### Supporting information for the manuscript

# Photocatalytic Oxidation of Methane over CuO Decorated ZnO Nanocatalysts

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### **Turnover number calculations**

Take reaction formula:  $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ , the number of electrons gain and loss in the reaction is  $8 \cdot e^{-1}$ . We assume that all electrons were excited by light. The amount of substance 20 mL  $CH_4$ :  $n_1 = 20 \text{mL}/(22.4 \text{L} \cdot \text{mol}^{-1}) = 8.929 \times 10^{-4} \text{ mol}$ ; The total amount of substance of electrons gain and loss in the photooxidation of 20 mL  $CH_4$ :  $n_2 = 8 \times 8.929 \times 10^{-4} \text{ mol} = 7.1432 \times 10^{-3} \text{ mol}$ ; For the 0.5 g 0.8wt%CuO/ZnO samples: the amount of substance for ZnO:  $n_3 = 99.2\% \times 0.5/81.39$  mol=  $6.094 \times 10^{-3}$ mol, the amount of substance for CuO:  $n_4 = 0.8\% \times 0.5/79.545$  mol=  $5.029 \times 10^{-5}$  mol. For ZnO, the Turnover number: n = 7.1432/6.094 = 1.172; For CuO, the Turnover number:  $n = 7.1432 \times 10^2/5.029 = 142.04$ 



Fig. S1. The XRD patterns of as-prepared CuO samples.



**Fig. S2.** The spectrum of simulated solar light. **a**, UV-vis spectrum with marked UV light; **b**, visible light spectrum.



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Fig. S6. Photocurrent responses of the samples under simulated solar light illumination.



Fig. S7. Room temperature photoluminescence (PL) spectra of pure ZnO and 0.8wt%CuO/ZnO.

**Table S1.** BET surface area and rate constant k in photo-oxidation reaction of ZnO and the CuO/ZnO samples.

Samples	ZnO	0.1wt%CuO/ ZnO	0.5wt%CuO/ ZnO	0.8wt%CuO/ ZnO	1.0wt%CuO/ ZnO	
$BET(m^2 \cdot g^{-1})$	29.3	31.1	31.4	33.8	32.3	
k(min <sup>-1</sup> )	0.014	0.050	0.086	0.112	0.081	_