

### Supporting Information

Fig. S1 The SEM image of TiO<sub>2</sub>/MoS<sub>2</sub> without H<sub>2</sub>O<sub>2</sub> treatment

Fig. S2 Photocurrent density-voltage of TiO<sub>2</sub>/MoS<sub>2</sub> with different H<sub>2</sub>O<sub>2</sub> treatment durations

Fig. S3 Photocurrent density-time (J-t) curve of TiO<sub>2</sub>/MoS<sub>2</sub> with H<sub>2</sub>O<sub>2</sub> treatment

Fig.S4 The cut-off energy of secondary electron (left) and low binding energy region (right) in ultraviolet photoelectron spectroscopy (UPS) of (a) TiO<sub>2</sub> and (b) MoS<sub>2</sub>

Tab. S1 The work function, valence band maximum (VBM, E<sub>VBM</sub>), conduction band minimum (CBM, E<sub>CBM</sub>) and energy of band gap (E<sub>g</sub>) of TiO<sub>2</sub> and MoS<sub>2</sub>

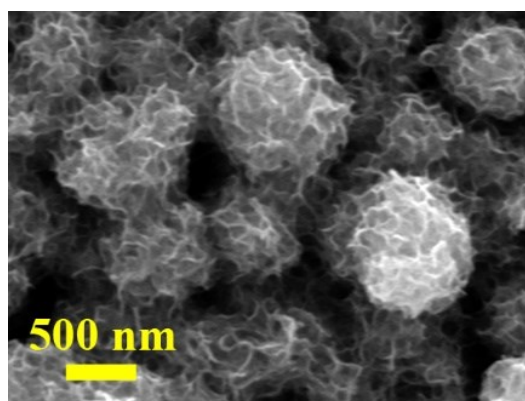


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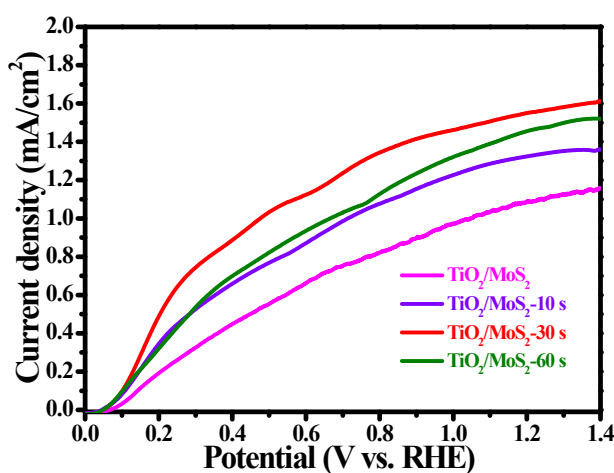


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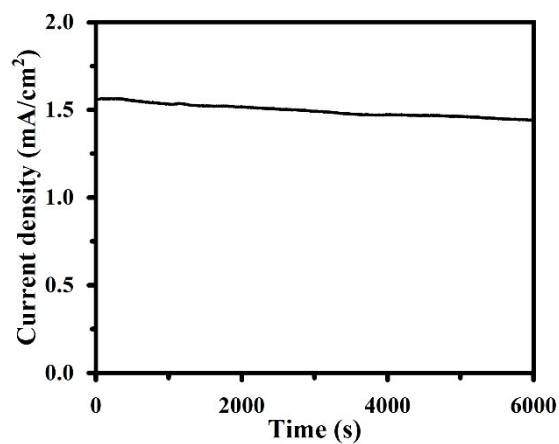


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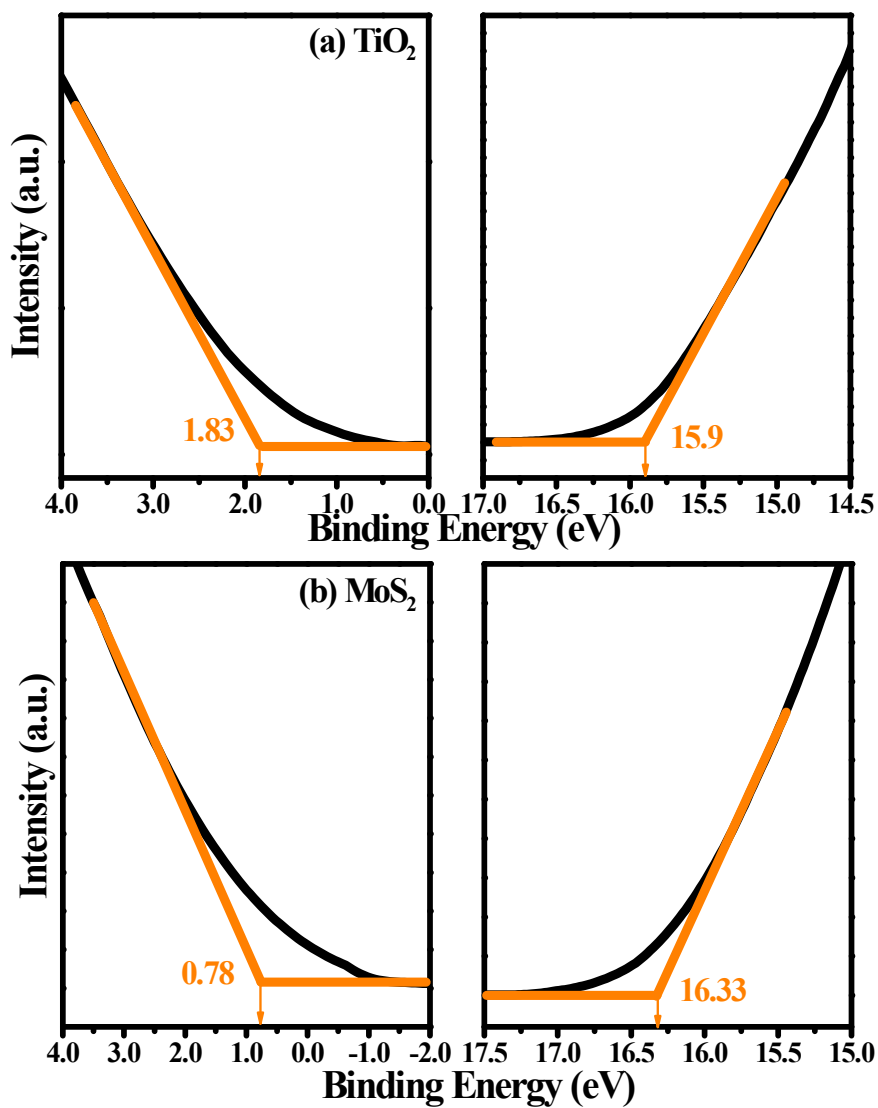


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Sample	Work function (eV)	$E_{\text{VBM}}$ (eV)	$E_{\text{CBM}}$ (eV)	$E_{\text{g}}$ (eV)
$\text{TiO}_2$	-5.32	-7.15	-4.14	3.01
$\text{MoS}_2$	-4.89	-5.67	-3.92	1.75

### The relevant equations

According to the UPS measurement, the valence band maximum (VBM) energy could be calculated by formula:

$$\text{VBM} = h\nu - (E_{\text{cutoff}} - E_{\text{onset}}) \quad (1)$$

where the photon energy  $h\nu = 21.22$  eV.