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Supporting Information

Enhanced removal of antibiotics in hospital wastewater by Fe-ZnO activated persulfate-based oxidation

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Tables and figures

Table S1. EDX analysis results for different samples

Chemical elements	Nanowire ZnO (wt %)	Nanoparticles Fe-doped ZnO
Zn	80	79.04
O	20	18.05
Fe	0	2.91

Table S2. Inorganic species and physico-chemical characteristics of SWW and RHW

	SWW	RHW
pH	8.0±0.5	6.8±0.2
Turbidity (NTU)	2±1	196±5
Conductivity (μS cm^{-1})	1250±5	1340±5
TOC (mg L^{-1})	80±5	50±10
Suspended solid (mg L^{-1})	0	20±2
Chloride (mg L^{-1})	450±20	620±10
Nitrate mg L^{-1})	35±2	7±2
Sulfate (mg L^{-1})	20±2	60±10
Phosphate (mg L^{-1})	150±10	60±10

Synthetic wastewater (SWW) were prepared by adding 400 mg L^{-1} of NaCl, 50 mg L^{-1} of citric acid, 30 mg L^{-1} of ascorbic acid, 100 mg L^{-1} of sucrose and 230 mg L^{-1} Na_2HPO_4 to tap water (conductivity 408 μS cm^{-1}).

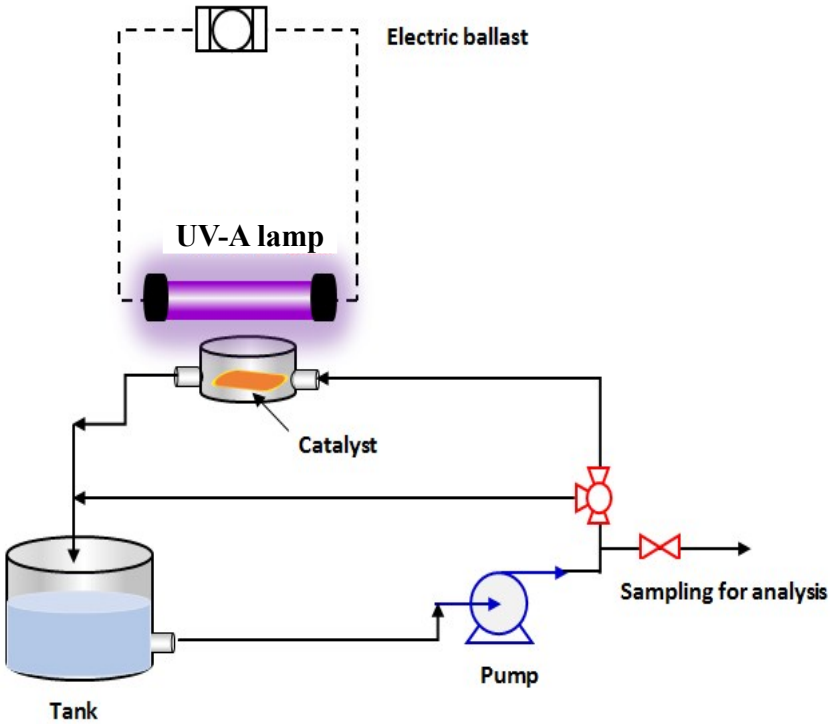

Fig. S1. Schematic diagram of recirculation glass reactor system

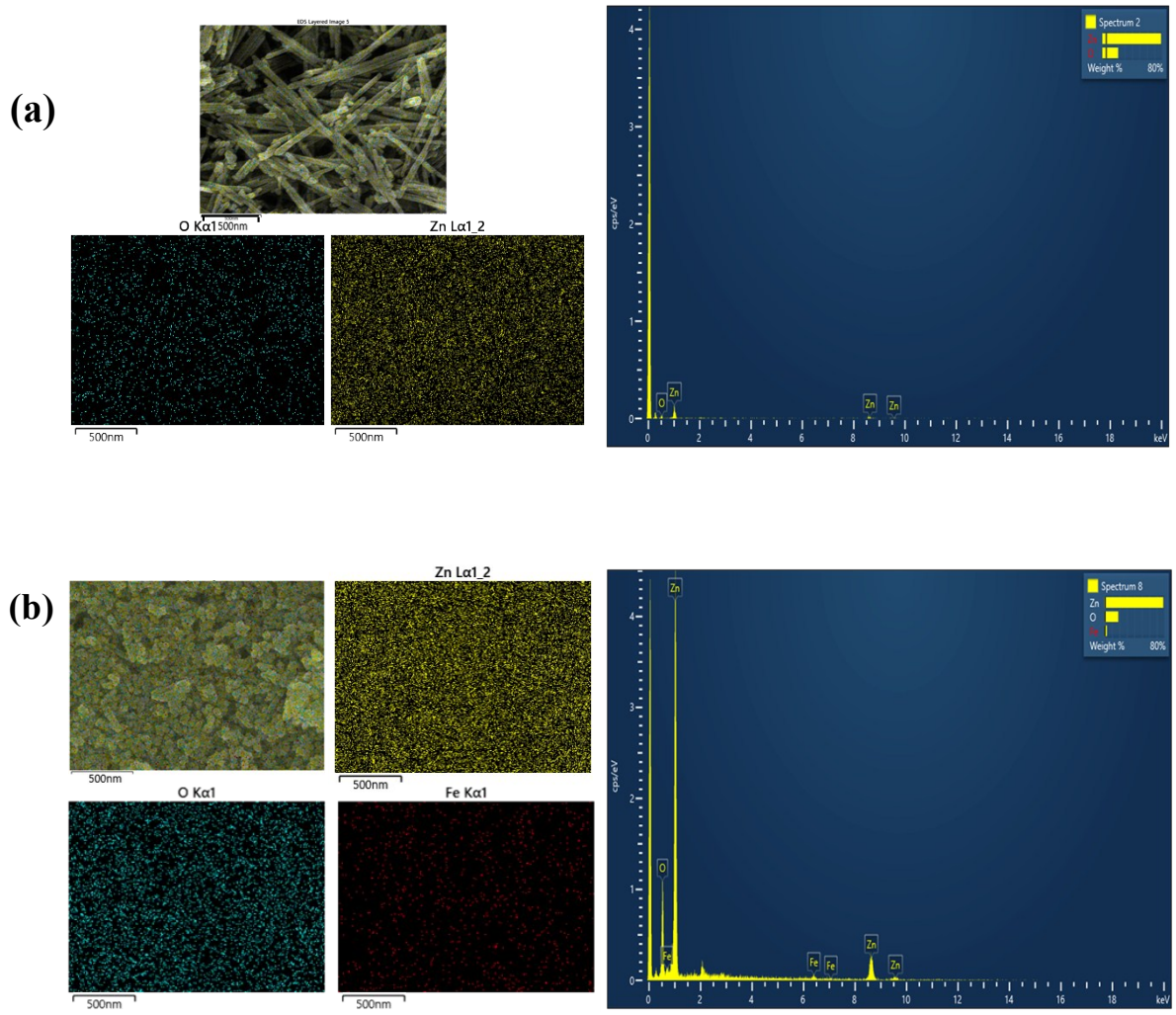

Fig. S2. EDX analysis of (a) ZnO and (b) Fe-ZnO particles. Abbreviations: energy dispersive X-ray (EDX)

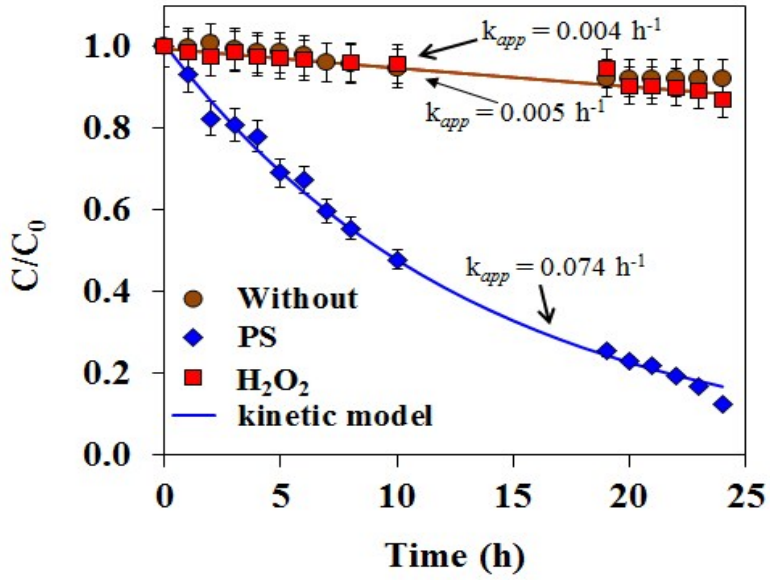

Fig. S3. FLU removal kinetics in presence of oxidants. Experimental conditions: $[FLU]_0$ = 5 µM, $[PS]_0$ = 0.5 mM, $[H_2O_2]_0$ = 0.2 mM, UV-A reaction time = 24 h. pH_0 = 7.0 ± 0.2, V = 1 L, recirculation flow rate = 222 mL min^{-1}. The correlation coefficients for kinetic models were more than 0.98). Abbreviations: FLU = flumequine, PS = Persulfate, H_2O_2 = hydrogen peroxide.

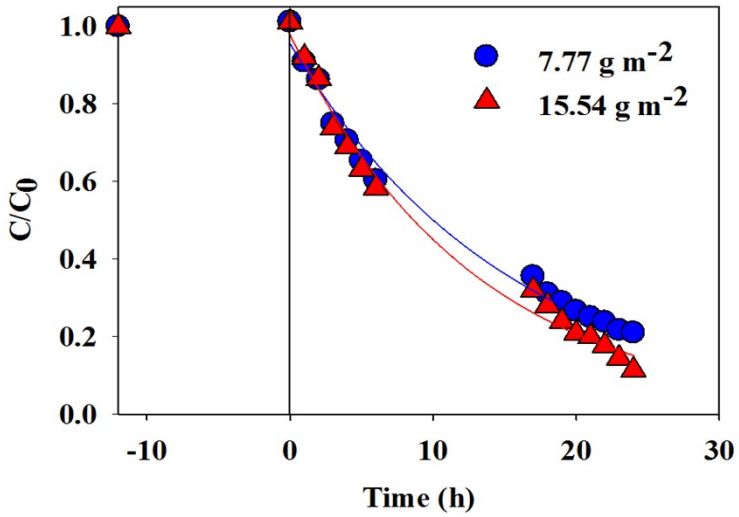

Fig. S4. Removal kinetics of FLU with 0.7 wt% Fe-ZnO/CA membrane catalyst at different concentration. Experimental conditions: [FLU] $_0$ = 5 µM, UV-A reaction time = 24 h UV-A reaction time = 24 h. pH $_0$ =7.0 ± 0.2, recirculation flow rate = 222 mL min^{-1}. The correlation coefficients for kinetic models were more than 0.99.

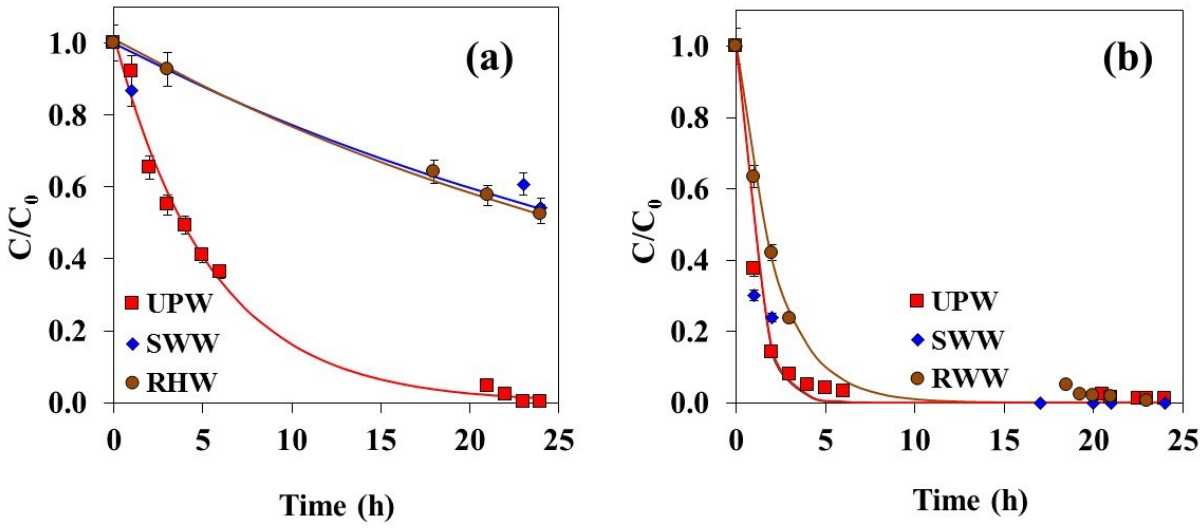

Fig. S5. Removal of (a): FLU and (b): CIP in single system in different water matrices. Experimental conditions: $[FLU]_0 = [CIP]_0 = 5$ µM, $[PS]_0 = 0.5$ mM, [0.7 wt % Fe-ZnO] = 7.77 g m^{-2} CA membrane, UV-A reaction time = 24 h , $pH_0 = 7.0 \pm 0.2$, V = 1 L, recirculation flow rate = 222 mL min^{-1}. The correlation coefficients for kinetic models were more than 0.99. Abbreviations: FLU = flumequine, CIP = ciprofloxacin, PS = Persulfate: UPW = Ultra-pure water, SWW = Synthetic wastewater, RHW = Real hospital wastewater.

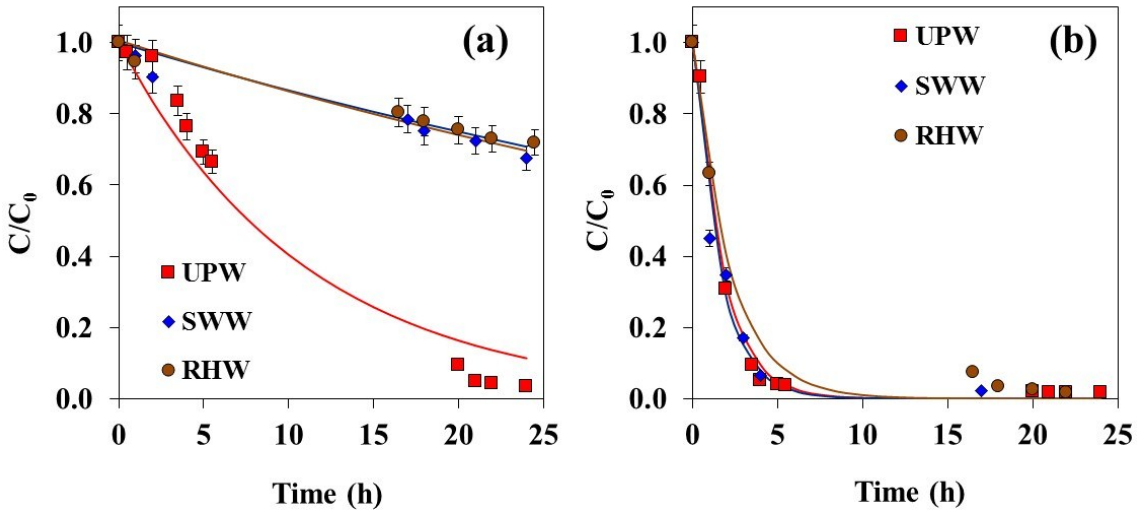

Fig. S6. Effect of water matrices in (a): FLU and (b): CIP degradation in binary system. Experimental conditions: [FLU] = [CIP] $_0$ = 5 μM, [PS] $_0$ = 0.5 mM, [0.7 wt % Fe-ZnO] = 7.77 g m^{-2} CA membrane, UV-A reaction time = 24 h, pH_0=7.0 ± 0.2, V = 1 L, recirculation flow rate = 222 mL min^{-1}. The correlation coefficients for kinetic models were more than 0.95. Abbreviations: FLU = flumequine, CIP = ciprofloxacin, PS = persulfate, UPW = Ultra-pure water, SWW = Synthetic wastewater, RHW = Real hospital wastewater.

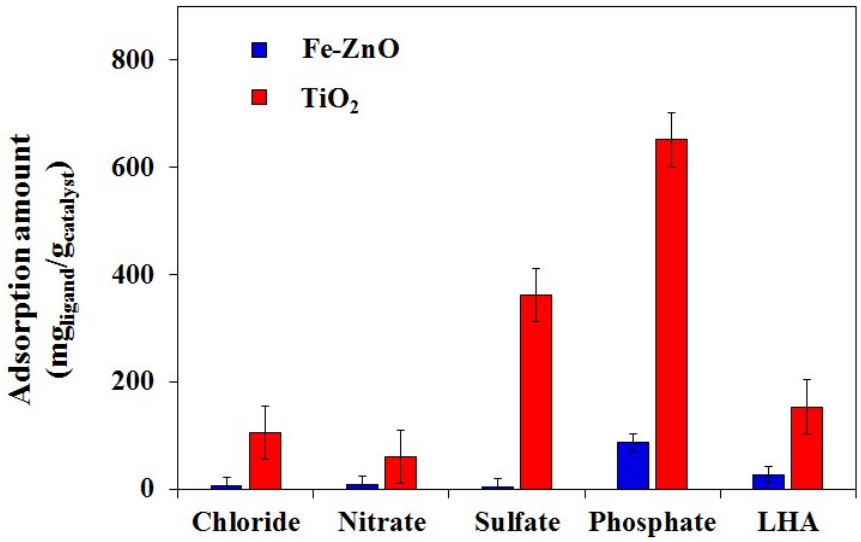

Fig. S7. Adsorption of inorganic ligands and LHA on TiO_2 and 0.7 wt % Fe-ZnO/CA membrane surface in dark, without FLU and PS. Experimental conditions: catalyst mass = 0.025 g, $[Phosphate]_0$ = 150 mg L^{-1}, $[Nitrate]_0$ = 10 mg L^{-1}, $[Sulfate]_0$ = 120 mg L^{-1}, $[Chloride]_0$ = 250 mg L^{-1} and $[LHA]_0$ = 40 mgC L^{-1}, reaction time = 12 h, pH_0 = 7.0 ± 0.2, V = 1 L, recirculation flow rate = 222 mL min^{-1}. Abbreviation: FLU = flumequine, PS = Persulfate, LHA = Leonardite Humic Acid.