

## Supporting Information

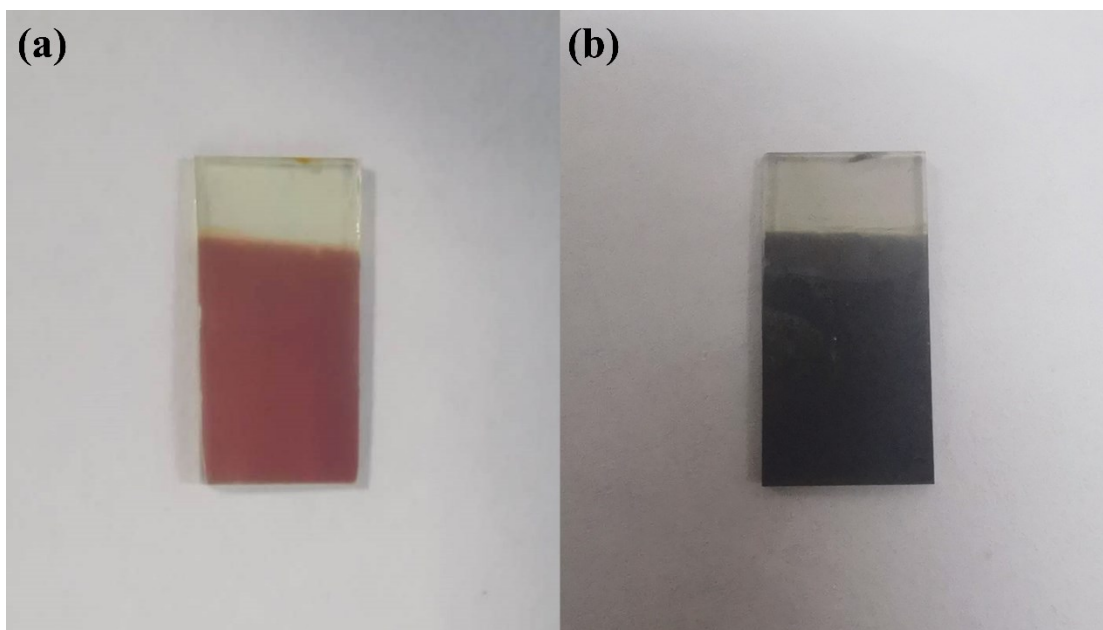


Fig.S1 (a)As-prepared  $\text{Sb}_2\text{S}_3$  photoelectrode; (b)pure  $\text{Sb}_2\text{S}_3$  electrode after annealing.

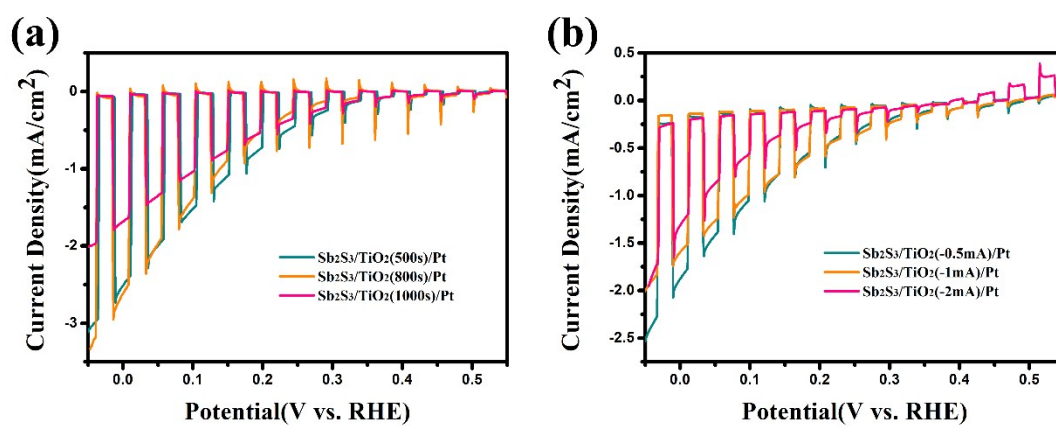


Fig.S2 (a)Current-Potential curve of photocathodes with  $\text{TiO}_2$  layer synthesized by different current density; (b)Current-Potential curve of photocathodes with  $\text{TiO}_2$  layer synthesized with different time.

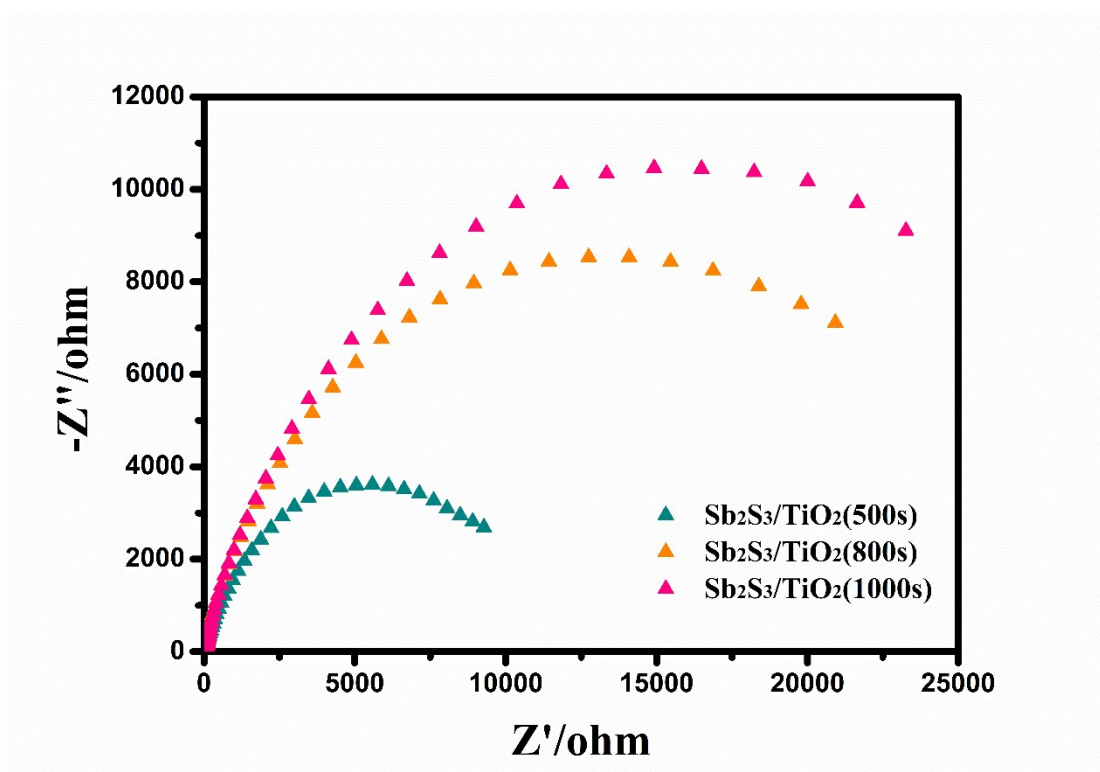


Fig.S3 Nyquist plots of  $\text{Sb}_2\text{S}_3/\text{TiO}_2$  photoelectrodes with different  $\text{TiO}_2$  deposition time without illumination.

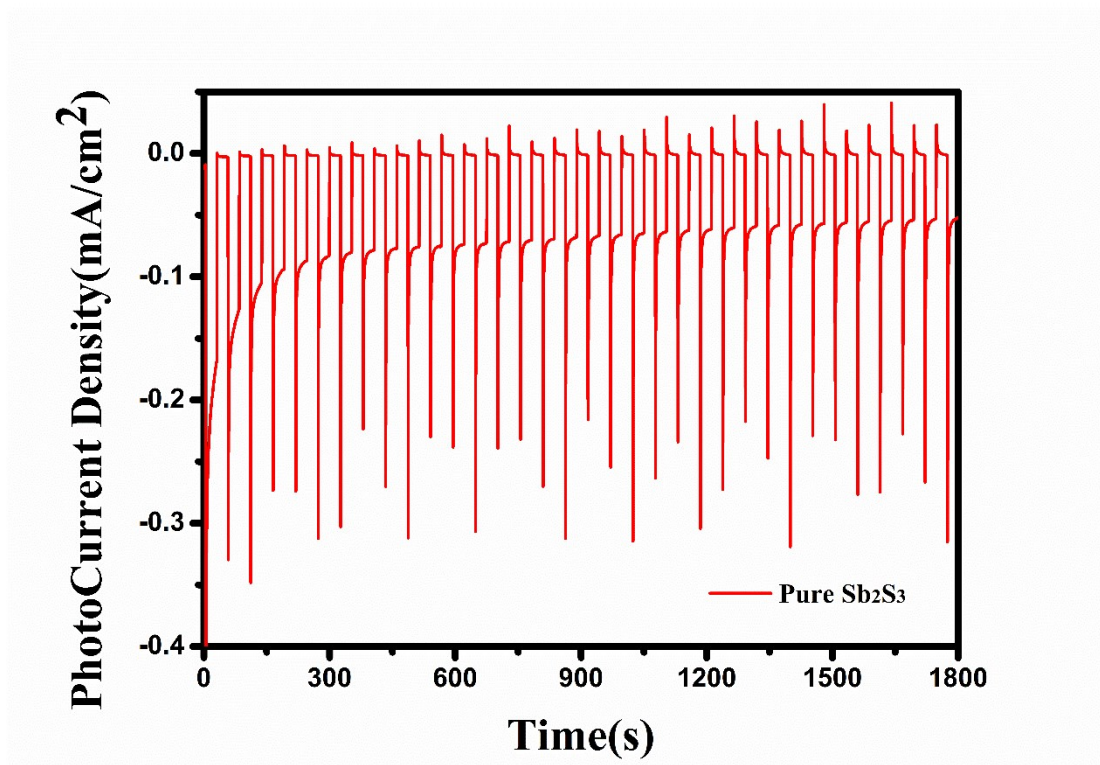


Fig.S4 Current-time curve of pure  $\text{Sb}_2\text{S}_3$  at 0 V vs. RHE.

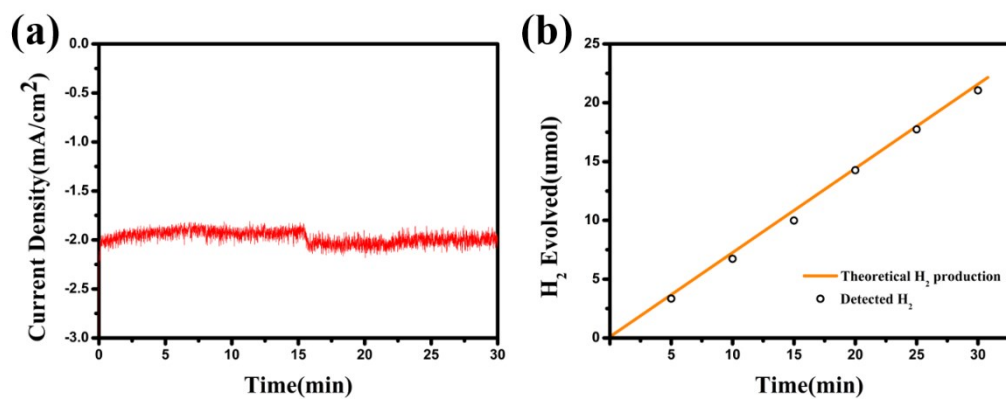


Fig.S5 (a)Current-time curve of Sb<sub>2</sub>S<sub>3</sub> based photocathode, and (b) corresponding gas measurement at 0 V vs. RHE under constant simulated sunlight illumination.

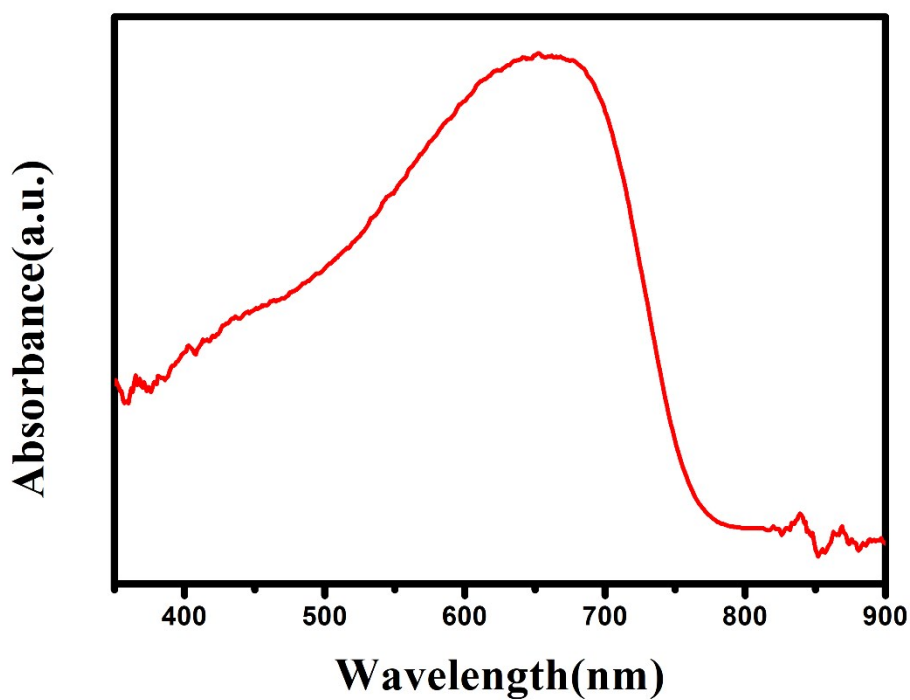


Fig.S6 UV-vis absorption curve of Sb<sub>2</sub>S<sub>3</sub>/TiO<sub>2</sub>/Pt photocathode.