adjust the pH to 1.65. Into the KI solution with the adjusted pH, 0.9701 g of bismuth nitrate pentahydrate ($Bi(NO_3)_3 \cdot 5H_2O$) was added. This mixture was labeled as solution A. Then, In another clean beaker, 0.498 g of 1,4-benzoquinone ($C_6H_4O_2$) was added to 20 mL of absolute ethanol at room temperature. This mixture was labeled as solution B. The contents of solution B were added drop by drop into solution A while stirring with a magnetic stirrer. As the addition progressed, the solution gradually changed in color from clear orange to orange-red. Stirring was continued for approximately 20 minutes to ensure thorough mixing. The deposition of the obtained solution was carried out using a three-electrode cyclic voltammetry (CV) technique. The potential range utilized was -0.13 V to 0 V, and the scanning rate was set to 5 mV/s. The BiOI film was then rinsed with deionized water and dried. Onto the prepared BiOI film, 100 μL of a 0.2 M $VO(acac)_2$ (DMSO) solution was dropped. The film was subsequently annealed at 450 °C for 2 hours, using a heating rate of 2 ℃

/min. Finally, the samples were immersed in a 1.0 M sodium hydroxide solution to remove any excess vanadium pentoxide. After that, they were rinsed with distilled water and dried in an oven to obtain pure $BiVO_4$ electrode material.

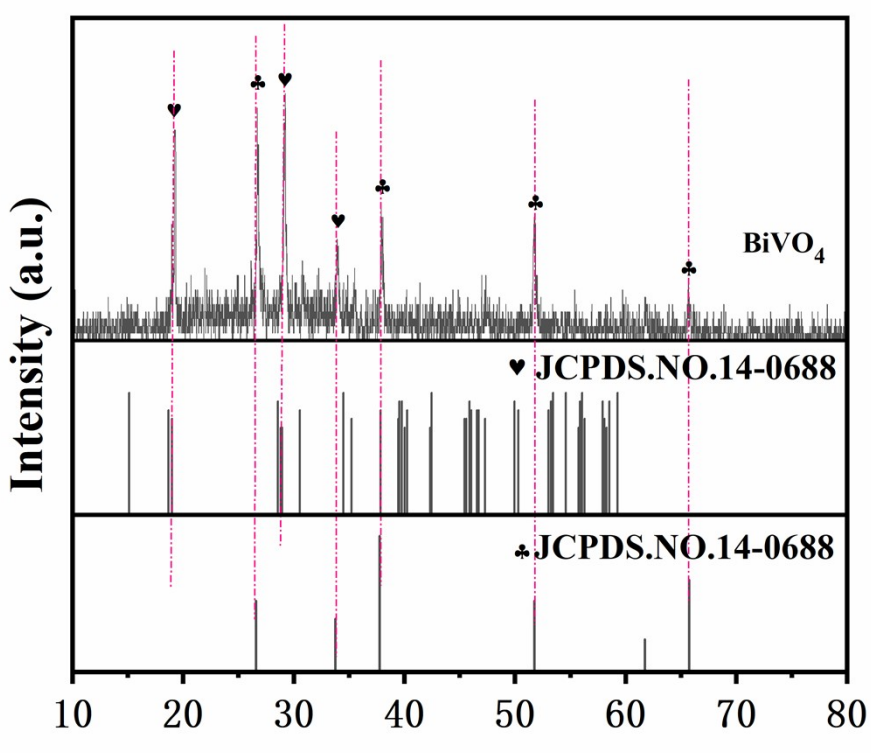

Fig. S1. XRD images of $BiVO_4$.

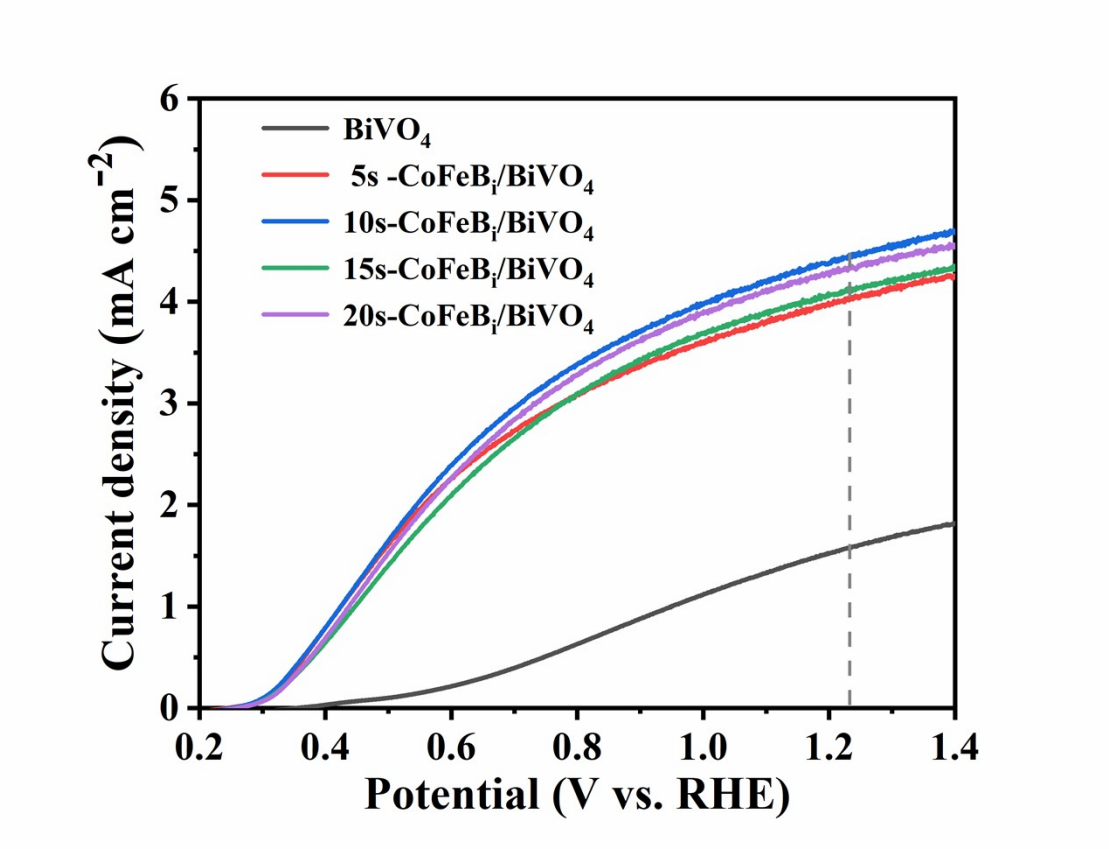

Fig. S2. LSV curves of $CoFeB_i/BiVO_4$ with different deposition time.

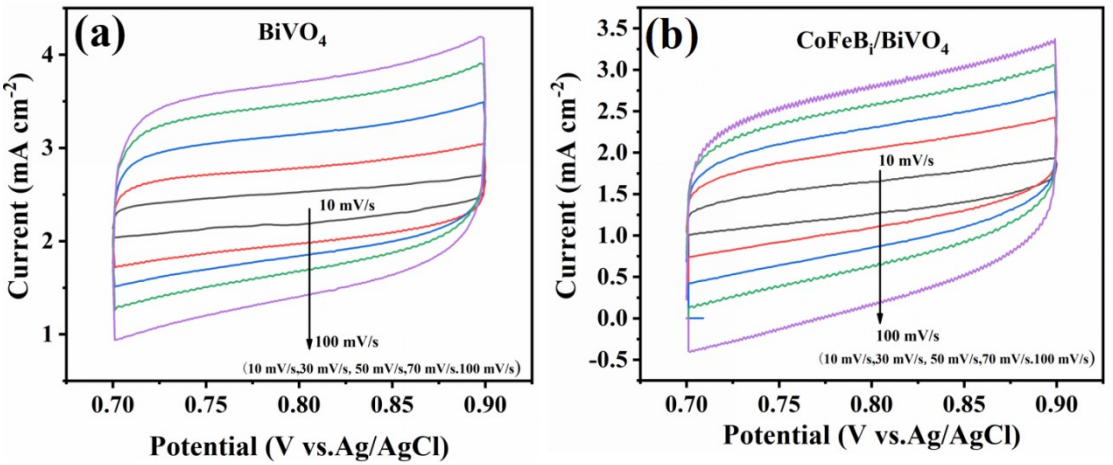

Fig. S3.CV of photoanodes performed at different scan rates in the non-Faradaic potential range.

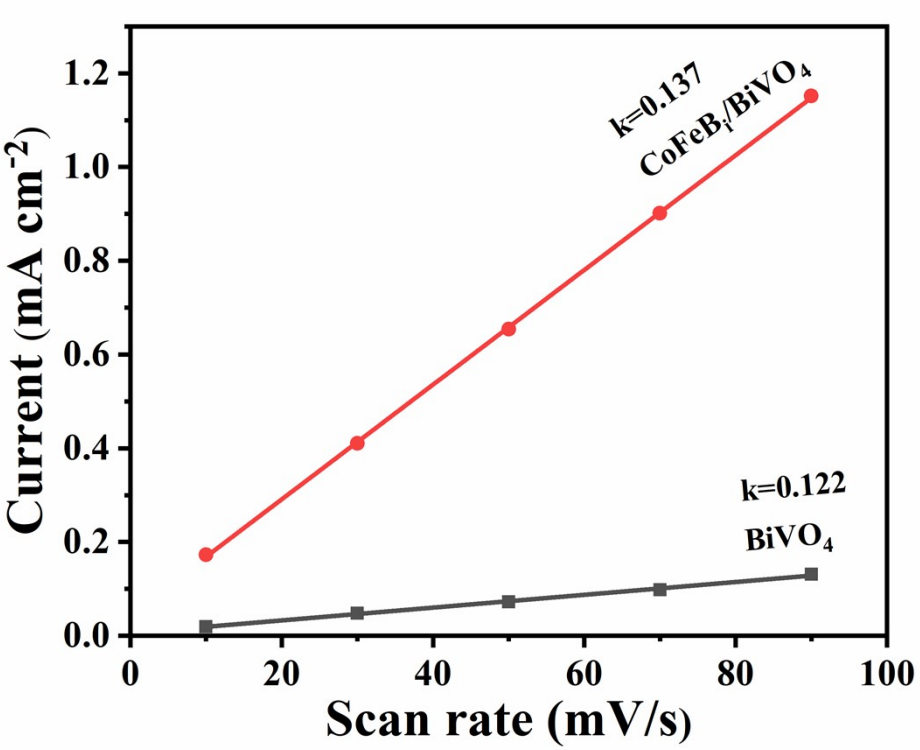

Fig. S4. Relationship between current density difference and scan rate of $BiVO_4$ and $CoFeB_i/BiVO_4$ photoanodes.

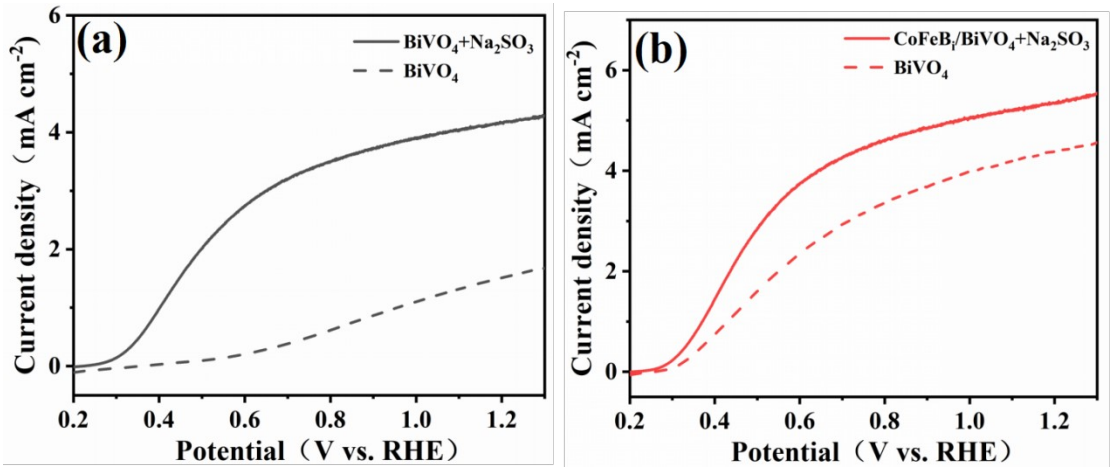

Fig. S5. $BiVO_4$ and $CoFeB_i/BiVO_4$ electrodes measured by in 1 M Na_2SO_3 solution of linear sweep voltammetric curves (a), (b).

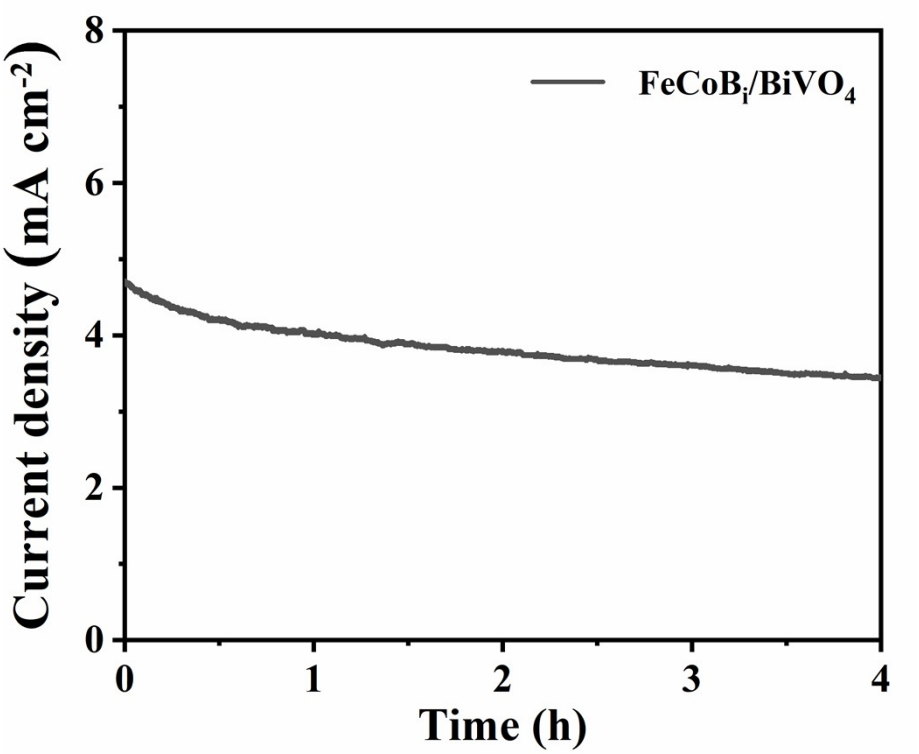

Fig. S6. The stability test curves of $CoFeB_i/BiVO_4$ electrodes.

Table.S1. The charge transfer resistance (R_{ct}) of electrodes.

Sample	R_s (Ω)	R_{ct} (Ω)
$BiVO_4$	18.86	496.1
$FeB_i/BiVO_4$	28.77	203.4
$CoB_i/BiVO_4$	26.73	168.4
$CoFeB_i/BiVO_4$	27.79	140.6

Table. S2. Comparison of the $CoFeB_i/BiVO_4$ with the recent $BiVO_4$ photoanodes for PEC water oxidation under AM 1.5 G (100 mW cm^{-2}) illumination.

Photoelectrode	Electrolyte	Performance (at 1.23 V vs. RHE)	Ref.
$F/Mo:BiVO_4$	0.1M KPi	1.45 mA cm^{-2}	[1]
$BiVO_4/NdCo_3$	0.1M KPi	2.25 mA cm^{-2}	[2]
$FeOOH/Ni-BiVO_4$	0.1M KPi	3.02 mA cm^{-2}	[3]
$Zr-CoF_2/BiVO_4$	0.5 M KPi	3.6 mA cm^{-2}	[4]
$BiVO_4$ /CuPc/FeOOH	0.1 M KPi	3.65 mA cm^{-2}	[5]
$CoFeB_i/BiVO_4$	0.5 M KPi	4.4 mA cm^{-2}	This work

References

1. M. Rohloff, B. Anke, O. Kasian, S. Y. Zhang, M. Lerch, C. Scheu and A. Fischer, *Acs Applied Materials & Interfaces*, 2019, **11**, 16430-16442.
2. G. D. Gao, R. Chen, Q. J. Wang, D. W. F. Cheung, J. Zhao and J. S. Luo, *Acs Applied Energy Materials*, 2023, **6**, 4027-4034.
3. M. H. Chen, X. B. Chang, C. Li, H. Q. Wang and L. C. Jia, *Journal of Colloid and Interface Science*, 2023, **640**, 162-169.
4. K. Y. Chen, L. Zhang, X. Huang, F. C. Zhang, G. Q. Zhu and Q. Z. Wang, *Journal of Alloys and Compounds*, 2023, **963**, 9.
5. M. M. Fan, Z. Y. Tao, Q. Zhao, J. P. Li, G. Liu and C. Zhao, *Adv. Mater. Technol.*, 2023, DOI: 10.1002/admt.202201835, 9.