

## Supporting Information

# Cobalt Phosphate Nanocrystals: A Catalase-Like Nanozyme and in Situ Enzyme Encapsulating Carrier for Efficient Chemoenzymatic Synthesis of $\alpha$ -Keto Acid

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**Table S1.** Performance comparison of different cascade catalysis systems for  $\alpha$ -keto acids synthesis.

Catalyst	Catalyst preparation	Substrate concentration	Conversion yield	TOF based on AAO <sup>a</sup>	Reference
DAAO from <i>Trigonopsis variabilis</i> and bovine CAT	DAAO immobilization on functionalized silica bead,  free CAT	50 mM  alanine	90.0% pyruvate	0.79 min <sup>-1</sup>	[38]
DAAO from <i>Trigonopsis variabilis</i> and bovine CAT	Coimmobilization on functionalized agarose bead	20 mM  phenylalanine	98.0%  phenylpyruvic acid	2.86 min <sup>-1</sup>	[39]
LAAO from <i>Crotalus adamanteus</i> and Pt	Immobilization on Pt@UiO-66	0.5 mM L-Trp	99.7% IPA	19.25 min <sup>-1</sup>	[19]

LAAO from *Crotalus*

In situ encapsulation of LAAO in

*adamanteus* and CoPs

CoPs

0.5 mM L-Trp

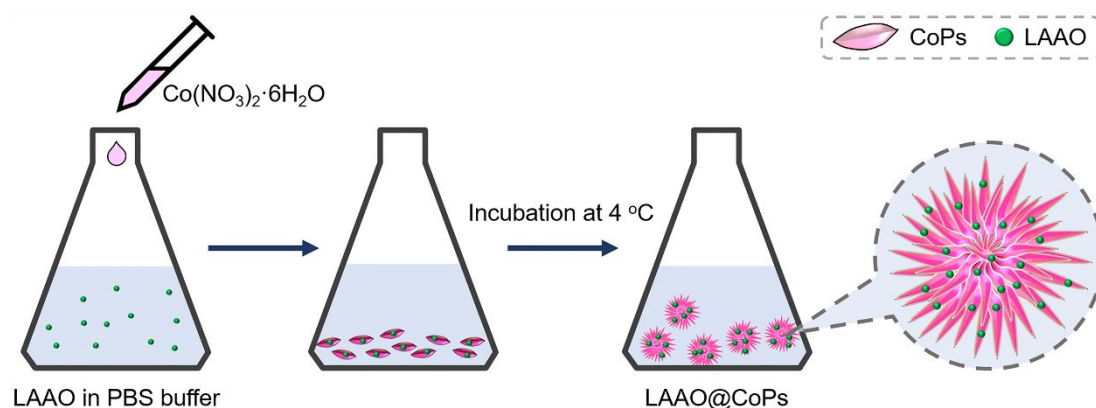
100.0% IPA

16.33 min<sup>-1</sup>

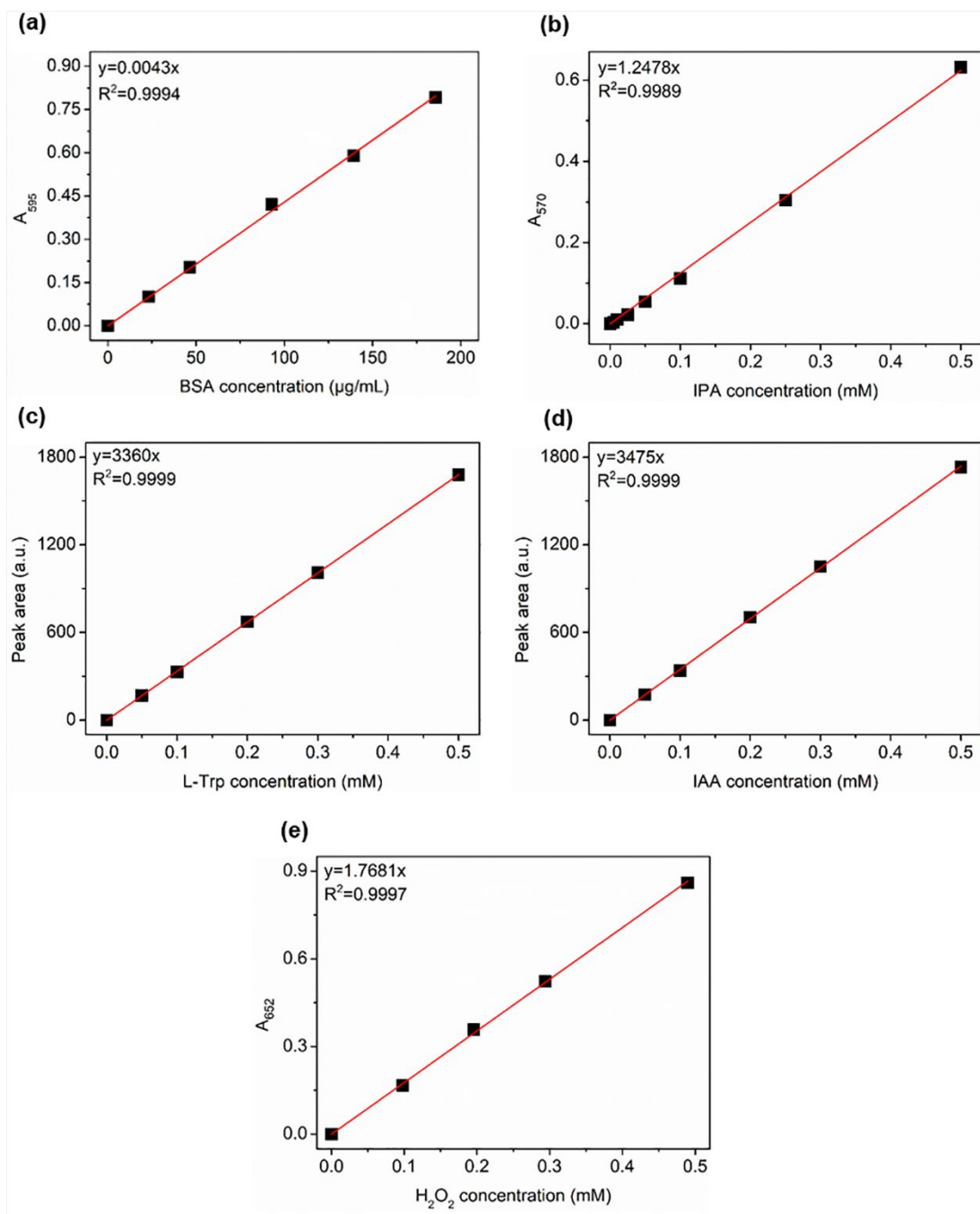
This work

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<sup>a</sup> TOF based on AAO is expressed as molecules of  $\alpha$ -keto acid produced per minute per molecule of AAO.

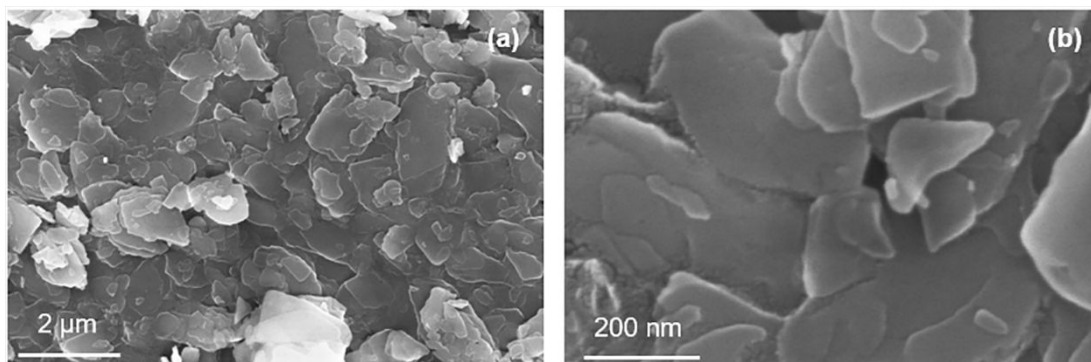


**Figure S1.** Schematic illustration of the preparation of LAAO@CoPs. Preparation conditions: 0.2 mg/mL LAAO, 10 mM  $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ , 10 mM phosphate buffer (pH 8.5), 4 °C, 24 h.

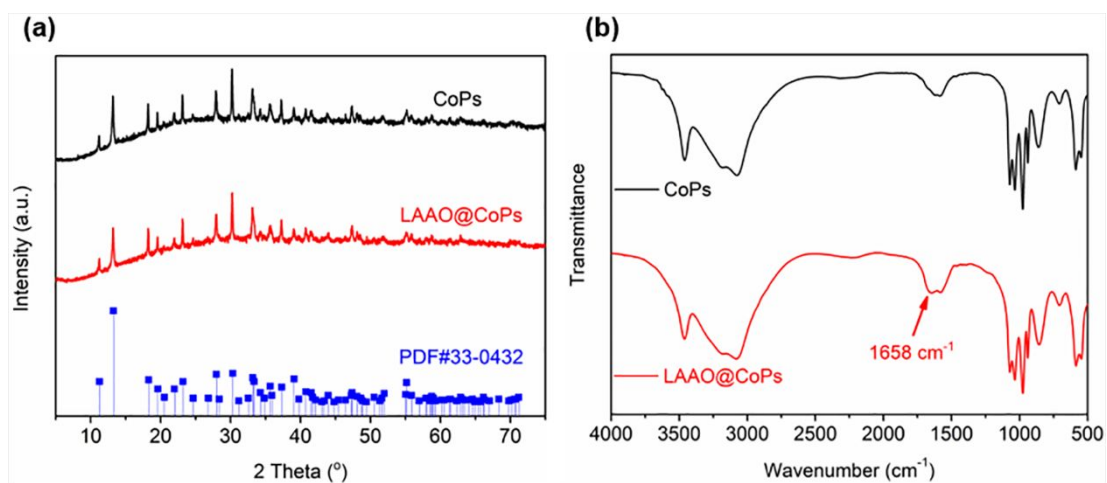


**Figure S2.** (a) Calibration curve of bovine serum albumin measured by Bradford method, the wavelength for the spectrophotometry measurement was 595 nm; (b) Calibration curve of IPA, the wavelength for the spectrophotometry measurement of IPA was 570 nm; (c) Calibration curve of L-Trp; (d) Calibration curve of IAA; (e) Calibration curve of  $\text{H}_2\text{O}_2$ . The wavelength for the HPLC

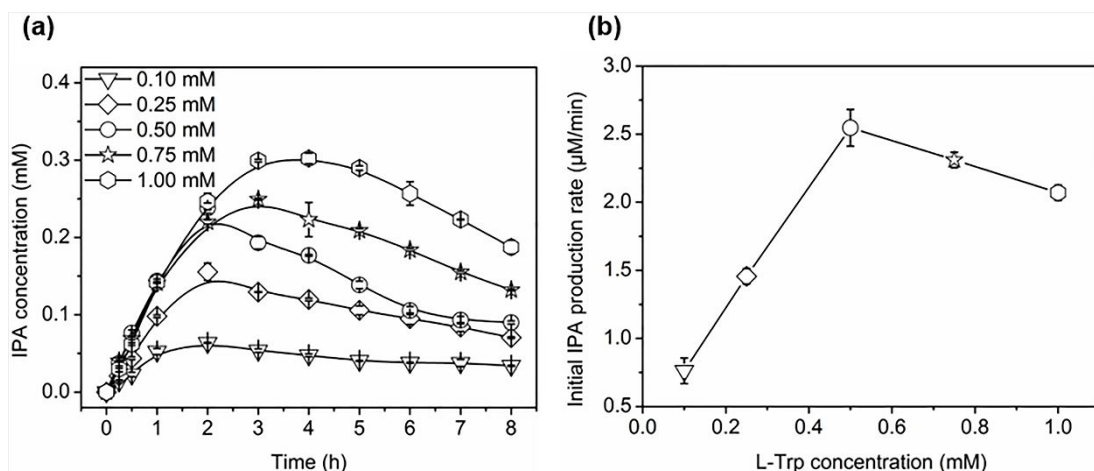
detection of L-Trp and IAA was 280 nm. The wavelength for the spectrophotometry measurement of  $\text{H}_2\text{O}_2$  was 652 nm.



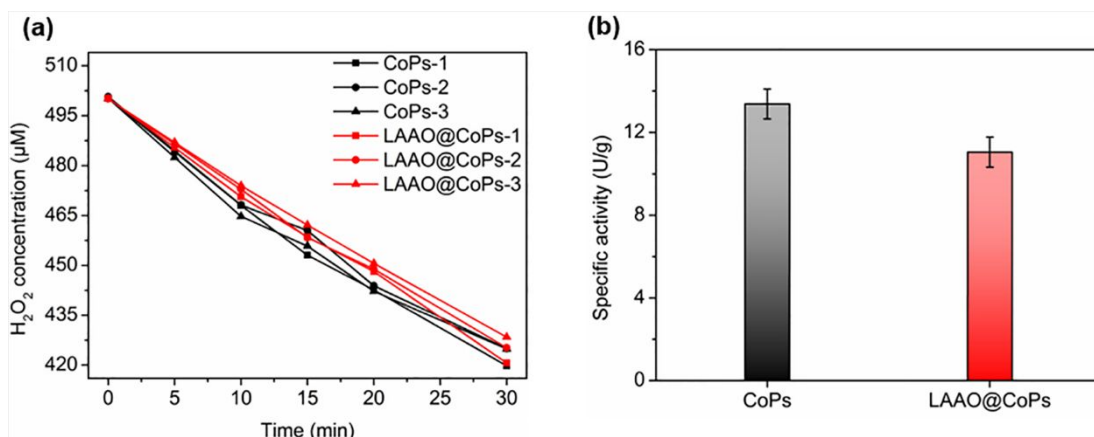
**Figure S3.** SEM images of CoPs at two amplifications, (a) 2  $\mu\text{m}$ , (b) 200 nm.



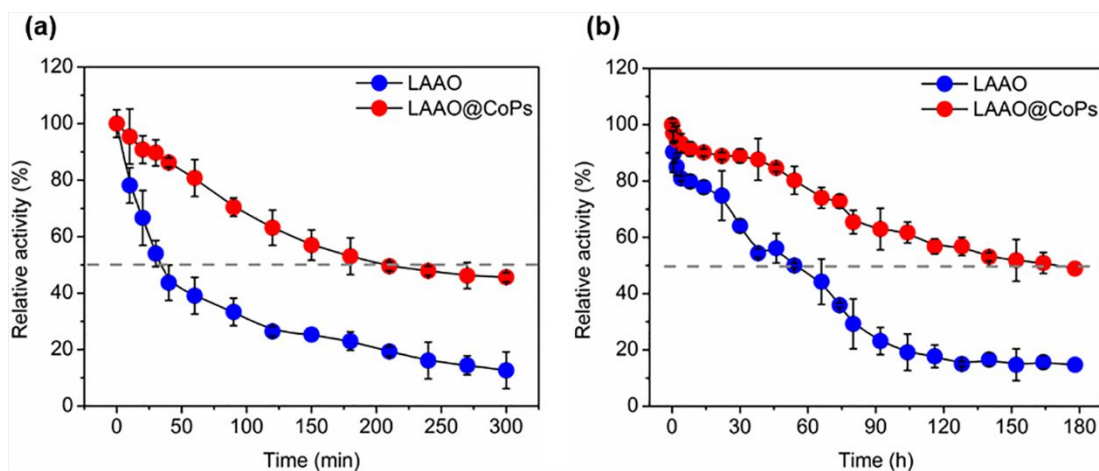
**Figure S4.** (a) XRD patterns and (b) FTIR spectra of CoPs and LAAO@CoPs.



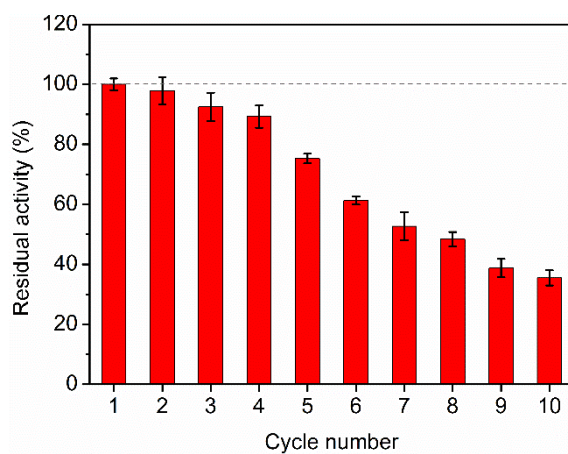
**Figure S5.** (a) Time course of IPA concentration in the reactions catalyzed by LAAO at different initial L-Trp concentrations; (b) Initial IPA production rate catalyzed by LAAO as a function of L-Trp concentration. Reaction condition: 0.01 mg/mL LAAO, 50 mM HEPES buffer (pH 8.0), 25 °C. Error bars represent standard deviations from triplicate experiments.



**Figure S6.** (a)  $\text{H}_2\text{O}_2$  decomposition performance of CoPs and LAAO@CoPs; (b) Specific activities of CoPs and LAAO@CoPs for  $\text{H}_2\text{O}_2$  decomposition. Reaction condition: 0.5 mM  $\text{H}_2\text{O}_2$ , 0.25 mg/mL CoPs or LAAO@CoPs, 50 mM HEPES buffer (pH 8.0), 25 °C. Error bars represent standard deviations from triplicate experiments.



**Figure S7.** (a) Thermal stability of LAAO and LAAO@CoPs at 40 °C; (b) Storage stability of LAAO and LAAO@CoPs at 25 °C. Reaction condition: 0.5 mM L-Trp, 0.01 mg/mL LAAO or 0.25 mg/mL LAAO@CoPs (0.01 mg/mL LAAO), 50 mM HEPES buffer (pH 8.0), 25 °C. Error bars represent standard deviations from triplicate experiments.



**Figure S8.** Reusability of LAAO@CoPs. Reaction condition: 0.5 mM L-Trp, 0.25 mg/mL LAAO@CoPs (0.01 mg/mL LAAO), 50 mM HEPES buffer (pH 8.0), 25 °C. Error bars represent standard deviations from triplicate experiments.