Electronic Supplementary Material

Synergistic adsorption-photocatalytic degradation of levofloxacin using $Zn_{1-x}Cu_xS$-modified cellulose/chitosan sponge

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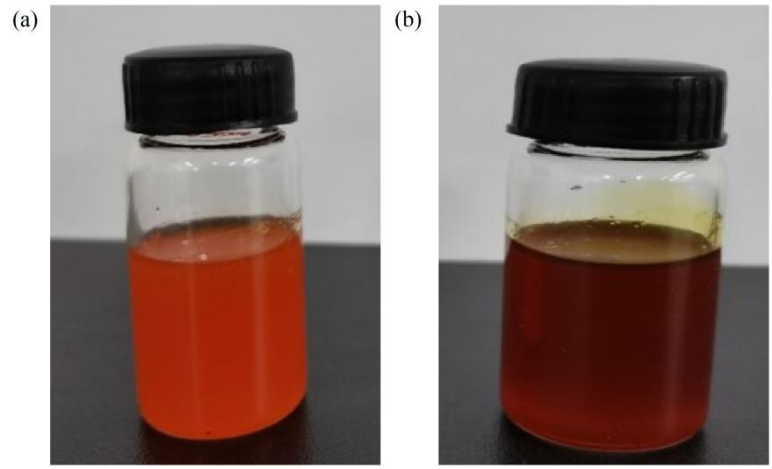

Fig. S1. (a) Cellulose xanthate; (b) Chitosan xanthate

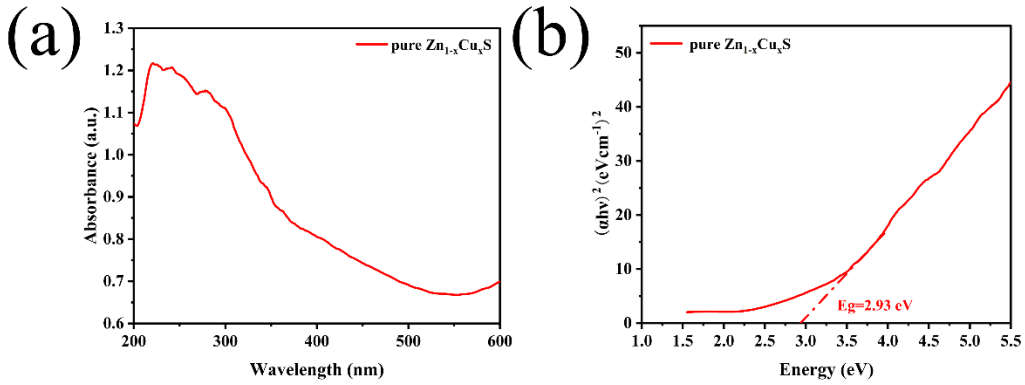

Fig. S2. UV-vis spectra (a), and Tauc plots (b) of pure $Zn_{1-x}Cu_xS$

To gain an insight into the adsorption reaction efficiency, the adsorption kinetics of ZnCuCCS for LEV were studied using pseudo-first-order (PFO) and pseudo-second-order (PSO) kinetic models.

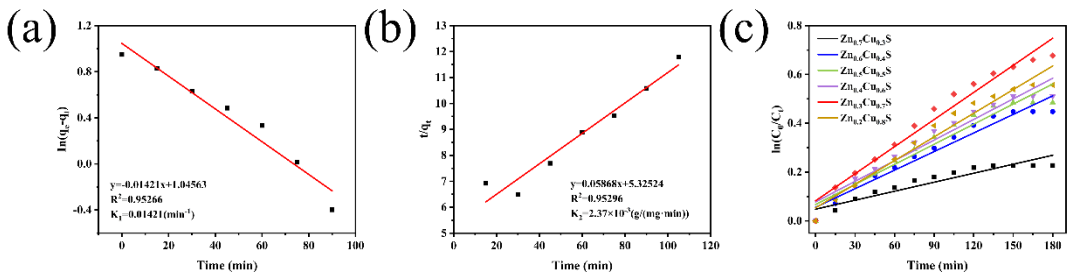

Fig. S3. (a) PFO model of adsorption LEV; (b) PSO model of adsorption LEV; (c) Relationship between $\ln(C_0/C_t)$ and irradiation time of the ZnCuCCS.

The PFO model can be formulated as

$$ln(q_e - q_t) = lnq_e - k_1 t \quad (1)$$

The PSO model can be formulated as

$$\frac{t}{q_t} = \frac{1}{k_2 q_e^2} + \frac{t}{q_e} \quad (2)$$

In the equations, q_e (mg/g) is the adsorption capacity of ZnCuCCS at equilibrium; q_t (mg/g)) represents the adsorption capacity at t time (min); k_1 (min^{-1}) is the rate constant of the PFO model; and k_2 (g/(mg·min)) is the adsorption rate constant of the PSO model.

The linear fitting images of the PFO and PSO models for ZnCuCCS are shown in Fig. S3 (a) and (b). It could be seen from the figures that the correlation coefficient R^2 of the PSO model was higher than that of the PFO model, indicating that the PSO kinetic equation better predicted the kinetic process. According to the assumptions of the PSO model, the adsorption process might involve chemisorption. This suggested that the amino and hydroxyl groups of ZnCuCCS might play important roles in the adsorption of LEV, indicating that the adsorption system involved a chemical process related to electron sharing or electron transfer.

The photocatalytic activity of ZnCuCCS was evaluated using the PFO model. Based on the reaction rate constant (k), the photocatalytic degradation rates for different $Zn_{1-x}Cu_xS$ loadings were calculated using equation (3):

$$\ln(\frac{C_0}{C_t}) = kt + b \quad (3)$$

Where C_0 is the initial concentration of the LEV solution, C_t is the concentration of the TC solution after a reaction time (t), and k is the relative degradation rate constant,

which can be calculated based on the slope and intercept of the linear plot. As shown in Fig. S3(c), the linear plot of the PFO kinetic model indicated that the k values were in the order of $Zn_{0.3}Cu_{0.7}S$> $Zn_{0.2}Cu_{0.8}S$ > $Zn_{0.4}Cu_{0.6}S$ > $Zn_{0.5}Cu_{0.5}S$ > $Zn_{0.7}Cu_{0.3}S$. The related parameters are shown in Table.S1, with all samples having a correlation coefficient (R^2) greater than 0.90, indicating that the photocatalytic degradation process of LEV conformed to the PFO kinetic model. As the Cu content in $Zn_{1-x}Cu_xS$ increases, the degradation rate of LEV by ZnCuCCS also increased, with the maximum value reaching $3.7\times10^{-3}min^{-1}$, demonstrating that ZnCuCCS was an excellent photocatalyst.

Table.S1 Photodegradation parameters of different samples.

Sample	Apparent rate constant, k (min^{-1})	Correlation coefficient, R^2
$Zn_{0.7}Cu_{0.3}S$	1.23×10^{-3}	0.88778
$Zn_{0.6}Cu_{0.4}S$	2.54×10^{-3}	0.95617
$Zn_{05}Cu_{0.5}S$	2.74×10^{-3}	0.94663
$Zn_{0.4}Cu_{0.6}S$	2.82×10^{-3}	0.94746
$Zn_{0.3}Cu_{0.7}S$	3.7×10^{-3}	0.96577
$Zn_{0.2}Cu_{0.8}S$	3.23×10^{-3}	0.96082

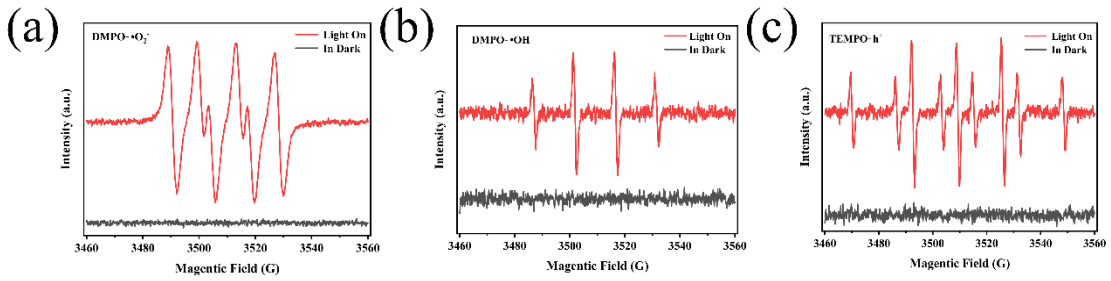

Fig. S4. The ESR spectra of ZnCuCCS in the dark and under 5 min of irradiation. (a) DMPO-•O_2^- ; (b) DMPO-•OH; (c) TEMPO-h^+.

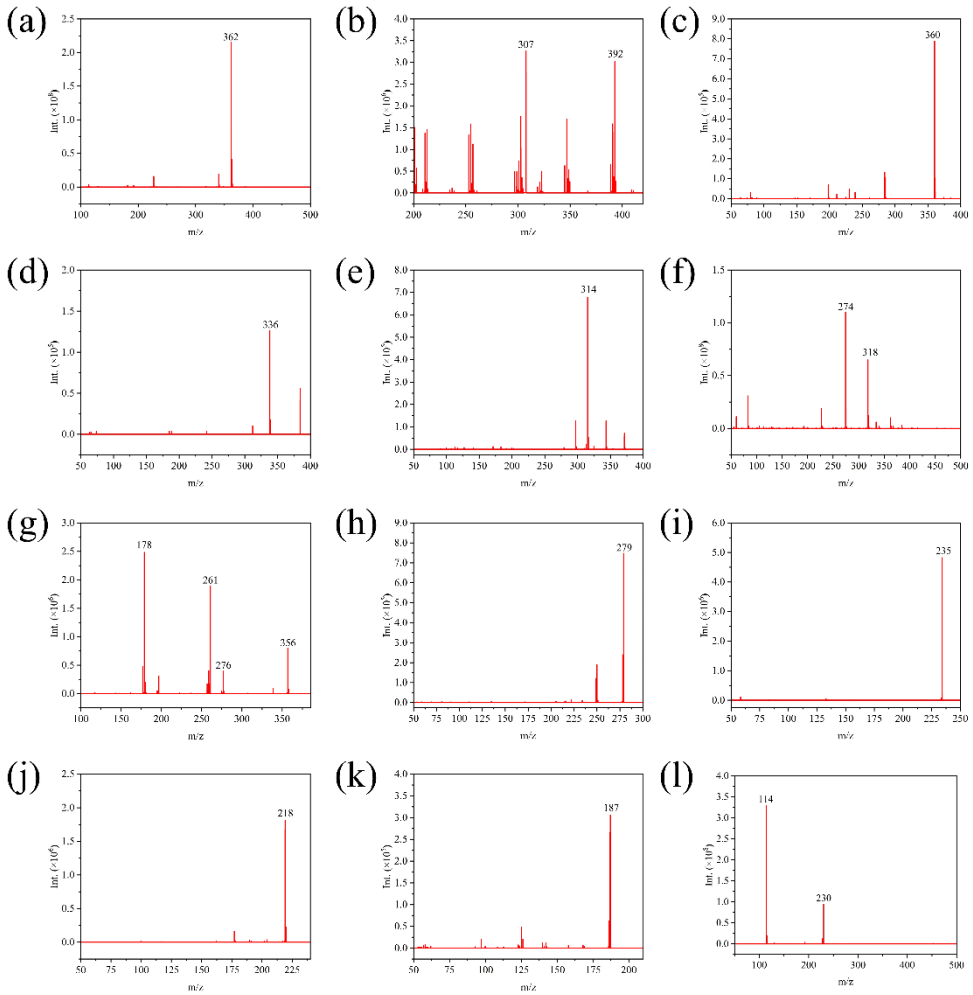

Fig. S5. (a-l) Mass spectrometry of degradation intermediates detectedat 0 min and 60 min of LEV solution degradation.

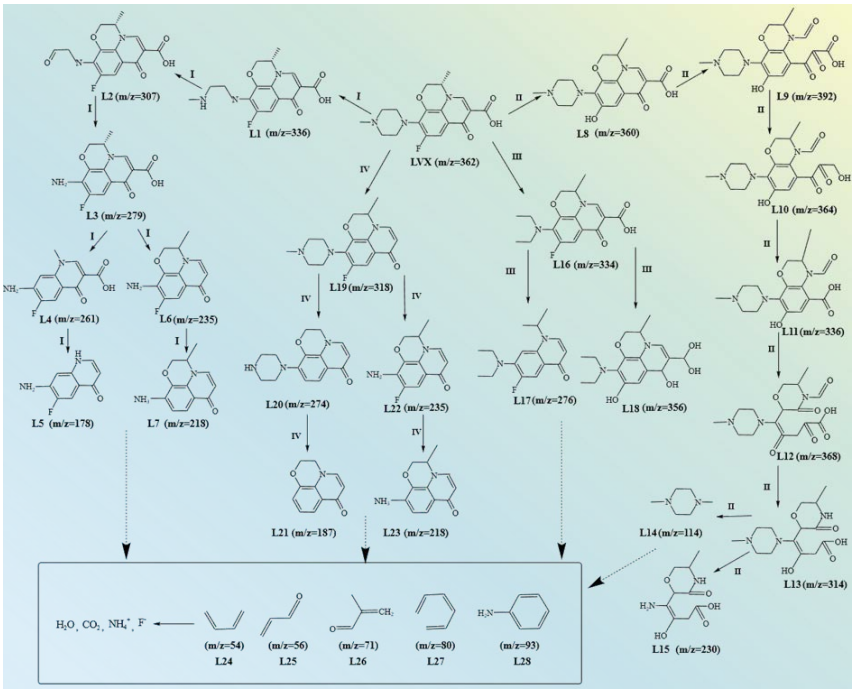

Fig. S6. Principle of ZnCuCCS photocatalytic degradation of levofloxacin

To study the feasibility of ZnCuCCS in practical applications, a 10 mg/L LEV solution was prepared using tap water to investigate the photocatalytic performance of ZnCuCCS in natural environments.

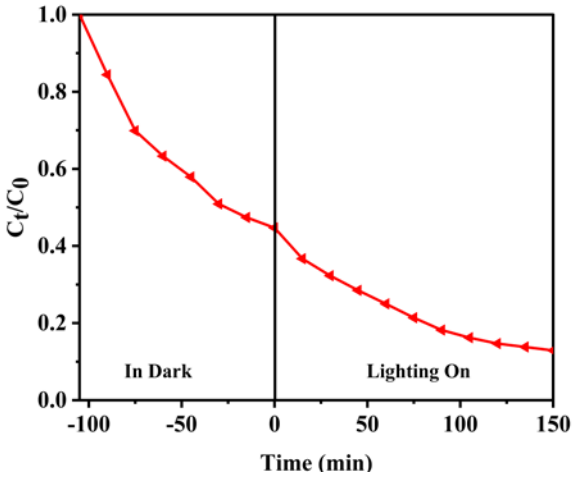

Fig. S7. Photocatalytic Performance of ZnCuCCS in Natural Environment