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# Supporting Information

## A general approach towards multi-faceted hollow oxide composites using zeolitic imidazolate frameworks

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**S1**

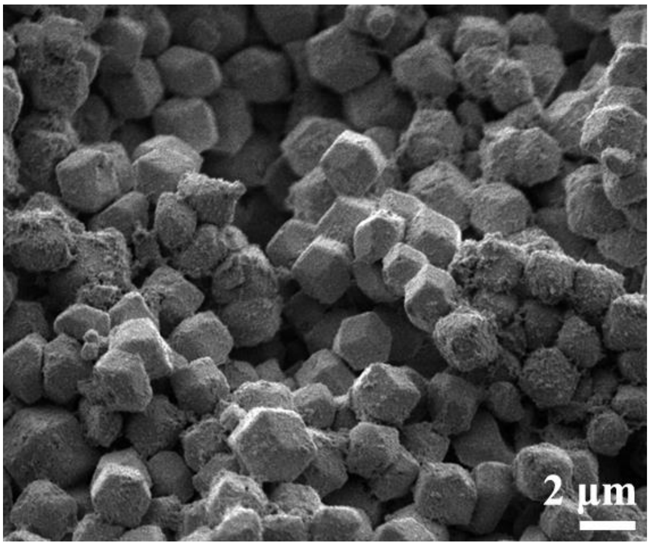


**Fig. S1** An FESEM image of XRD patterns of $Co_3O_4/SiO_2$ hollow dodecahedra.

**S2**

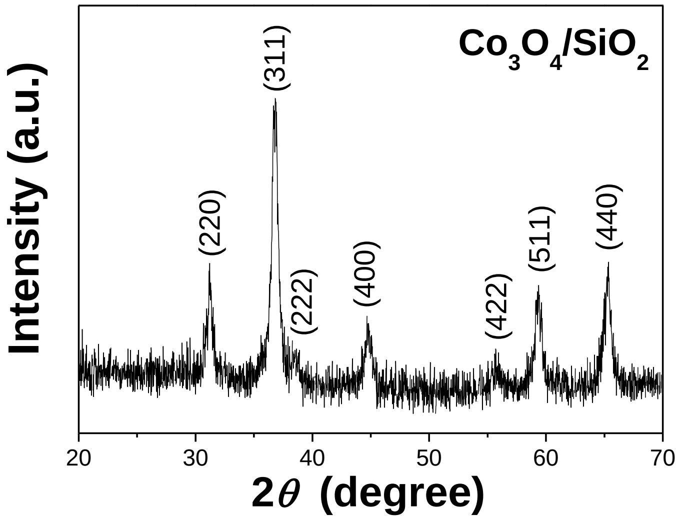


**Fig. S2** XRD patterns of $Co_3O_4/SiO_2$ hollow dodecahedra.

**S3**

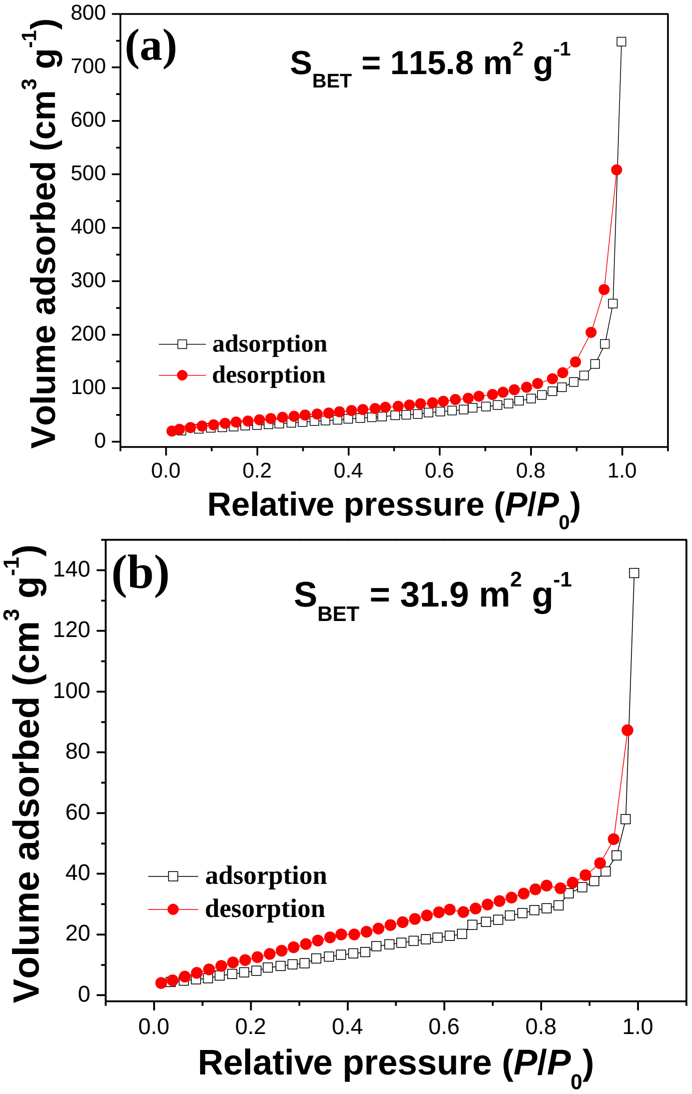


**Fig. S3** Nitrogen adsorption-desorption isotherms of (a) $Co_3O_4/SiO_2$-100 hollow dodecahedra and (b) $Co_3O_4$ nanostructures

**S4**

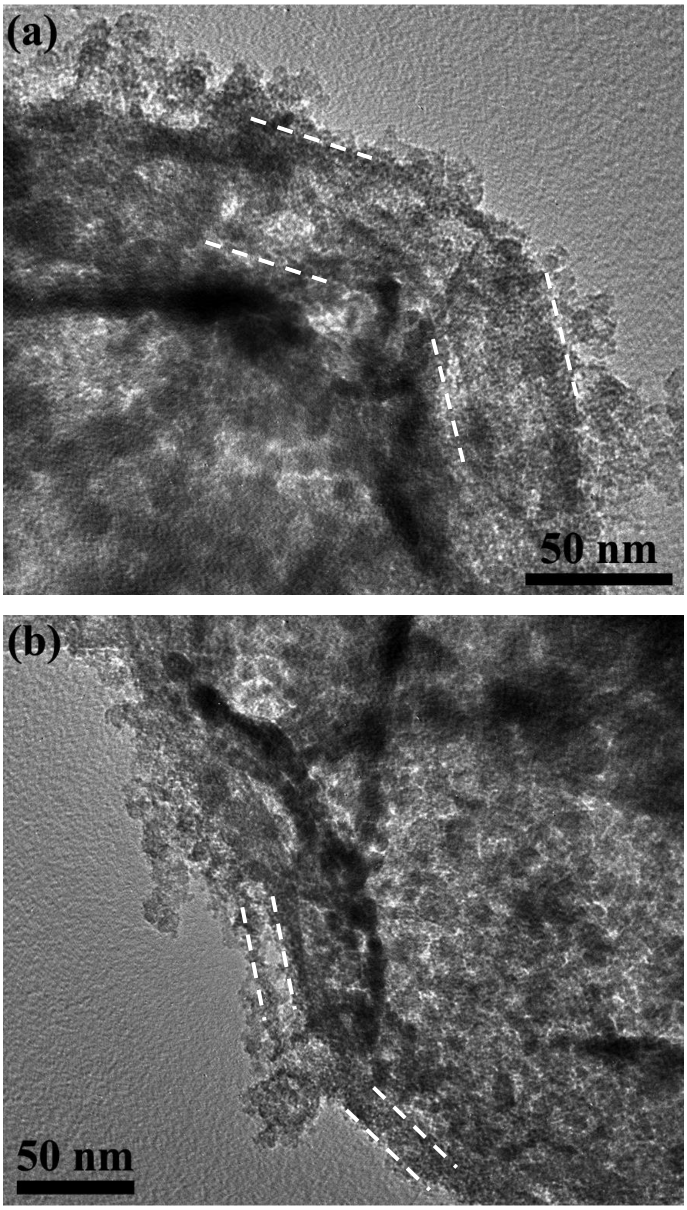


**Fig. S4** TEM images of the $Co_3O_4/SiO_2$ hollow dodecahedra with different $SiO_2$ shell thicknesses obtained by adding different amounts of TEOS in the sol-gel process: (a) 60 μL and (b) 30 μL.

**S5**

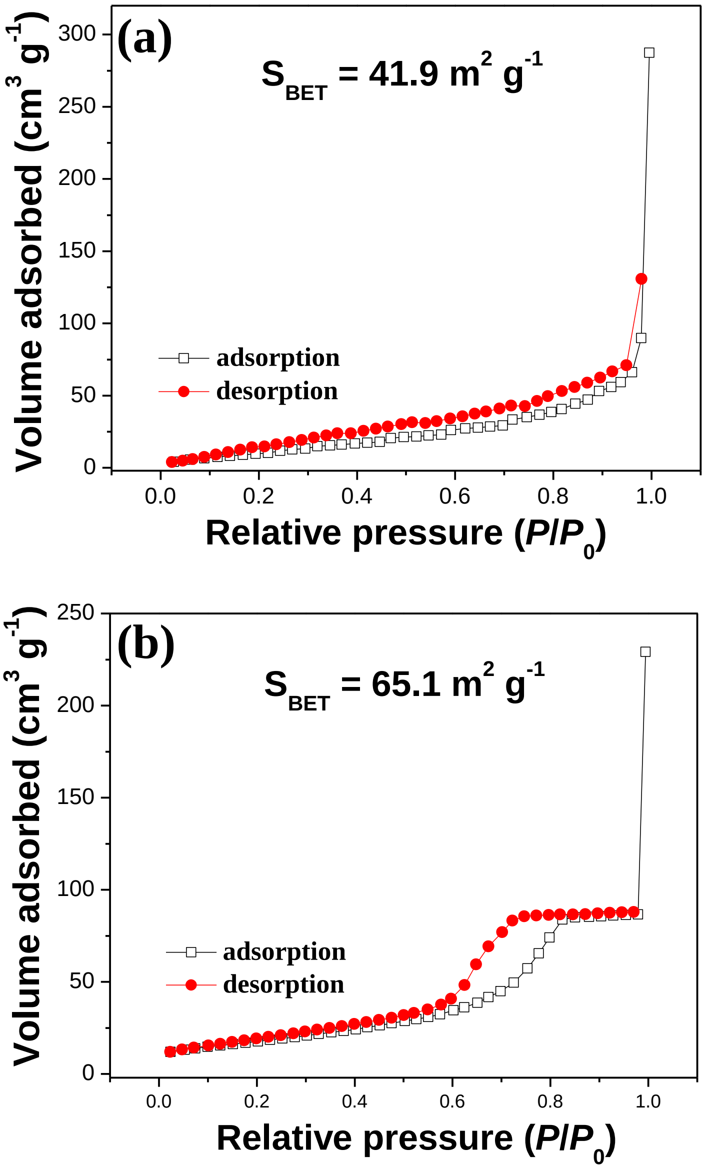


**Fig. S5** Nitrogen adsorption-desorption isotherm curves of (a) $Co_3O_4/TiO_2$ hollow dodecahedra and (b) $TiO_2$.

**S6**

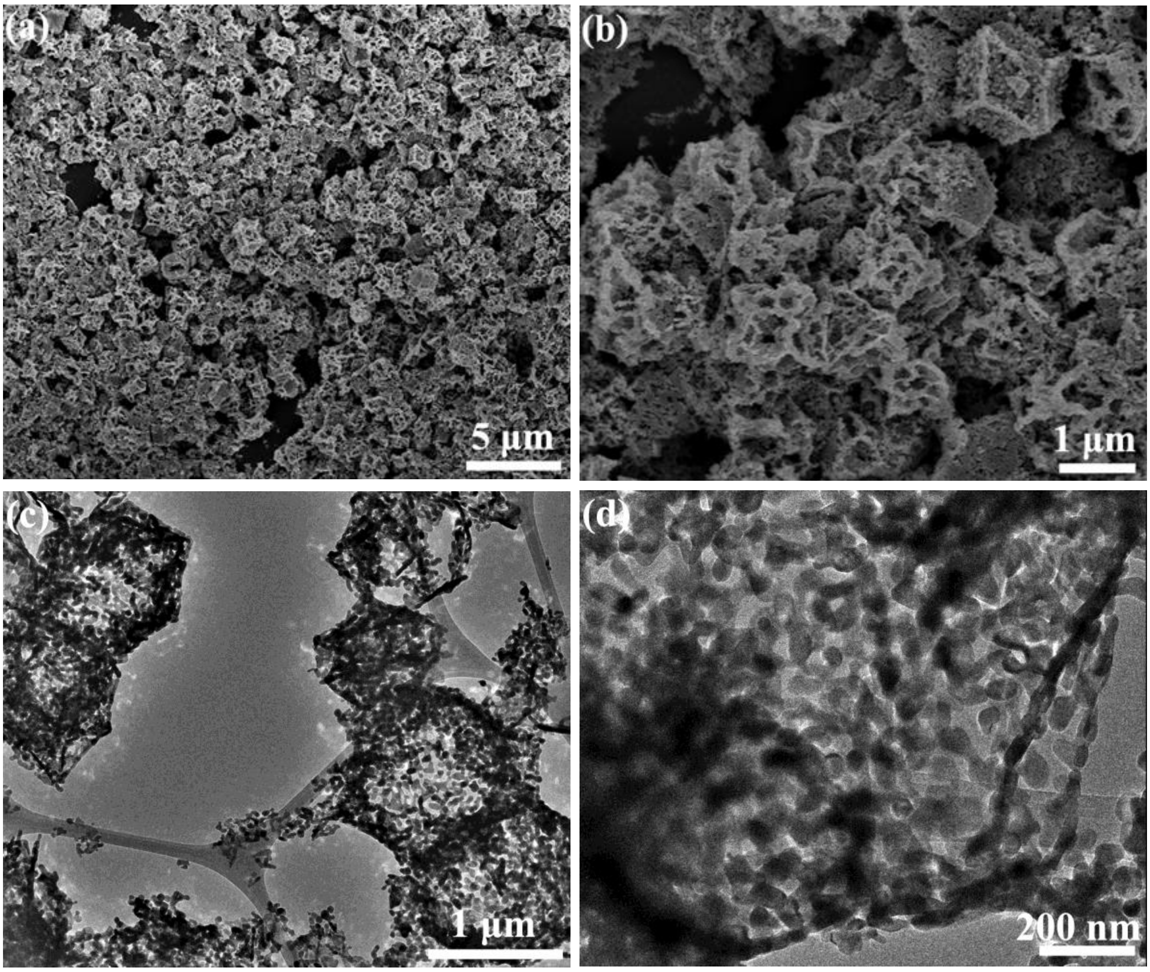


**Fig. S6** (a) Low- and (b) high-magnified FESEM images, and (c) low- and (d) high-magnified TEM images of $Co_3O_4$ nanostructures obtained by directly heating bare ZIF-67 templates.

## S7

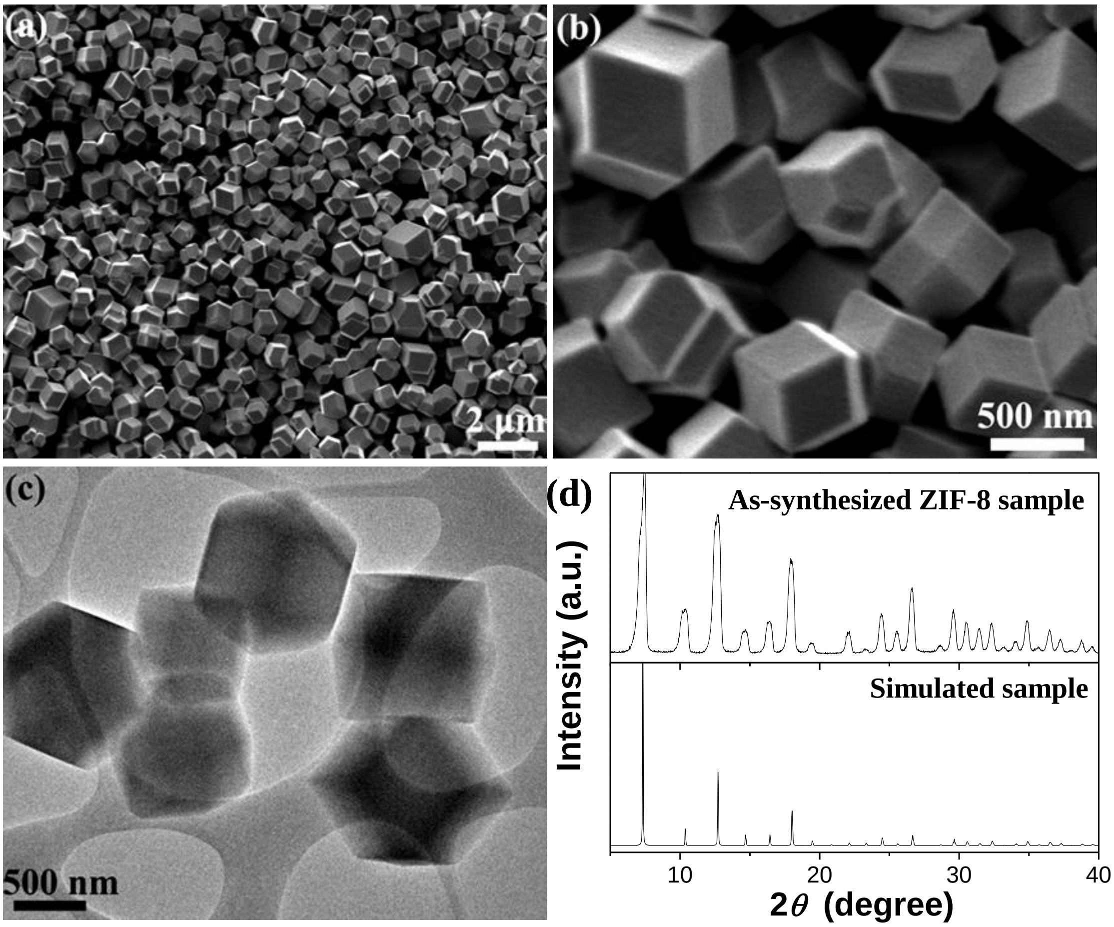


**Fig. S7** (a) Low- and (b) high-magnified FESEM images, and (c) TEM image of ZIF-8; (d) experimental and simulated XRD patterns of ZIF-8.

**S8**

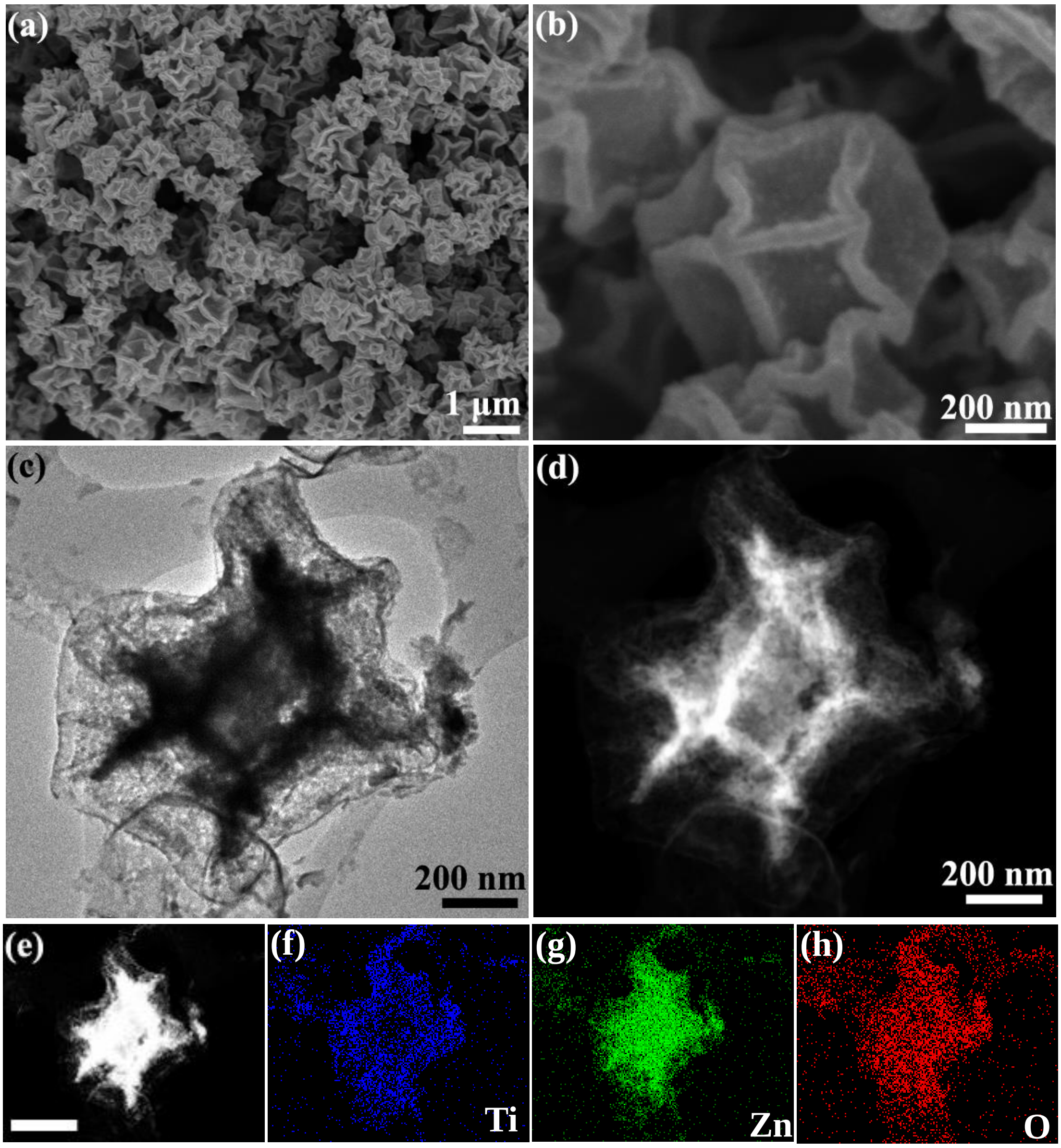


**Fig. S8.** (a) Low- and (b) high-magnified FESEM images of $ZnO/TiO_2$ hollow dodecahedra, (c) TEM image and (d) HAADF-STEM image of a single $ZnO/TiO_2$ hollow dodecahedron, (e)-(h) EDX-elemental mapping images of a single $ZnO/TiO_2$ hollow dodecahedron, the scar bar in (e) is 500 nm.

## S9

Turnover frequency was calculated based on the total Co species added into reactor, assuming all the Co atoms present evolved in the photocatalytic reaction.[1-4]

Turnover frequency calculation as follows:

$$\text{Turnover frequency} = \frac{\text{Produced oxygen in first 10 mins (mol/s)}}{\text{Active sites number (mol)}}$$

$$\text{Active sites number (mol)} = 3 \times \frac{\text{mCo3O4}}{\text{MCo3O4}}$$

**Table S1**. Turnover frequencies for all catalyst

| Catalyst | $Co_3O_4$ (wt.%) | $O_2$ yield as in 1st 10 mins (μmol) | Turn frequencies ($s^{-1}$ per Co atom) × $10^4$ |
|---|---|---|---|
| $Co_3O_4$ | 100 | 17.7 ± 1.5 | 2.4 |
| $Co_3O_4$ + $SiO_2$ | 70.3 | 14.4 ± 2.0 | 2.8 |
| $Co_3O_4$-30 | 80.7 | 19.1 ± 2.3 | 3.2 |
| $Co_3O_4$-60 | 70.3 | 48.3 ± 2.6 | 9.2 |
| $Co_3O_4$-100 | 63.8 | 34.6 ± 1.4 | 7.3 |

## References


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[2] Y. Surendranath, M. W. Kanan, D. G. Nocera, *J. Am. Chem. Soc.* **2010**, *132*, 16501.

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[4] R. Zheng, G. Yanbing, Z. H. Zhang, C. H. Liang, P. Gao. *J. Mater. Chem. A***, 2013,** 1**,** 9897.