Enhanced photoelectrochemical performance from all spin-coated WO_3/$BiVO_4$/ZnO photoanode for maximizing charge transfer *via* ZnO decoration control

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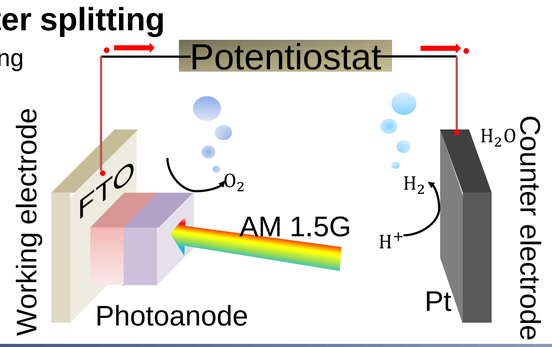
Introduction

▪ Photoelectrochemical (PEC) water splitting

- To induce eco-friendly redox reaction by absorbing the solar energy, we can use the solar-activated electrode – photoanode.
- Redox reactions at electrode

- Photoanode $H_2O + 2h^+ \rightarrow 2H^+ + 0.5O_2$

- Counter electrode $2H^+ + 2e^- \rightarrow H_2$



▪ Triple photoanode heterojunction

- To enhance the photoelectrochemical performance, there needs to be proper semiconductor band gap alignment.
- WO_3/$BiVO_4$ heterojunction has proved to be efficient by many researchers. For improved PEC output, we fabricate the triple photoanode structure by adding the ZnO layer.

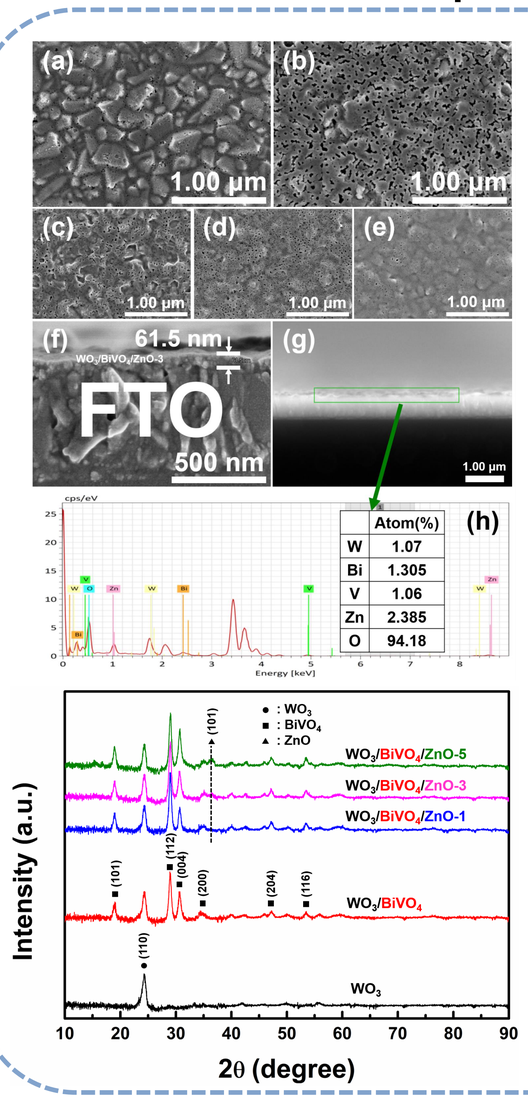
Experimental

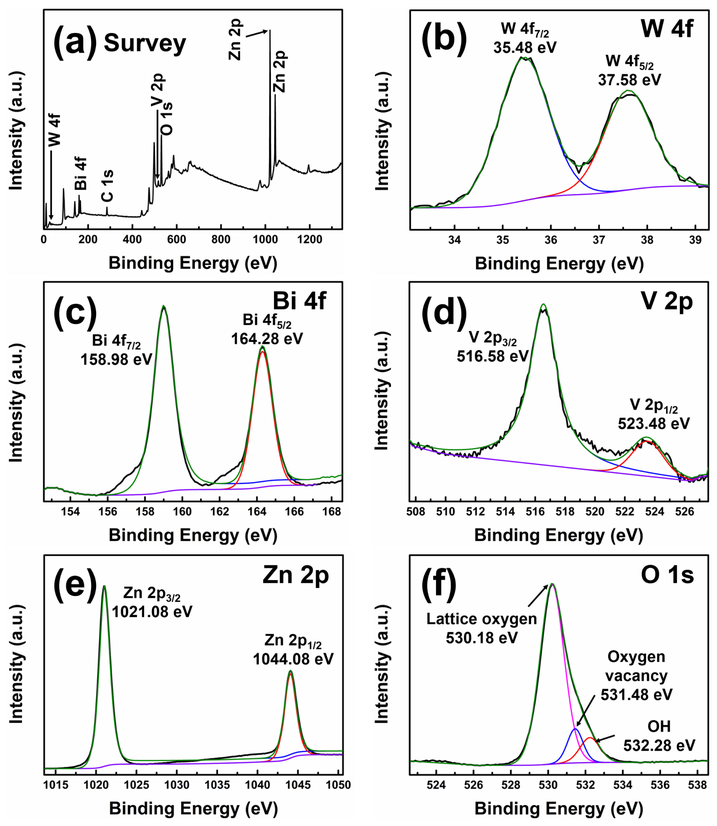
All materials are prepared by the simple spin-coating & annealing process.

- WO_3
  - Spin coated Tungstic acid → WO_3 by annealing at 500 ℃.
- $BiVO_4$
  - Spin coated Bismuth nitrate pentahydrate & Ammonium metavanadate → $BiVO_4$ by annealing at 500 ℃.
- ZnO
  - Spin coated Zinc acetate dihydrate → ZnO by annealing at 500 ℃.

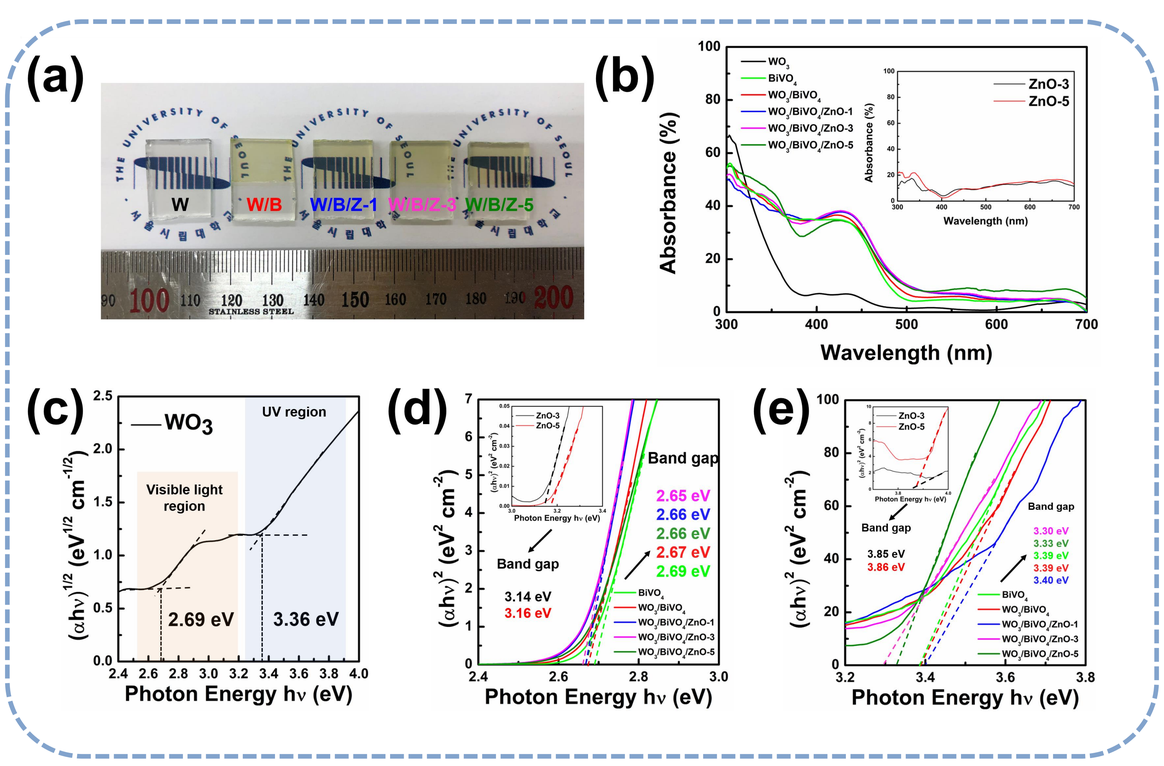
Results & Discussion

▪ Characterizations of photoanodes

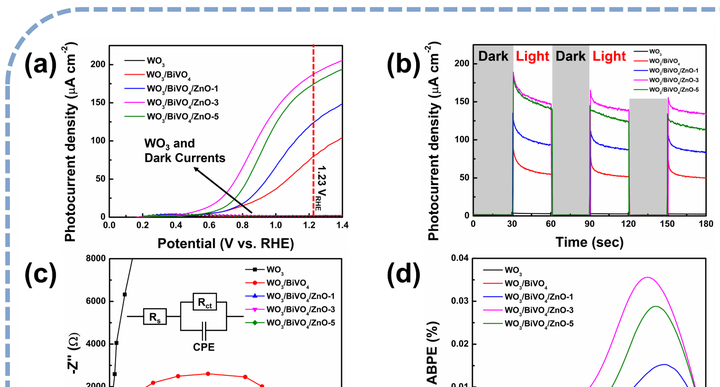


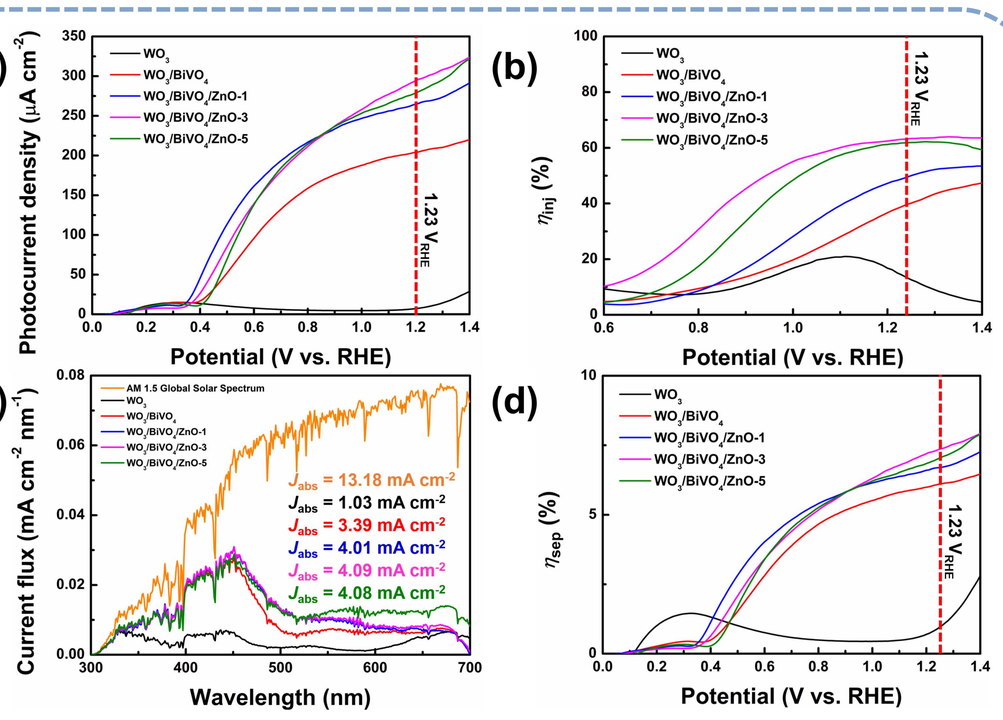


▪ Optical properties

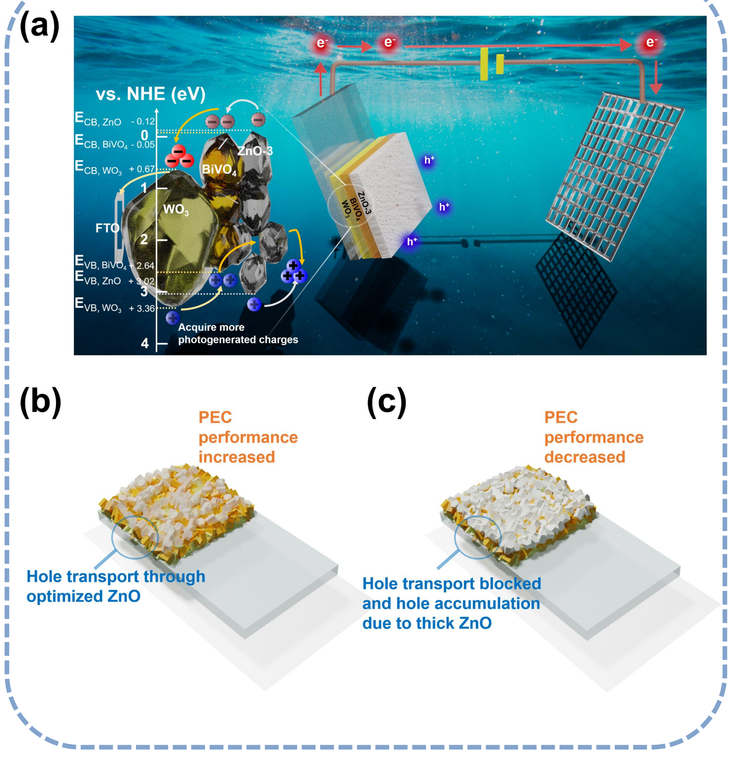


▪ Photoelectrochemical measurements





▪ Photoelectrochemical mechanisms



Conclusion

1) In this study, we investigate the effects of the number of the ZnO spin-coatings.
2) PEC performance of the WO_3/$BiVO_4$ type Ⅱ photoanode can be improved by applying optimized ZnO components with proper band gap alignment.
3) This result implies that the ZnO layer can suppress the charge recombination and improve the charge separation efficiency. Furthermore, it can passivate the photoanode surface against the photocorrosion.

Reference

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