Supporting Information

Ultrathin Porous Co$_3$O$_4$ Nanoplates as Highly Efficient Oxygen Evolution Catalysts

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**Fig. S1.** SEM images of vertically aligned $\beta$-Co(OH)$_2$ nanoplates. The scale bar for all three images is 50 nm. The thickness of nanoplates is around 10 nm.

**Fig. S2.** TEM image of $\beta$-Co(OH)$_2$ nanoplates annealed at 600 ºC.
Fig. S3. XPS spectrum (a) and high-resolution spectra (b) for Co(OH)$_2$ and Co$_3$O$_4$-250.

Fig. S4. Nitrogen adsorption/desorption isotherms of the Co$_3$O$_4$-250. Inset is pore size distribution of the Co$_3$O$_4$-250.
Fig. S5. HRTEM image of Co$_3$O$_4$-250 for observing the pore size (red circle).

Fig. S6. TEM images of ordered mesoporous Co$_3$O$_4$ synthesized through a nanocasting method. KIT-6 mesoporous silica was used as the template and synthesis was performed at 35 °C.
**Fig. S7.** Electrochemical performance of three catalysts after 90% and 95% iR corrections in 0.1 M KOH solution. (a) Co$_3$O$_4$-250, (b) Co$_3$O$_4$-Meso, and (c) Commercial available 10wt % Ir/C. (d) Electrochemical performance of Co$_3$O$_4$-250, Co$_3$O$_4$-Meso and commercial 10 wt% Ir/C after 95% iR corrections in 0.1 M KOH.
3. Photocatalytic Oxygen Evolution from Water

The photocatalytic oxygen evolution activities of the catalysts were studied in a Clark electrode system. In a typical Clark electrode experiment, a solution composed of 8 ml of aqueous buffer solution (pH=5.8), 5 mg of catalyst, 4.6 mg of Ru(byp)$_3$Cl$_2$·6H$_2$O, 13 mg of Na$_2$S$_2$O$_8$, and 40 mg of Na$_2$SO$_4$ was first prepared and diluted eightfold. 1 ml of the dilute solution was used for the Clark electrode system. Before the Clark electrode system was exposed to 150 W Xe light, the solution was degassed with high purity Ar for 30 min. Oxygen evolution was continuously monitored for 1 min by the Clark electrode system. OER reactions for each catalyst were repeated for 5 times under the identical conditions.

Calculation of TOF

Turnover frequency (TOF) value is calculated from the equation$^{1,2}$

$$\text{TOF} = \frac{J \times A}{4 \times F \times m}$$

$J$ (A cm$^{-2}$) is the current density at a specified overpotential. $A$ is the area of the ITO electrode. $F$ is the faraday constant (96485 C mol$^{-1}$). The $m$ is the number of moles of the active materials loaded onto the ITO.
Fig. S8. Electrochemical performance of ITO bare electrodes, commercial 10 wt% Ir/C, $\beta$-Co(OH)$_2$ nanoplates, and porous Co$_3$O$_4$-250, Co$_3$O$_4$-300, Co$_3$O$_4$-400 and Co$_3$O$_4$-500 nanoplates loaded on ITO electrodes in 0.01 and 1.0 M KOH electrolyte solutions. (a) Linear sweep voltammograms of all catalysts in 0.01 M KOH solution. (b) Linear sweep voltammograms of all catalysts in 1.0 M KOH solution.
References