Supplementary Information

## Hexagonal nanoplates of NiO/CoO/Fe<sub>2</sub>O<sub>3</sub> composite acting as an

## efficient photocatalytic and electrocatalytic water oxidation catalyst

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Fig. S1 Representative EDX spectrum of NiO/CoO/Fe<sub>2</sub>O<sub>3</sub> composite.



Fig. S2 Scanning TEM (STEM) and element mapping images of NiO/CoO/Fe<sub>2</sub>O<sub>3</sub> composite.



Fig. S3 (a) NiO/CoO/Fe<sub>2</sub>O<sub>3</sub> composite is dispersed in a reaction solution; (b) NiO/CoO/Fe<sub>2</sub>O<sub>3</sub> composite is attracted to a magnet in the reaction solution.



**Fig. S4** Observed and theoretical relative abundances of <sup>18</sup>O-labeled and unlabeled oxygen evolved during the photocatalytic oxidation of a buffer solution (5.0 mL) prepared with  $H_2^{18}O$  enriched water (10.8%  $H_2^{18}O$ ) containing NiO/CoO/Fe<sub>2</sub>O<sub>3</sub> composite (0.33 g L<sup>-1</sup>), Ru(bpy)<sub>3</sub><sup>2+</sup> (1.0 mM) and Na<sub>2</sub>S<sub>2</sub>O<sub>8</sub> (5.0 mM) (green, detected mass intensity; red, calculated values assuming that evolved O<sub>2</sub> results exclusively from water).



**Fig. S5** Cyclic voltammograms (CVs) of 80 mM sodium borate buffer solution at pH 8.5 with 1.0 mM Ru(bpy)<sub>3</sub>Cl<sub>2</sub> (red line) and NiO/CoO/Fe<sub>2</sub>O<sub>3</sub> composite (blue line). The black line displays the CV of 80 mM sodium borate buffer solution (pH 8.5).



**Fig. S6** X-ray photoelectron spectra (XPS) of NiO/CoO/Fe<sub>2</sub>O<sub>3</sub> composite before (black) and after the reaction (red) in the survey energy regions.



Fig. S7 (a), (b) TEM images of NiO/CoO/Fe<sub>2</sub>O<sub>3</sub> composite before and after the reaction.



Fig. S8 The spectrum of LED lamp.



**Fig. S9** Linear sweep voltammograms (LSVs) of the catalysts in 1 M potassium hydroxide with a scan rate of 1 mV s<sup>-1</sup>; scan direction, from lower to higher potentials.



Fig. S10 Tafel slopes of catalysts CoO, NiO and Fe<sub>2</sub>O<sub>3</sub>.



Fig. S11 Chronoamperometry study of NiO/CoO/Fe<sub>2</sub>O<sub>3</sub> composite at  $\eta = 300$  mV for the electrocatalytic water oxidation in 1 M potassium hydroxide.