Electronic Supplementary Material (ESI) for Catalysis Science & Technology.


# Supporting Information

# ZnO nanorod modified with noble metal-free $Co_3O_4$ nanoparticles as a photocatalyst for the efficient ethylene-degradation under light irradiation

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1. Pure $RuO_2$ and $Co_3O_4$ were also prepared in the same method, except that no ZnO was added to the solution before the chemical deposition reaction. The XRD patterns of the pure $Co_3O_4$ and $RuO_2$ samples with 300℃ are shown in **Fig. S1**.

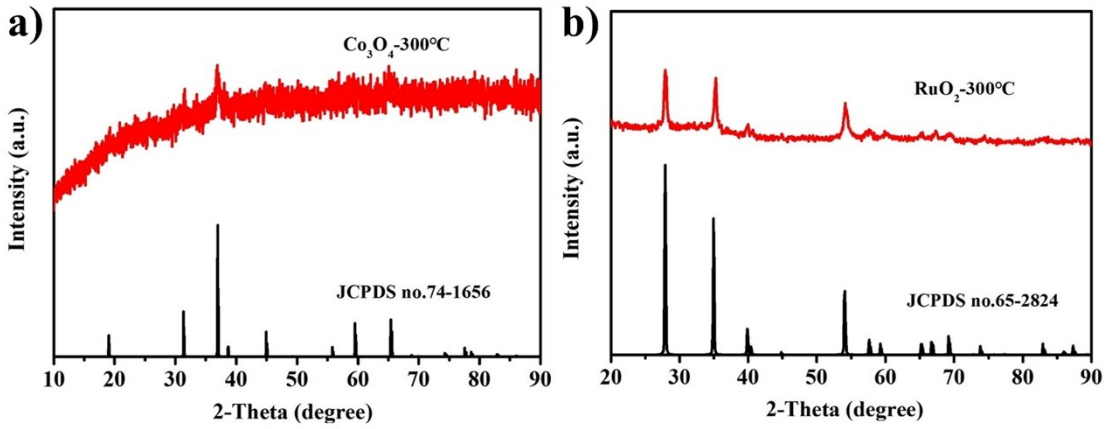



**Fig. S1.** The XRD patterns of the pure (a) $Co_3O_4$ and (b) $RuO_2$ samples with 300 ℃.

2. The XRD patterns of the pure ZnO and ZnO/$Co_3O_4$ samples annealed at different temperatures.

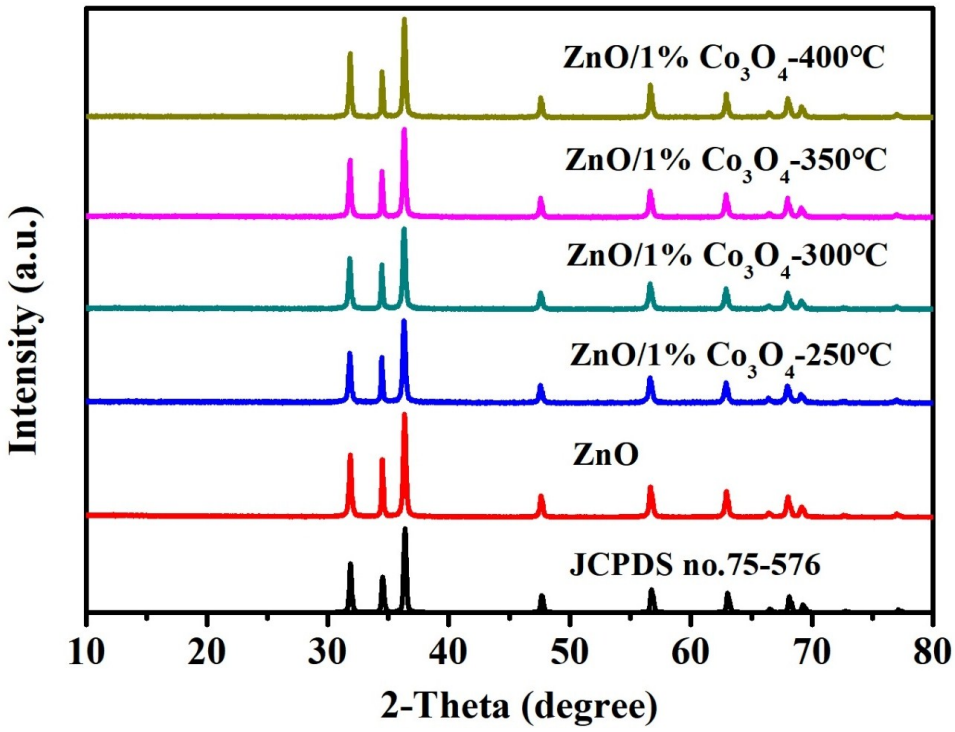


**Fig. S2.** The XRD patterns of the pure ZnO and $Co_3O_4$ nanoparticles decorated on ZnO samples annealed at different temperatures.

3. The EDS spectra of the ZnO/1% $Co_3O_4$-300 °C sample.

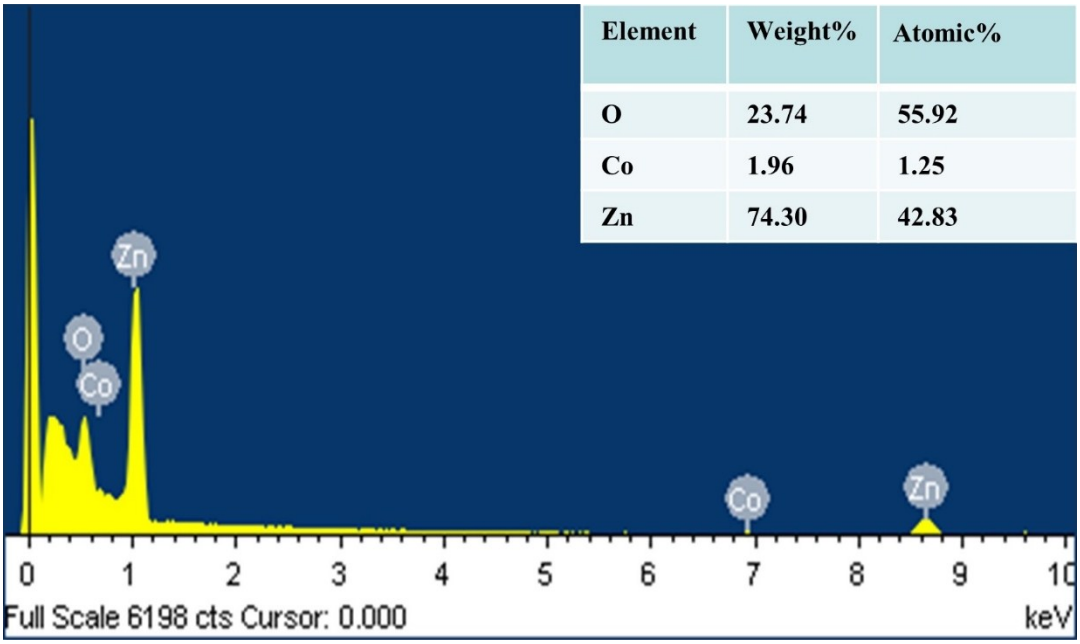



**Fig. S3.** The EDS spectra of the ZnO/1% $Co_3O_4$-300 °C sample.

4. The $(Ahv)^2$-$hv$ plots of ZnO, ZnO/0.5% $RuO_2$-300 ℃ and ZnO/1% $Co_3O_4$-300 ℃.

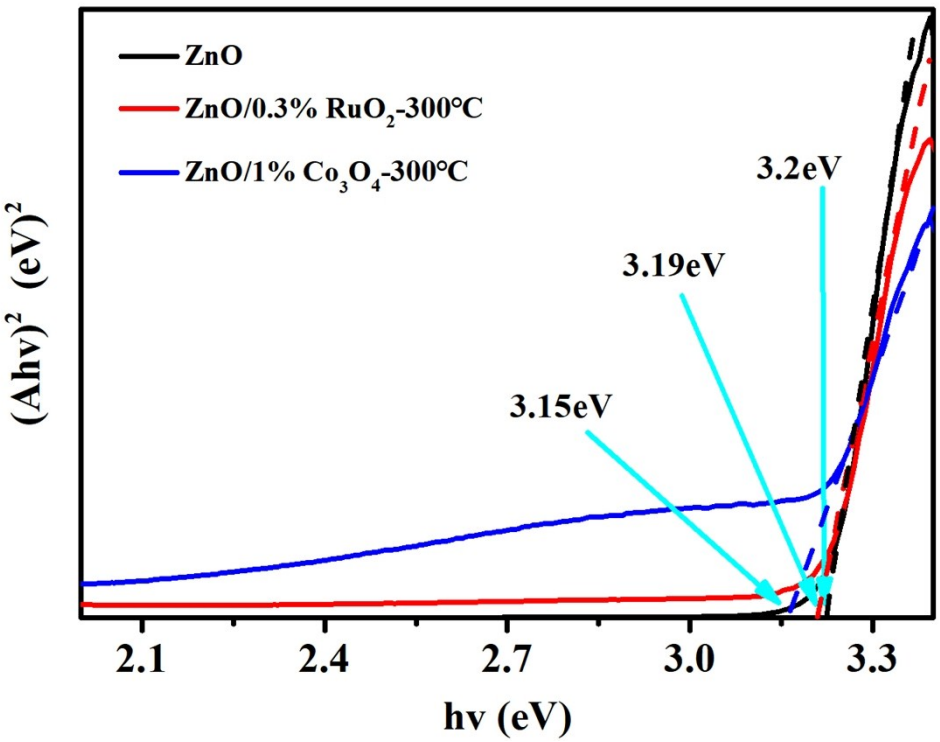
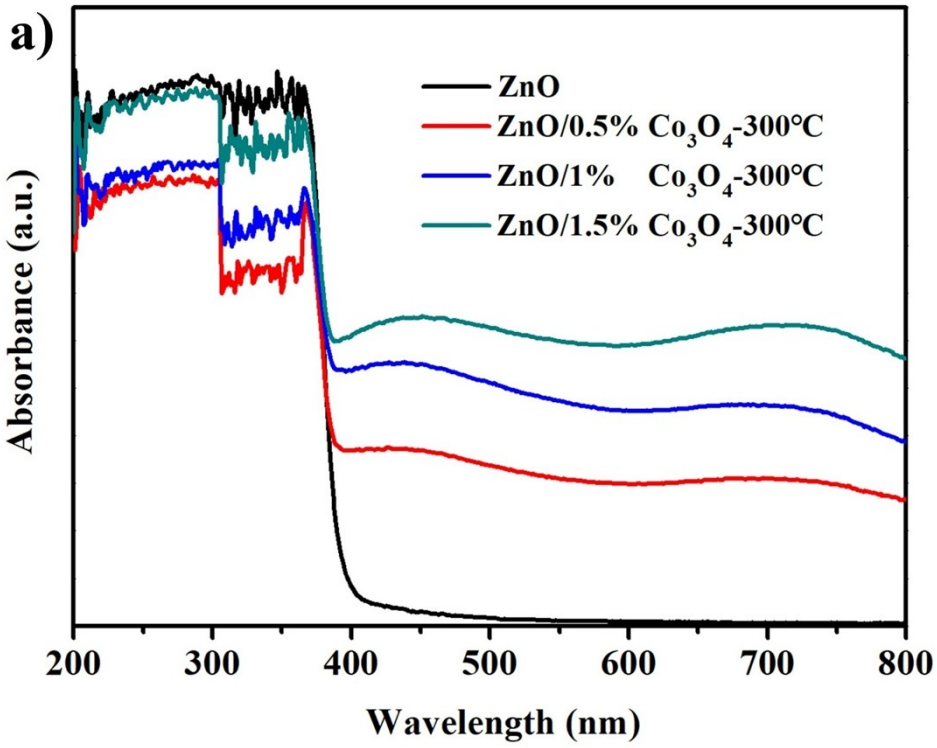
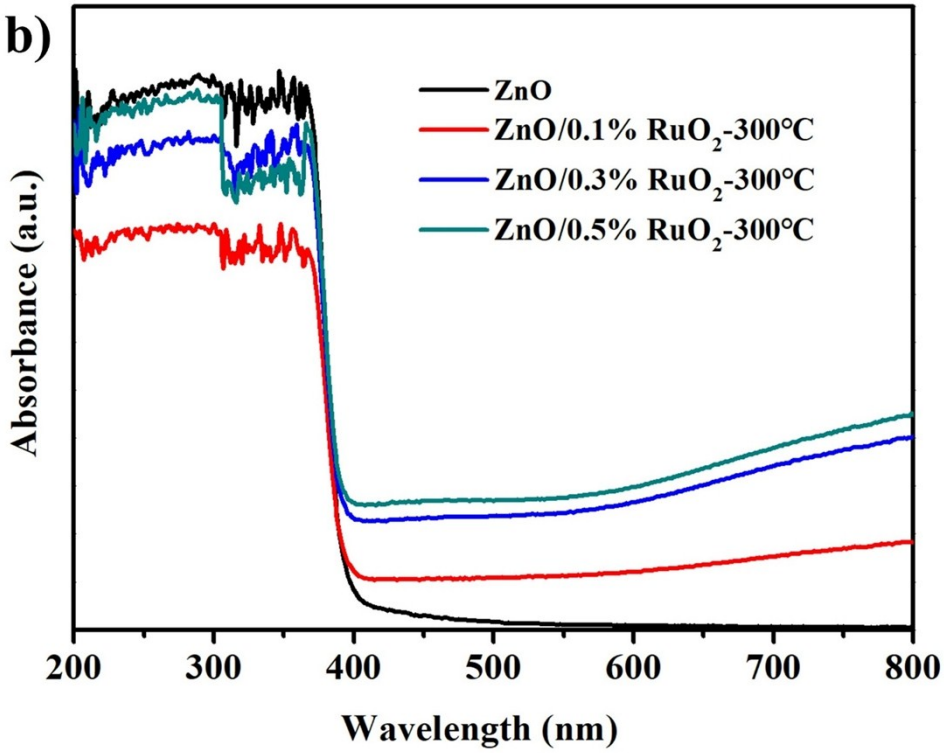



**Fig. S4.** The $(Ahv)^2$-$hv$ plots of ZnO, ZnO/0.5% $RuO_2$-300 ℃ and ZnO/1% $Co_3O_4$-300 ℃.

5. UV-vis diffuse reflectance spectra of ZnO/$Co_3O_4$ and ZnO/$RuO_2$.


a)
Absorbance (a.u.)
ZnO
ZnO/0.5% Co3O4-300°C
ZnO/1% Co3O4-300°C
ZnO/1.5% Co3O4-300°C
200
300
400
500
600
700
800
Wavelength (nm)


b)
Absorbance (a.u.)
ZnO
ZnO/0.1% RuO2-300°C
ZnO/0.3% RuO2-300°C
ZnO/0.5% RuO2-300°C
200
300
400
500
600
700
800
Wavelength (nm)

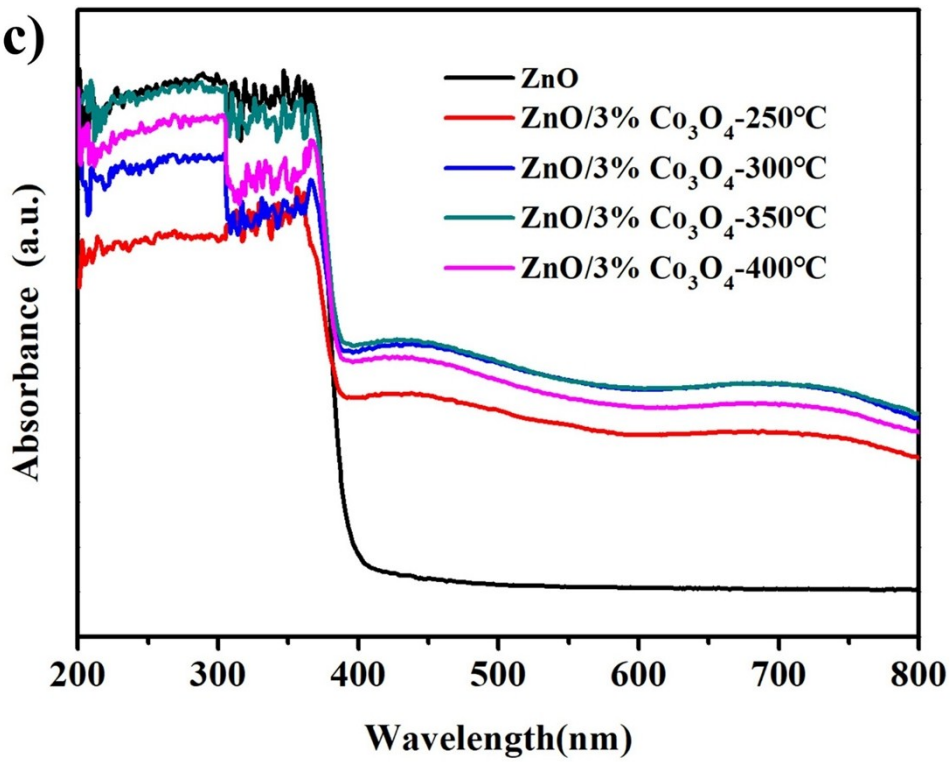



**Fig. S5.** UV-vis diffuse reflectance spectra of $ZnO/Co_3O_4$ (a) and $ZnO/RuO_2$ (b) samples with different molar ratios. (c) UV-vis diffuse reflectance spectra of $ZnO/Co_3O_4$ annealed at different temperatures.

6. Photocatalytic degradation of ethylene by using $ZnO/Co_3O_4$ annealed at different temperatures.

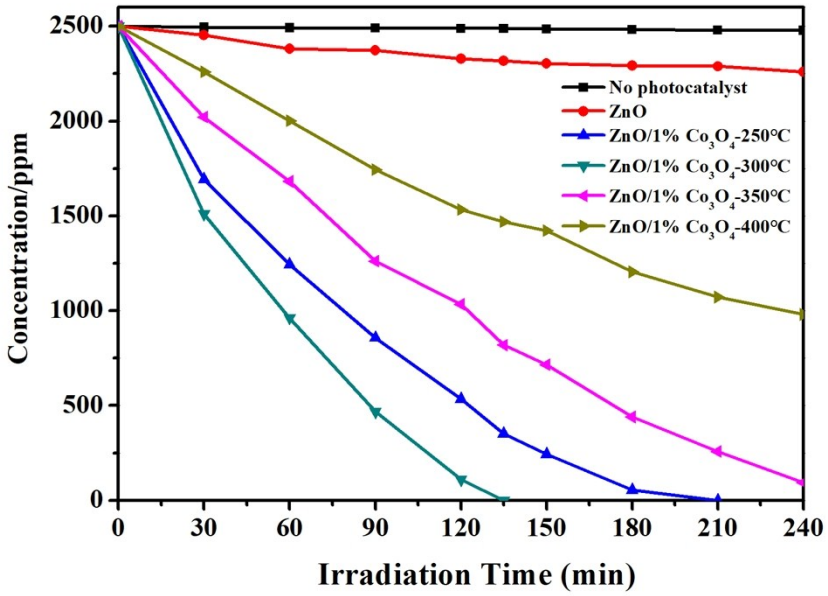



**Fig. S6.** Photocatalytic degradation of ethylene by using ZnO/$Co_3O_4$ annealed at different temperatures.

7. The XRD patterns of ZnO/1% $Co_3O_4$-300 °C samples before and after photocatalytic degradation of ethylene.

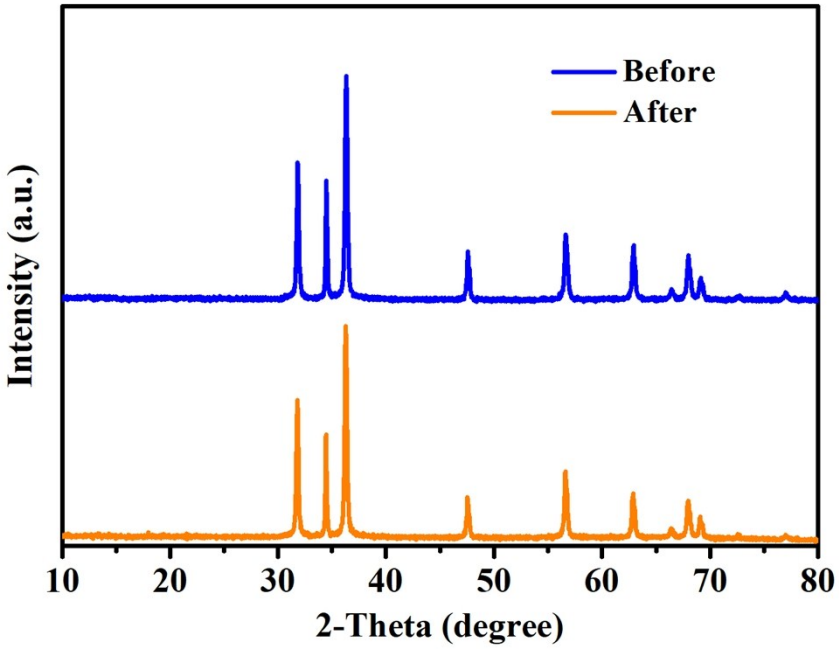


**Fig. S7.** The XRD patterns of ZnO/1% $Co_3O_4$-300 °C samples before and after photocatalytic degradation of ethylene.

**Table S1.** The comparison of photocatalytic $C_2H_4$ degradation activities of different photocatalysts.

| **Photocatalyst** | **$C_2H_4$ (ppm)** | **Amount (g)** | **Light source** | **Performance** | **Reference** |
|---|---|---|---|---|---|
| ZnO/1mol% $Co_3O_4$ | 2500 | 0.15 | 300W Xe lamp full spectrum irradiation | After 135 min light irradiation, $C_2H_4$ can be degrade completely | **This work** |
| ZnO/0.3mol% $RuO_2$ | 2500 | 0.15 | 300W Xe lamp full spectrum irradiation | After 210 min light irradiation, $C_2H_4$ can be degrade completely | **This work** |
| ZnO/1.5wt% Ag | 2500 | 0.5 | 300W Xe lamp full spectrum irradiation | After 150 min light irradiation, $C_2H_4$ can be degrade completely | [1] |
| ZnO/$CeO_2$-1.0%Ag | 1250 | 0.5 | 300W Xe lamp full spectrum irradiation | After 90 min light irradiation, $C_2H_4$ can be degrade completely | [2] |
| ZnO/$CeO_2$-1.5%Au | 1250 | 0.5 | 300W Xe lamp full spectrum irradiation | After 120 min light irradiation, $C_2H_4$ can be degrade completely | [2] |
| 0.75 wt% Pt@0.25 mol% Fe-$WO_3$ | 1250 | 0.4 | 300 W Xe lamp (visible light, λ>420 nm) | After 210 min light irradiation, $C_2H_4$ can be degrade completely | [3] |
| $In_2O_3$-Ag-$Ag_3PO_4$ | 200 | 0.2 | 300 W Xe lamp (visible light, λ>420 nm) | After 2 h light irradiation, $C_2H_4$ can be degrade completely | [4] |
| Pt-$TiO_2$ nanosheets | 200 | 0.1 | 300 W Xe lamp (visible light, λ> 420 nm) | After 12 min light irradiation, $C_2H_4$ can be degrade completely | [5] |

| | | | | | |
|---|---|---|---|---|---|
| $BiVO_4$ (040) facets | 100 | 0.5 | Schölly Fiberoptic Flexilux 650 Kaltlichtquelle 150 W | After 150 light irradiation, 60% $C_2H_4$ is degraded | [6] |
| $BiVO_4$/P25 | 1500 | 1 | 500 W Xe lamp (visible light, λ>400 nm) | After 6 h light irradiation, only 7.56% $C_2H_4$ is degraded | [7] |

## References


[1] X. L. Zhu, X. Z. Liang, P. Wang, Y. Dai, B. B. Huang, *Appl. Surf. Sci.* 456 (2018) 493-500.

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