

Supporting information

Stabilizing BiVO₄ photoanode in bicarbonate electrolyte for efficient photoelectrocatalytic alcohol oxidation

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1. Calculations of Faradaic efficiency

$$\text{Faradaic efficiency (\%)} = \frac{e \times n_1 \times N}{Q / n_2}$$

Where e is the number of holes required to oxidize one BA to BAD ($e=2$), n_1 is the amount of substance that produces BAD, N is Avogadro's constant ($N=6.02 \times 10^{23}$), Q is the quantity of electric charge, and n_2 is the elementary charge ($e=1.602 \times 10^{-19}$).

2. Figure S1-S9

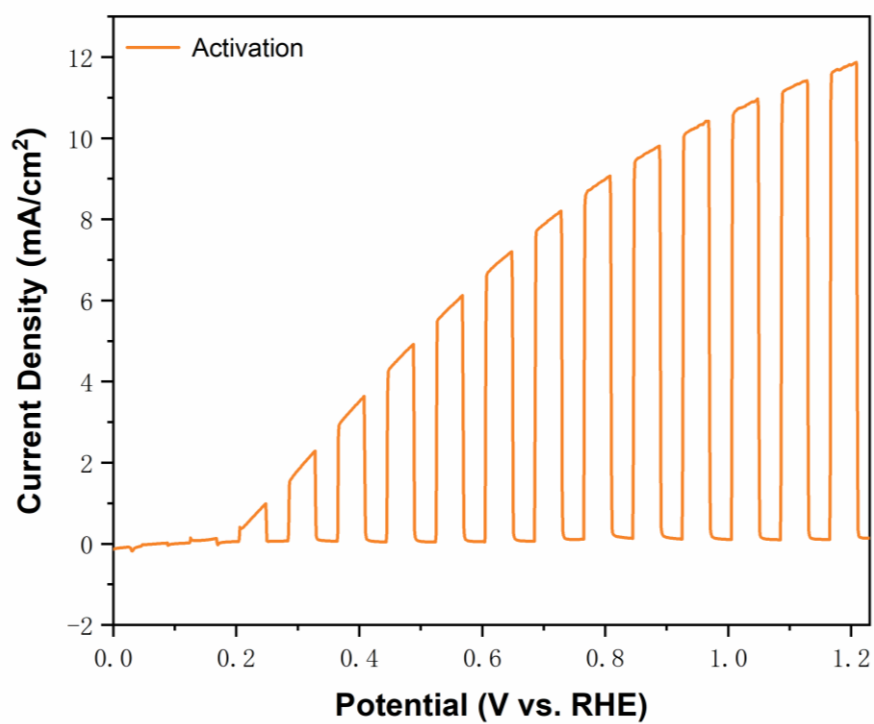


Figure S1. BVO activated LSV in boric acid buffer (pH 9) containing 0.2 M Na₂SO₃

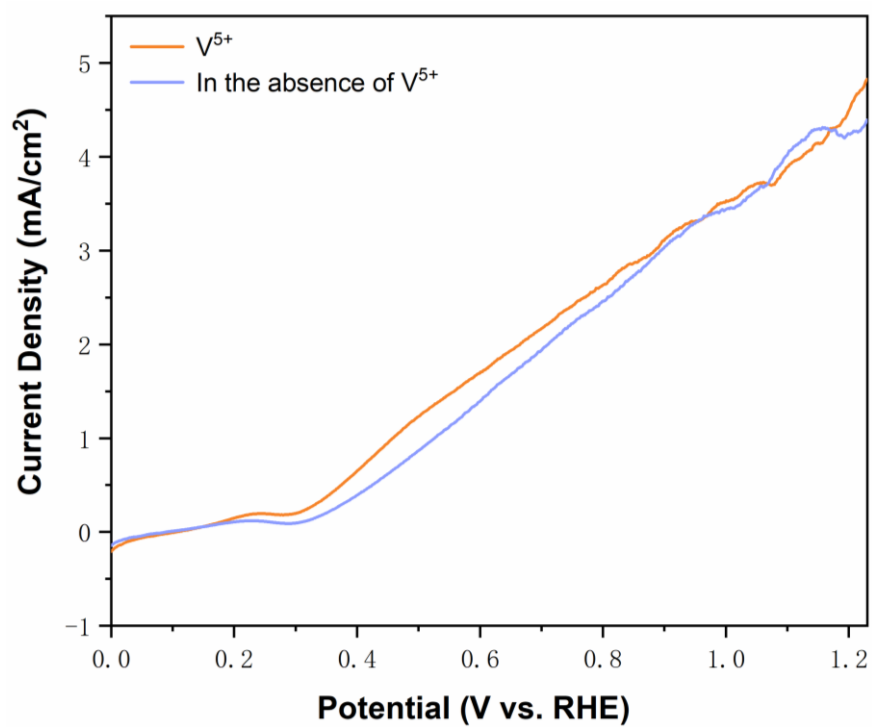


Figure S2. BVO tested LSV added saturated V⁵⁺ and without V⁵⁺ to the MeCN electrolyte (pH 9) containing 0.5 M NaHCO₃

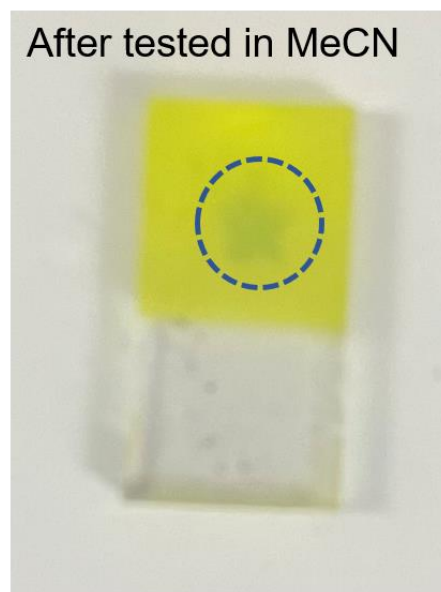
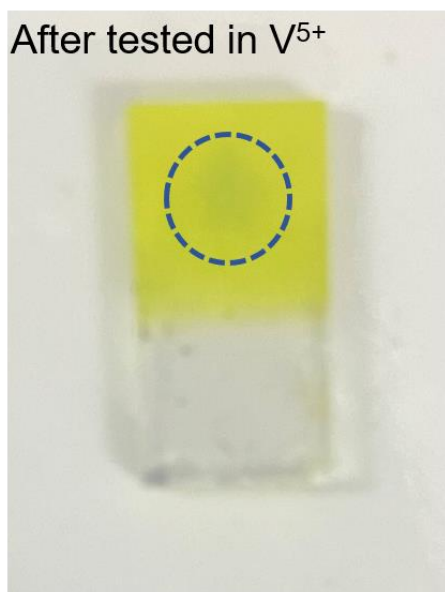


Figure S3. Comparison of thickness of BVO with saturated V^{5+} and without V^{5+} in MeCN electrolyte (pH 9) containing 0.5 M $NaHCO_3$ was observed by naked eye



Figure S4. Schematic diagram of assembling a flow pool

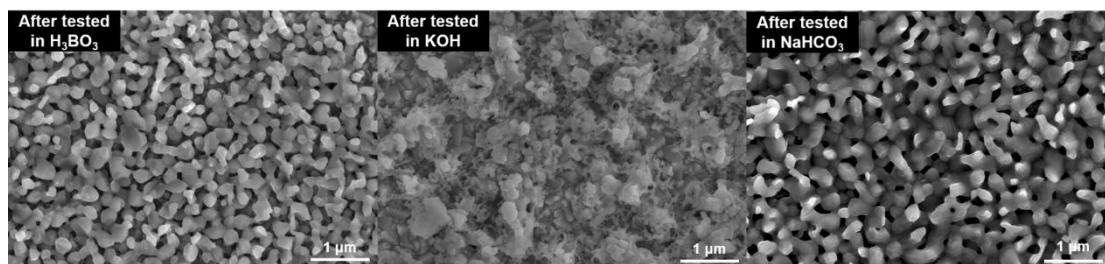


Figure S5. BVO test SEM after 6h testing in 0.5 M H₃BO₃, 0.1M KOH, and MeCN containing 0.5 M NaHCO₃

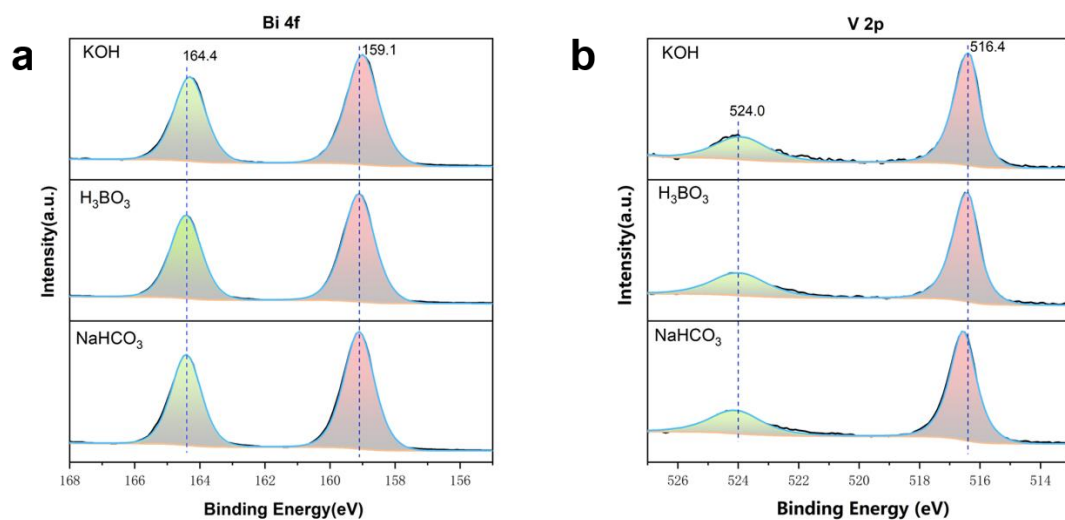


Figure S6. (a) Bi 4f of XPS spectrum after 30 min testing of BVO in 0.1 M KOH, 0.5 M H_3BO_3 and MeCN electrolyte containing 0.5 M NaHCO_3 (b) V 2p of XPS spectrum after 30 min testing of BVO in 0.1 M KOH, 0.5 M H_3BO_3 and MeCN electrolyte containing 0.5 M NaHCO_3

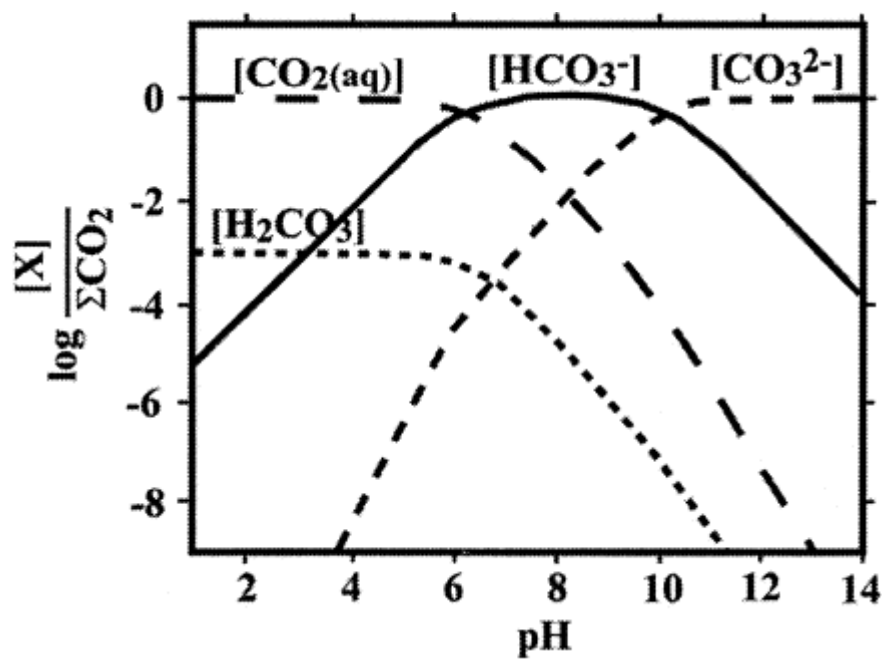


Figure S7. Carbonic acid species as a function of pH at 25 °C for total ion activity coefficients equal to unity[1].

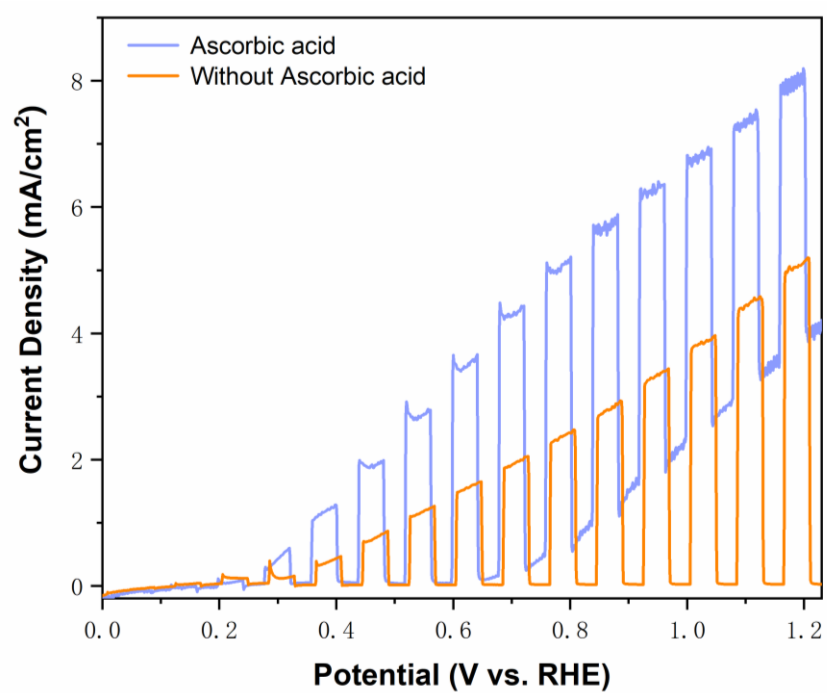


Figure S8. BVO test results of LSV added ascorbic acid and without ascorbic to MeCN electrolyte pH 9 containing 0.5 M NaHCO_3

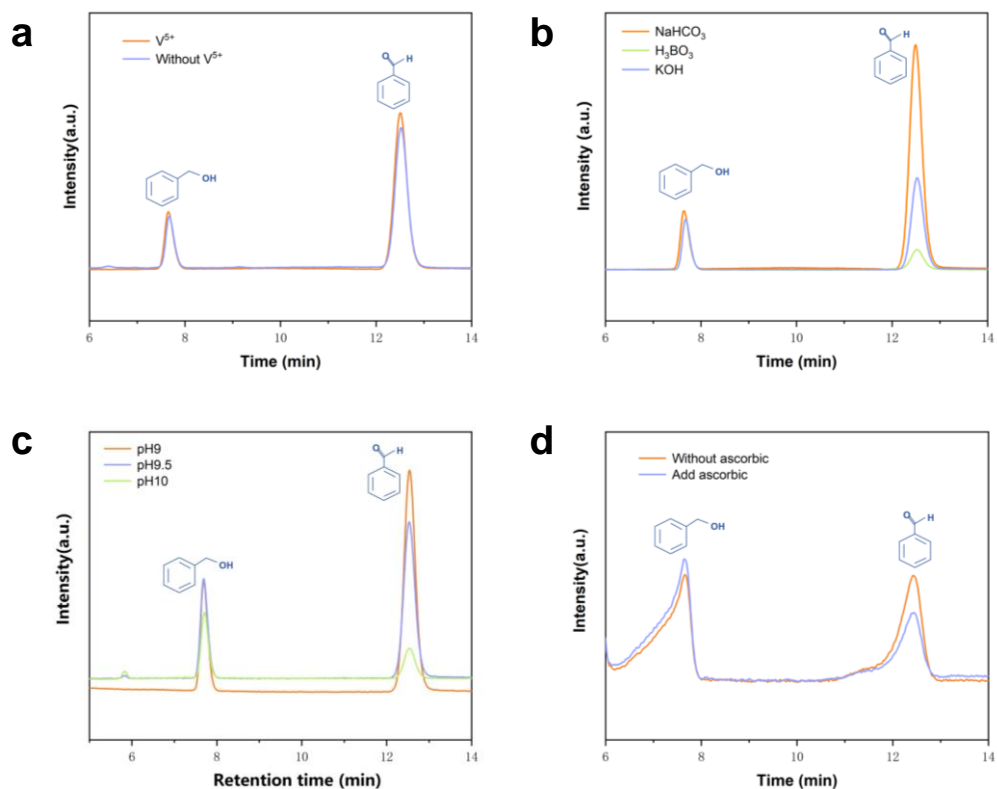


Figure S9. (a) HPLC results of BVO tests 6 h for 0.5 M NaHCO_3 MeCN electrolytes with saturated V^{5+} and without V^{5+} (b) HPLC results of BVO tests 12 h for 0.5 M H_3BO_3 , 0.1 M KOH, and MeCN containing 0.5 M NaHCO_3 (c) HPLC results of BVO test 12 h in aqueous electrolytes containing NaHCO_3 at pH 9, pH 9.5 and pH 10 (d) HPLC results of BVO test 12 h for 0.5 M NaHCO_3 MeCN electrolytes with ascorbic acid and without ascorbic.

Table S1. Results of HPLC tests in different systems

Electrolyte	Time(h)	Faraday efficiency(%)
0.5 M NaHCO ₃ in MeCN add V ⁵⁺ (pH 9)	6 h	25.9±5
0.5 M NaHCO ₃ in MeCN (pH 9)	6 h	20.1±5
0.5 M H ₃ BO ₃ (pH 9)	6 h	1.5±5
0.1 M KOH (pH 13.5)	6 h	12.7±5
0.5 M NaHCO ₃ in aqueous (pH 9)	12 h	23±5
0.5 M NaHCO ₃ in aqueous (pH 9.5)	12 h	20±5
0.5 M NaHCO ₃ in aqueous (pH 10)	12 h	0
0.5 M NaHCO ₃ in MeCN (pH 9)	2 h	10±5
0.5 M NaHCO ₃ in MeCN add ascorbic (pH 9)	2 h	0

Table S2. XPS surface composition ratio of elements

Element	KOH ¹	H ₃ BO ₃ ²	NaHCO ₃ ³
Bi	9.05	8.04	8.59
V	15.44	18.82	20.14
O	35.53	37.47	38.47
C	38.97	35.65	35.56

¹ After 30 min testing of BVO in 0.1 M KOH, ² After 30 min testing of BVO in 0.5 M H₃BO₃, ³ After 30min testing of BVO in 0.5 M NaHCO₃

4.References

1. Beck, W.C.; Grossman, E.L.; Morse, J.W. Experimental Studies of Oxygen Isotope Fractionation in the Carbonic Acid System at 15°, 25°, and 40°C. *Geochim. Cosmochim. Acta* **2005**, *69*, 3493–3503, doi:10.1016/j.gca.2005.02.003.