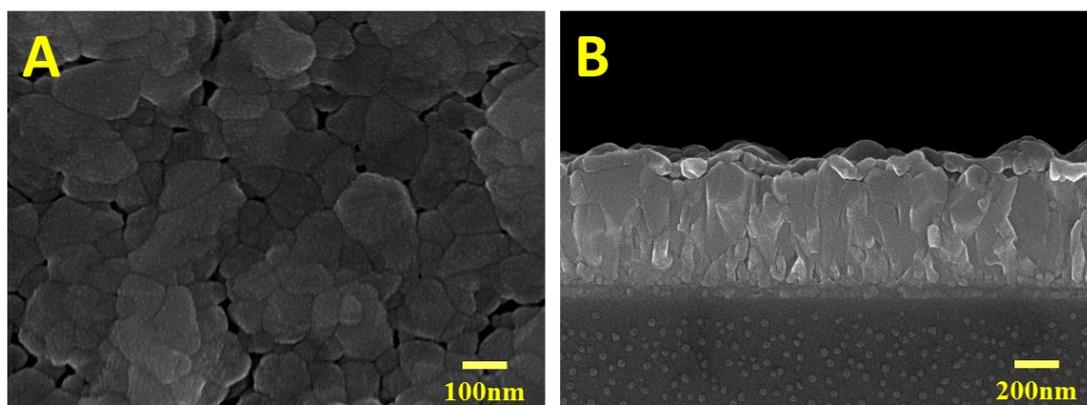


## Supporting Information

### **3D Triple-Deck Photoanode with Strengthened Structure Integrity:**

### **Enhanced Photoelectrochemical Water Oxidation**

Ming Ma, Xinjian Shi, Kan Zhang, Soonwoo Kwon, Ping Li, Jung Kyu Kim, Thanh Tran Phu, Gi-Ra Yi and Jong Hyeok Park\*



**Figure S1. SEM images of (a) the surface section and (b) the cross section of the WO<sub>3</sub> underlayer.**

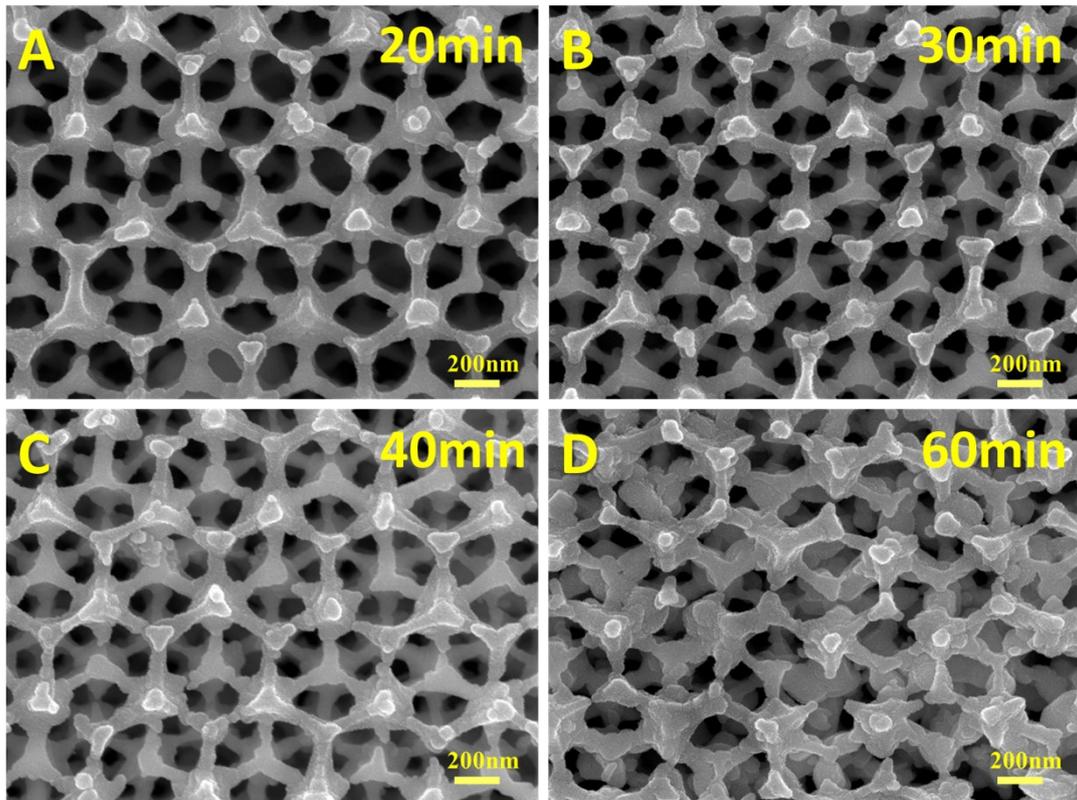


Figure S2. SEM images of TDIO-WO<sub>3</sub>/BiVO<sub>4</sub>/OEC photoanodes with different deposition time of the OEC layer.

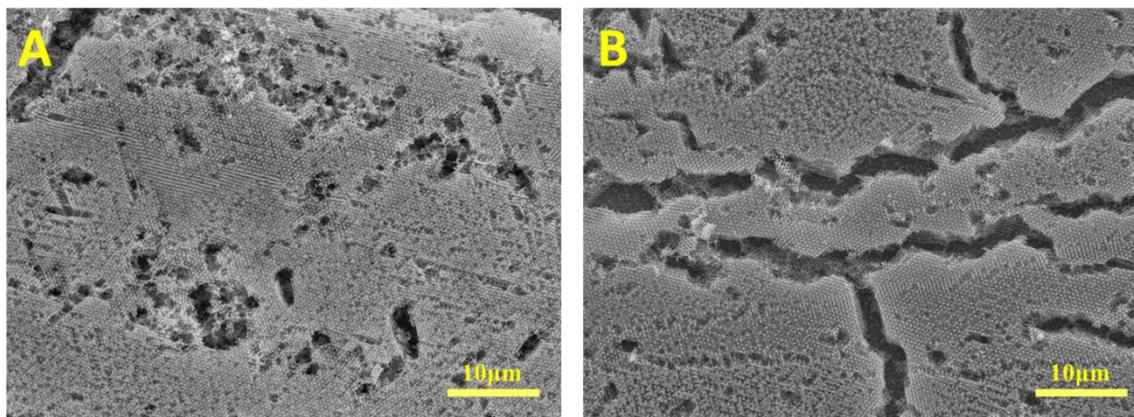


Figure S3. Morphologies showing cracks of DDIO-WO<sub>3</sub>/BiVO<sub>4</sub> (a) with and (b) without the WO<sub>3</sub> underlayer.

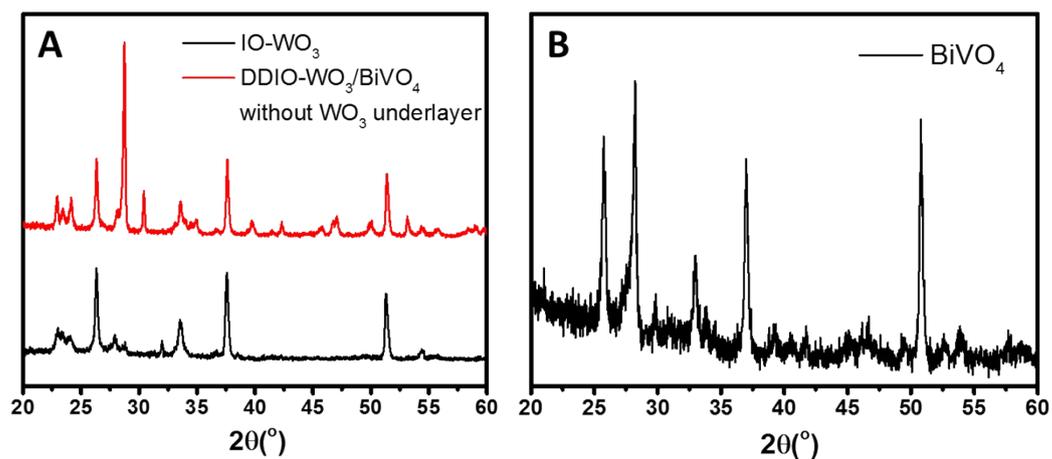


Figure S4. XRD spectrums of (a) IO-WO<sub>3</sub> and DDIO-WO<sub>3</sub>/BiVO<sub>4</sub> without WO<sub>3</sub> underlayer and (b) pure BiVO<sub>4</sub> photoanodes.

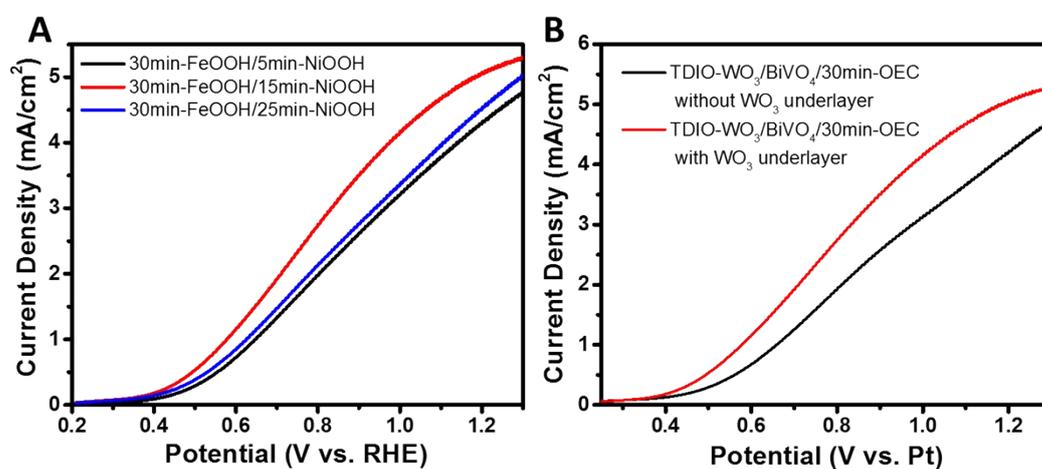


Figure S5. Photocurrent density of samples (a) with different ratios of FeOOH:NiOOH and (b) with or without WO<sub>3</sub> underlayer.

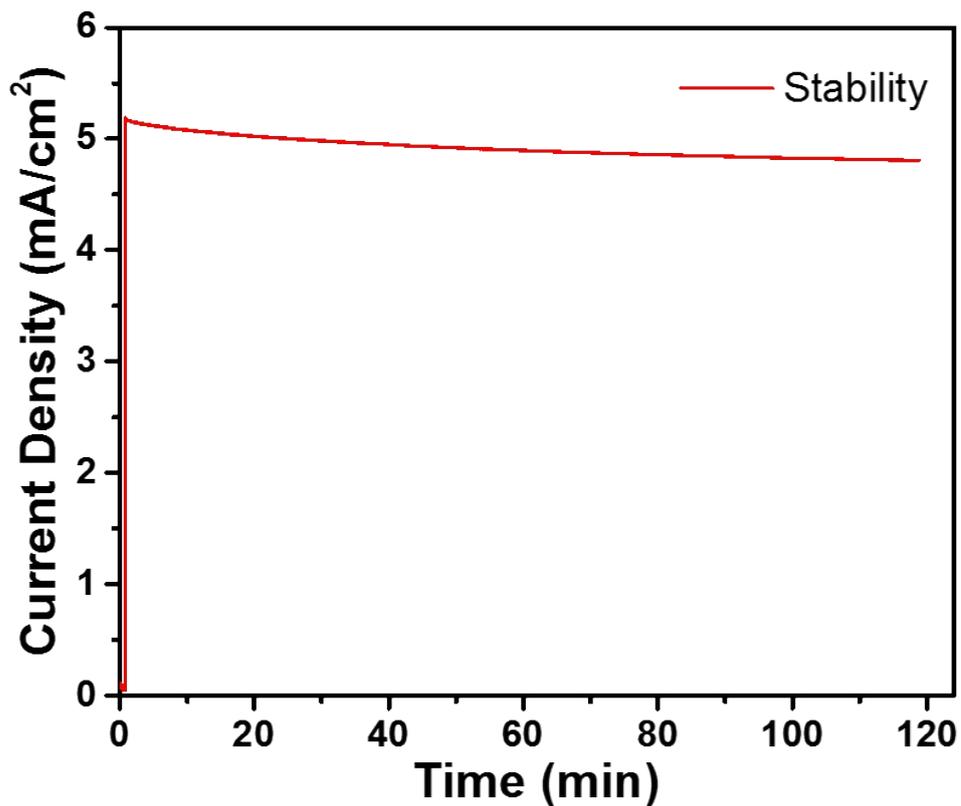


Figure S6. Stability measurement of the TDIO-WO<sub>3</sub>/BiVO<sub>4</sub>/OEC photoanodes.

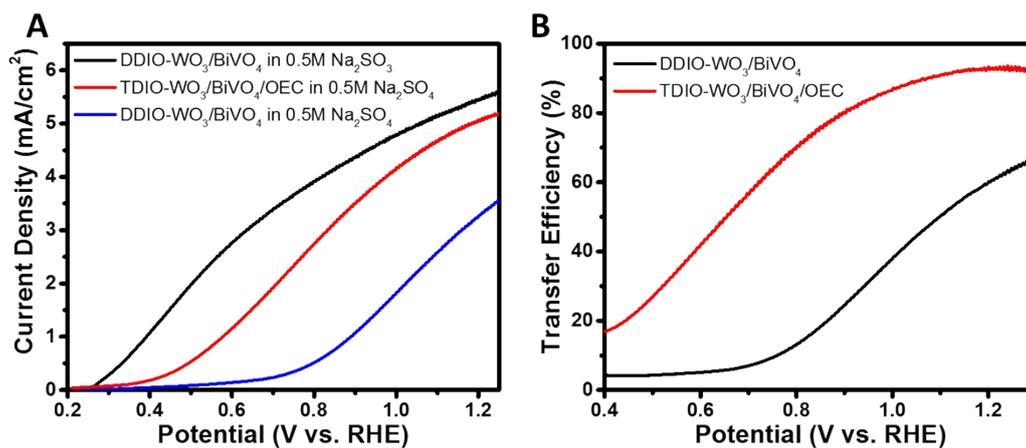


Figure S7. (a) Photocurrent density of samples measured in Na<sub>2</sub>SO<sub>4</sub> and Na<sub>2</sub>SO<sub>3</sub>. (b) Surface transfer efficiencies  $\eta_{\text{trans}}(\text{H}_2\text{O})$  of DDIO-WO<sub>3</sub>/BiVO<sub>4</sub> and TDIO-WO<sub>3</sub>/BiVO<sub>4</sub>/OEC.

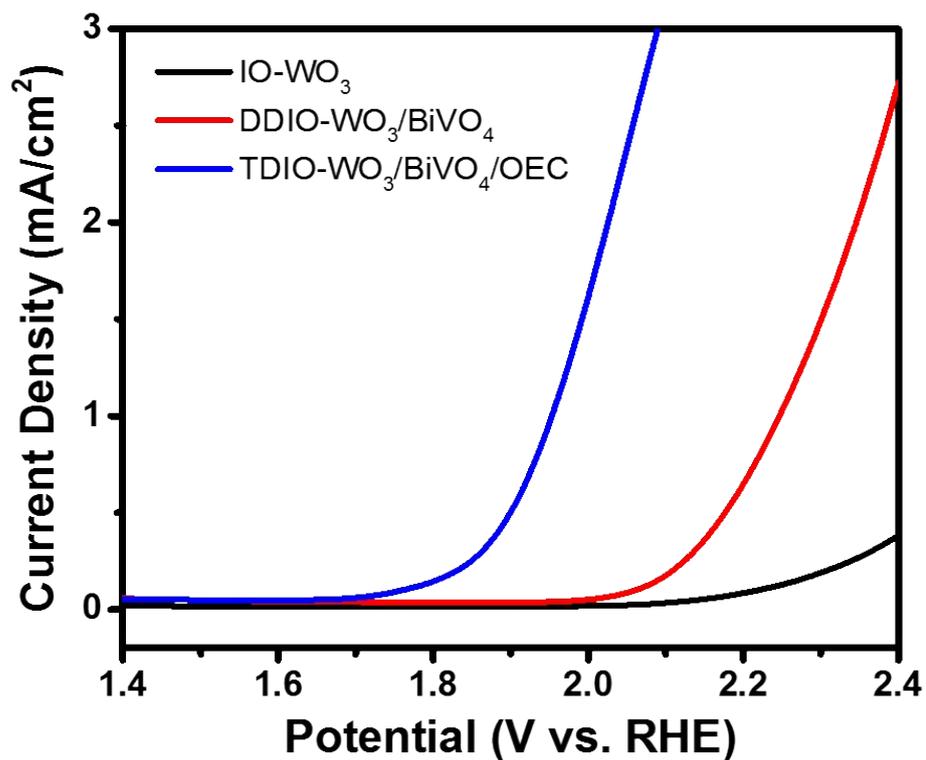


Figure S8. I-V curves of photoanodes measured in 0.5M Na<sub>2</sub>SO<sub>4</sub> without illumination.

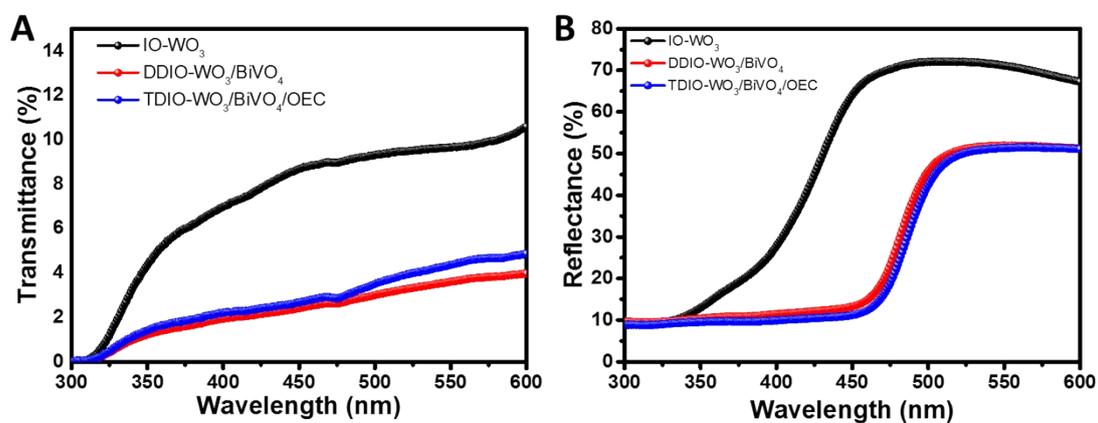


Figure S9. (a) Reflectance curves and (b) transmittance spectra of photoanodes.

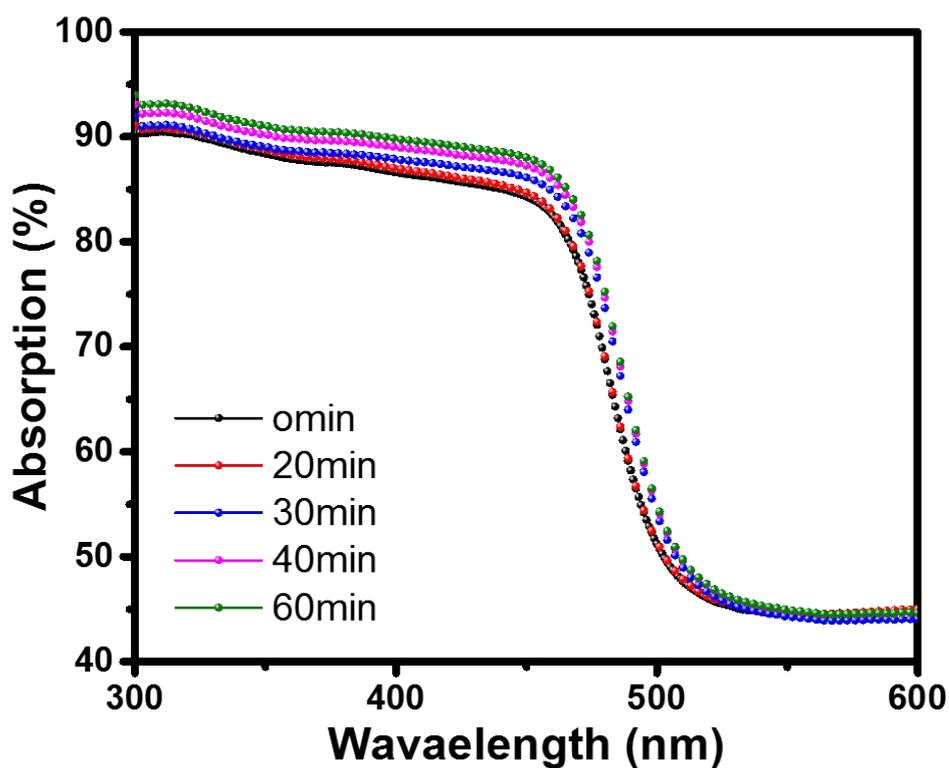


Figure S10. UV-vis absorption spectra of TDIO-WO<sub>3</sub>/BiVO<sub>4</sub>/OEC photoanodes with different deposition time of OEC layer.

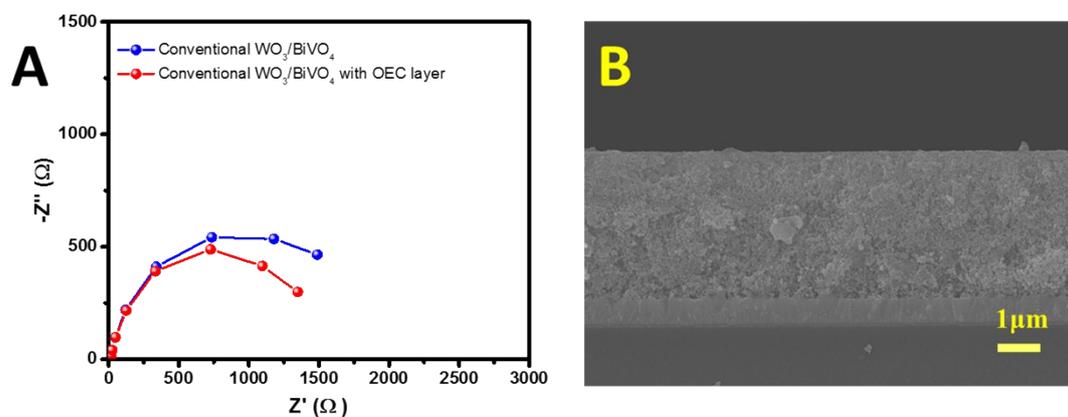


Figure S11. (a) The electrochemical impedance spectroscopy (EIS) analysis of conventional WO<sub>3</sub>/BiVO<sub>4</sub> samples and (b) the morphology of conventional WO<sub>3</sub>/BiVO<sub>4</sub> samples.

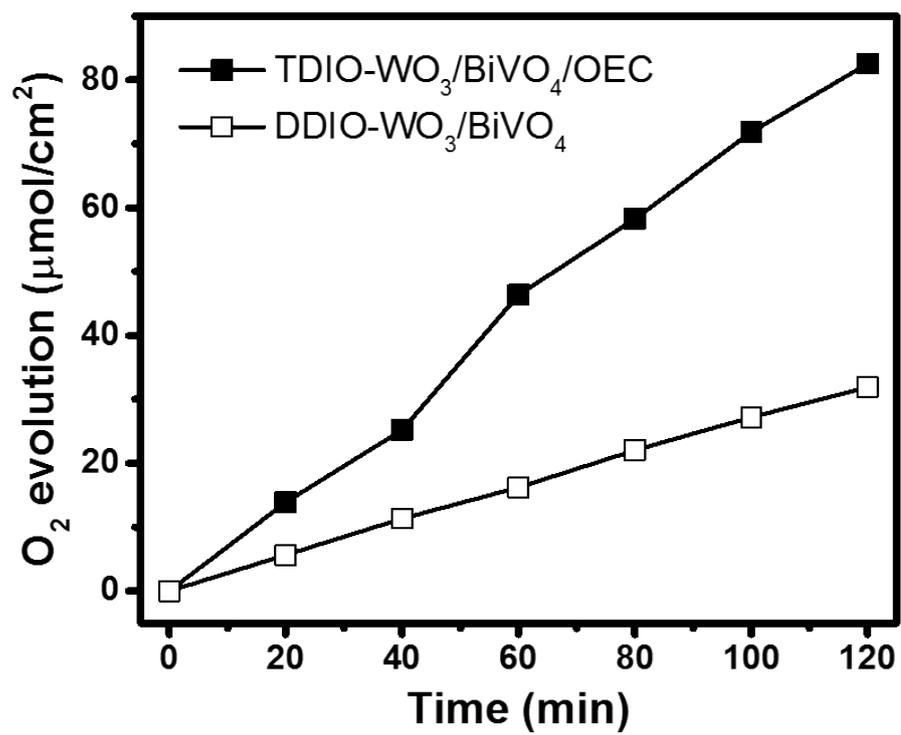


Figure S12. Oxygen evolution of DDIO-WO<sub>3</sub>/BiVO<sub>4</sub> and TDIO-WO<sub>3</sub>/BiVO<sub>4</sub>/OEC photoanodes.