Supporting Information

Construction of photo-induced zinc-doped carbon dots based on drug-resistant bactericides and their application for local treatment

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Instruments, reagents and materials

Fluorescence Spectrophotometer RF6000 (Shimadzu), Microplate Reader Varioskan LMX (Thermo), UV-2300 UV-Visible Spectrophotometer (Shanghai Tianmei Scientific Instruments Co., Ltd.), Infrared Spectrometer (Invenio R, Bruker), Transmission Electron Microscope (H-600, Hitachi, Japan)

Reactive oxygen assay kit (DCFDA, Solarbio), Singlet Oxygen Sensor Green Reagent (SOSG, Meilunbio), Protoporphyrin IX (PpIX, Sigma)

Mice (BALB/c, 7 weeks, female, SPF, Beijing Huafukang Biotechnology Co., Ltd.), *Staphylococcus aureus* and *Escherichia coli* were provided by the State Key Laboratory of Sichuan University.

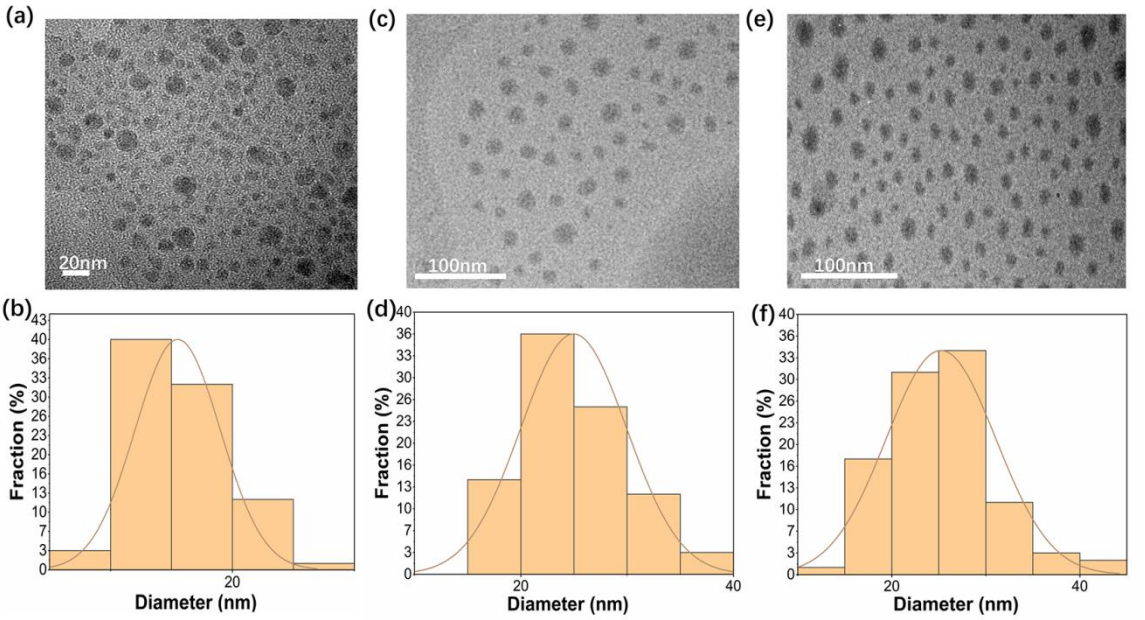

Figure S1 TEM photographs of (a)RCDs, (c)Zn-RCDs, and (e)EDTA-Zn-RCDs. Particle size distributions of (b)RCDs, (d)Zn-RCDs, and (f)EDTA-Zn-RCDs determined by the DLS method

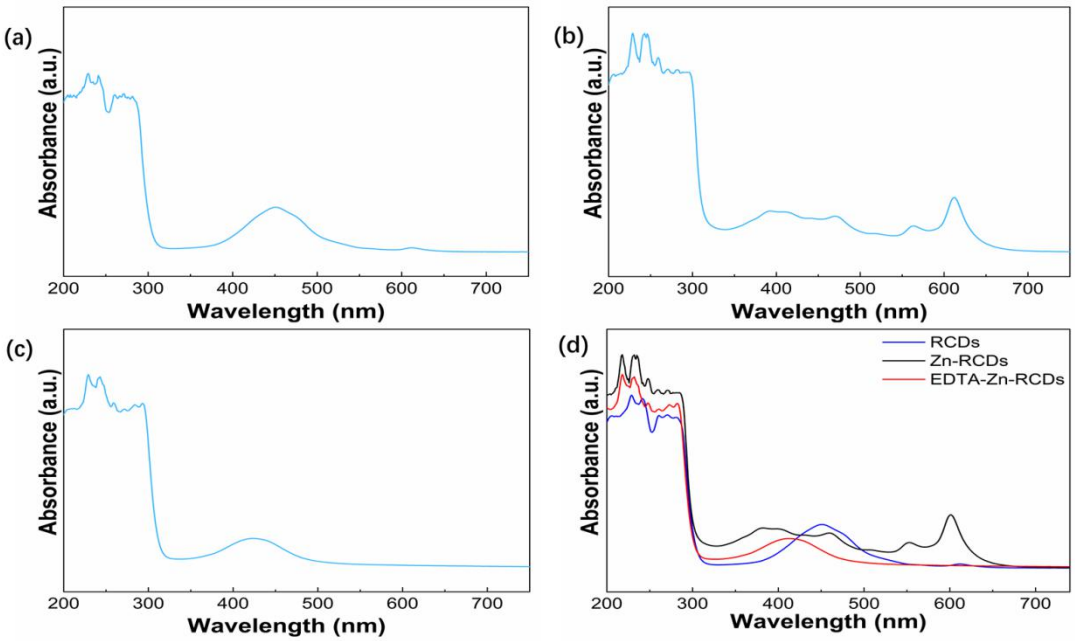

Figure S2 UV-Vis spectra of (a)RCDs, (b)Zn-RCDs, and (c)EDTA-Zn-RCDs. (d)The UV-Vis spectra of the three CDs

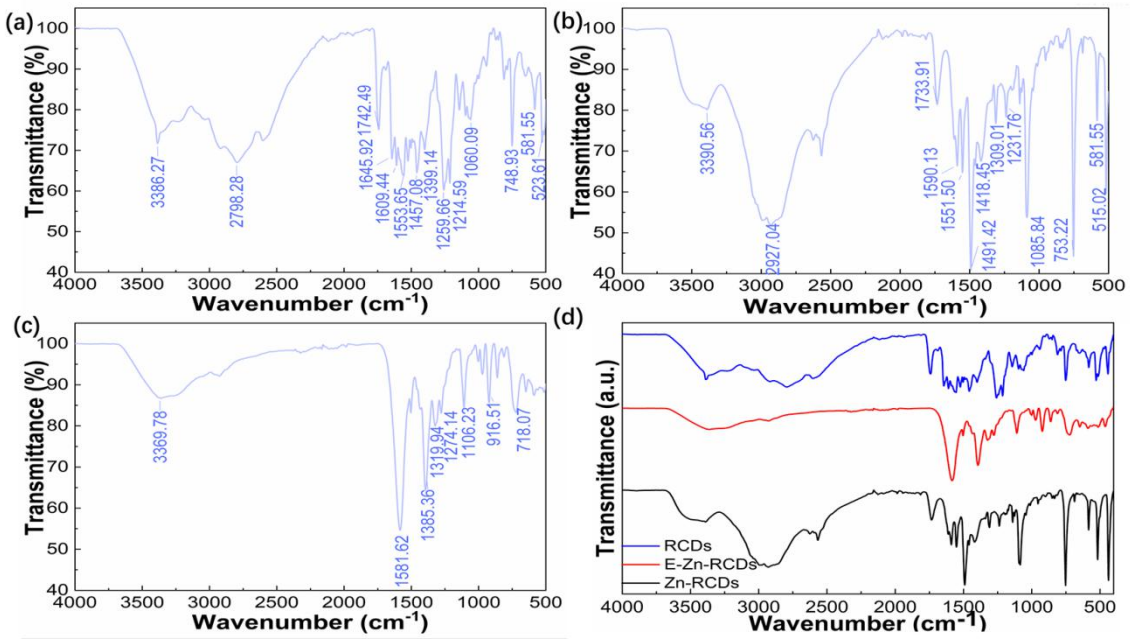

Figure S3 IR spectra of (a)RCDs, (b)Zn-RCDs, and (c)EDTA-Zn-RCDs. (d)The IR spectra of the three CDs

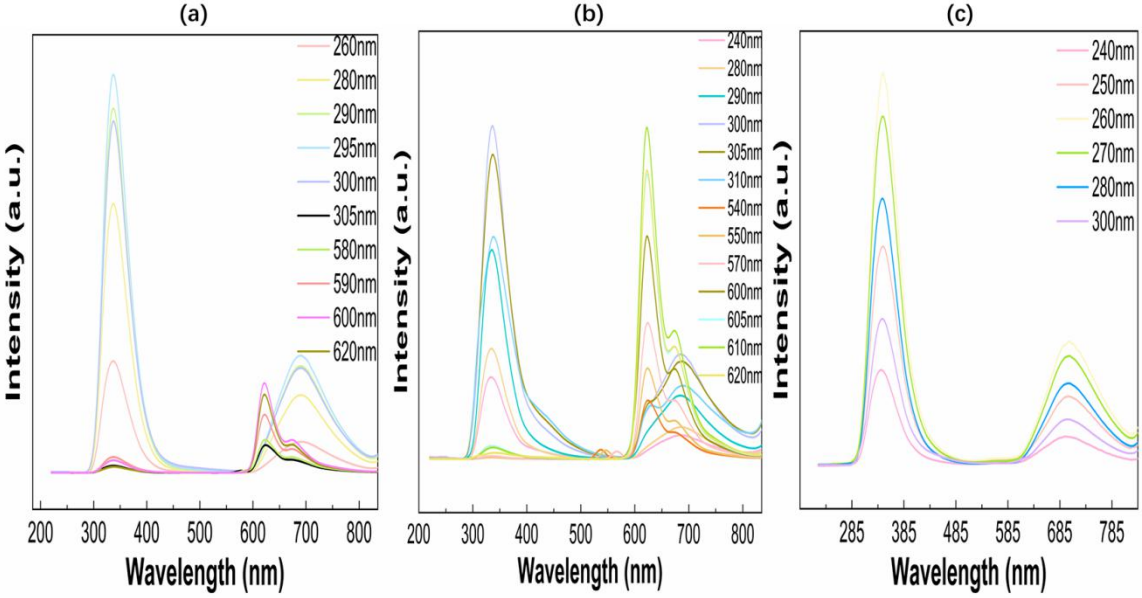

Figure S4 Fluorescence emission spectra of (a)RCDs, (b)Zn-RCDs, and (c)EDTA-Zn-RCDs.

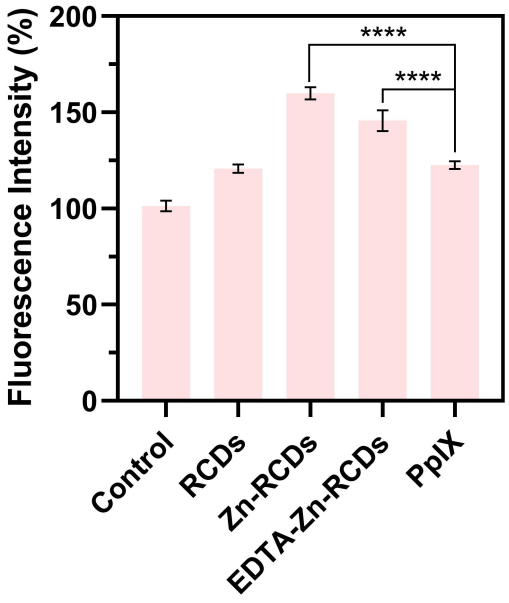

Figure S5 Extracellular ROS production in LB medium incubated with the same concentrations as 600 μg/ml of the RCDs, Zn-RCDs, EDTA-Zn-RCDs and PpIX (incubation time 15 min) were determined by SOSG fluorescent probe immediately after irradiation. PBS without receiving vehicles was used as the control. (n=6)

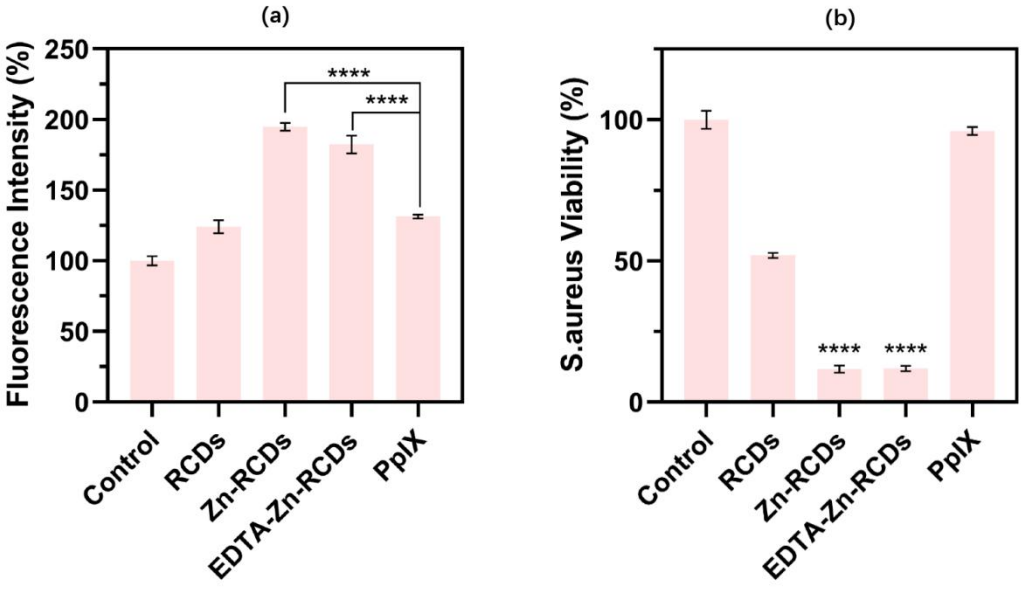

Figure S6 (a) Intracellular ROS production in *S. aureus* incubated with the same concentrations as 600 μg/ml of the RCDs, Zn-RCDs, EDTA-Zn-RCDs and PpIX (incubation time 15 min) were determined by DCFDA fluorescent probe immediately after irradiation. PBS without receiving vehicles was used as the control. (b) Viability of *S. aureus* cells incubated with the same concentrations as 600 μg/ml of the RCDs, Zn-RCDs, EDTA-Zn-RCDs and PpIX (incubation time 15 min) was determined at 24 h after irradiation. (n=6)

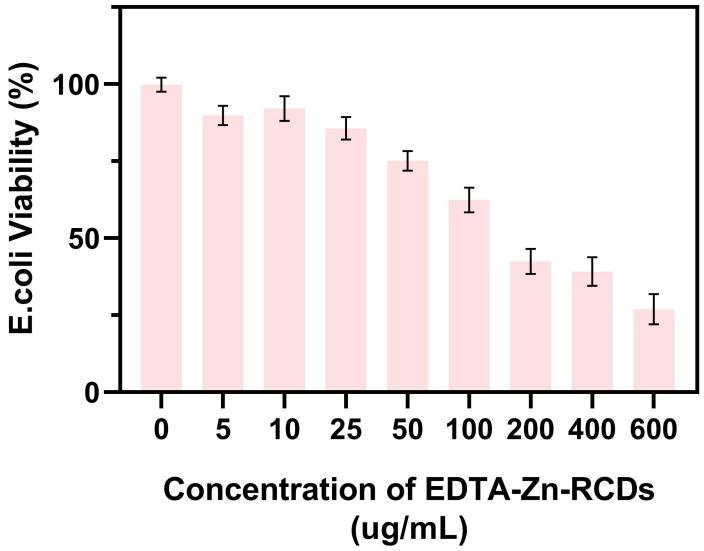

Figure S7 Viability of *E. coli* cells incubated with different concentrations of EDTA-Zn-RCDs (incubation time 15 min) and blue light radiation was determined at 24 h after irradiation. (n=6)

Figure S8 Outline of wound model experiment in vivo

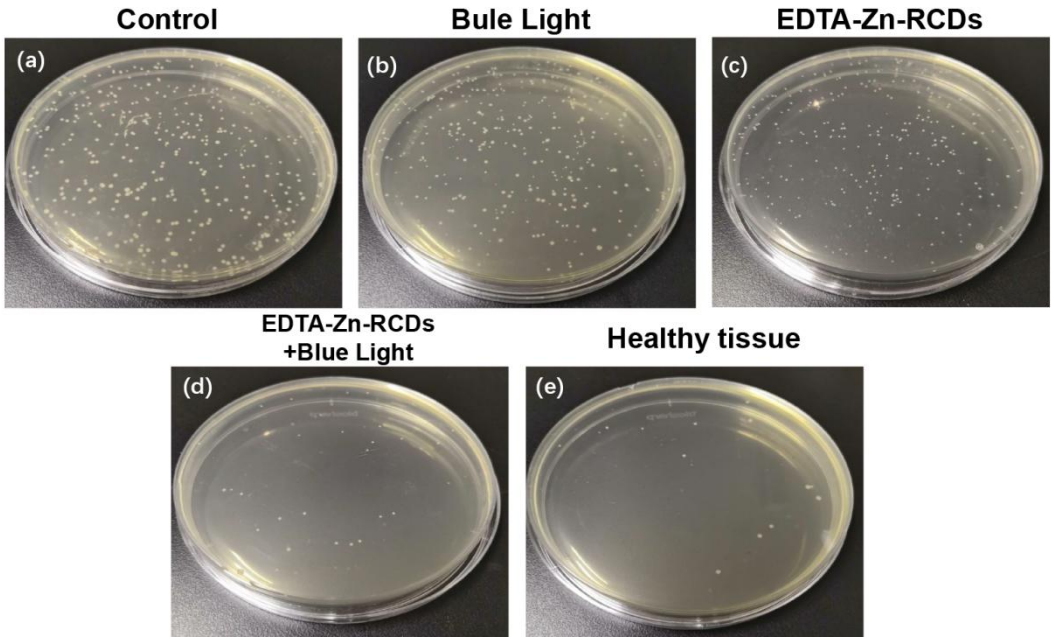

Figure S9 Images of bacterial colonies in skin tissue from wounds of mice in different treatment groups (a) Control (b) Blue Light alone (c) EDTA-Zn-RCDs alone and (d) EDTA-Zn-RCDs and Blue Light (e) Healthy tissue (n=6)

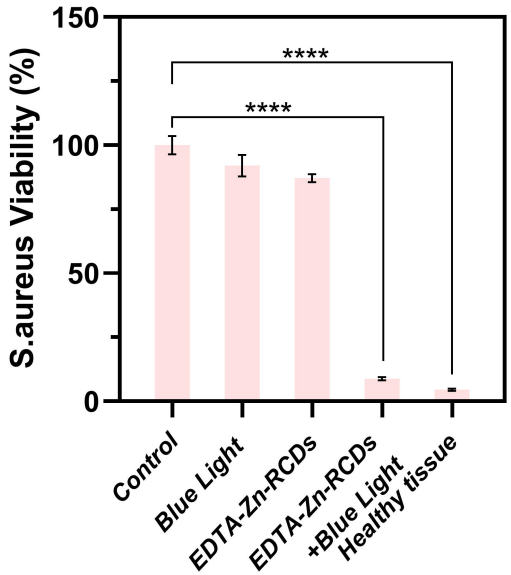

Figure S10 The corresponding viability of *S. aureus* is shown in Figure S9 (n=6)

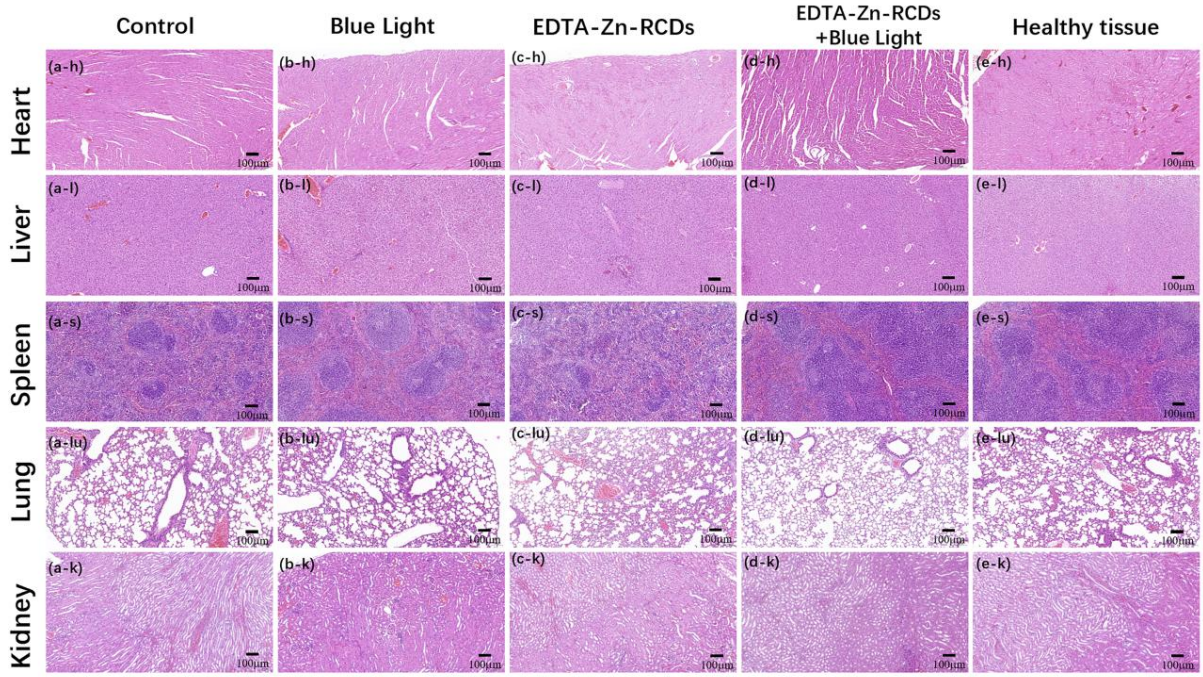

Figure S11 H&E chromatogram of organs (heart, liver, spleen, lung and kidney) from infected mice of different treatment groups (a) Control (b) Blue Light alone (c) EDTA-Zn-RCDs alone and (d) EDTA-Zn-RCDs and Blue Light (e) Healthy tissue (n=6)

Stability experiment

Stability experiment of EDTA-Zn and EDTA-Zn-RCDs lyophilized powders: The experimental results are shown in the Figure S12. Within 28 days, the cytotoxicity of 600 μg.ml^{-1} EDTA-Zn and EDTA-Zn-RCDs were higher than the threshold. The toxic zinc ion will not come out in the biological system within 28 days and EDTA-Zn and EDTA-Zn-RCDs in powder state are very stable.

Photostability experiment of EDTA-Zn-RCDs solution: The experimental results are shown in the Figure S13-S16. In Figure S13, in 0~1.3 mg/l NaCl solution, with the increasing of NaCl solution concentration, the fluorescence intensity of EDTA-Zn-RCDs was stable, indicating that the fluorescence intensity of EDTA-Zn-CDs solution were less influenced by salt solution and had good stability. As depicted in Figure S14, in BR buffer solution with pH2-12, the fluorescence intensity of EDTA-Zn-RCDs solution were stable in BR buffer solution with pH3-10. This carbon dots were greatly affected by strong acid (pH2) and strong alkaline environment (pH10-12). As depicted in Figure S15, the fluorescence intensity of EDTA-Zn-RCDs descended slightly after UV irradiation for 2 h, and decreased by 10% after 8 h. The results demonstrated that the fluorescence intensity of EDTA-Zn-RCDs were greatly affected by UV exposure. As depicted in Figure S16, the fluorescence intensity of EDTA-Zn-RCDs only slightly decreased after 8 h at room temperature, protecting from light indicating that the carbon dots can be stored stably at room temperature.

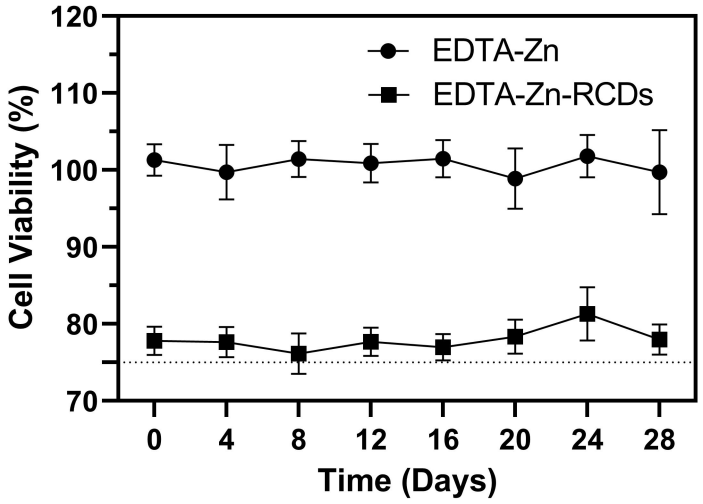

Figure S12 The effect of 600 μg.ml^{-1}EDTA-Zn and EDTA-Zn-RCDs on L929 cells within 28 days. (n=6)

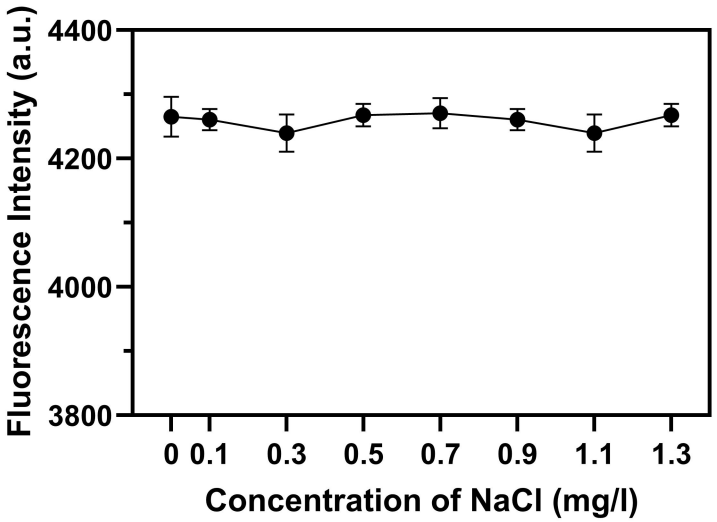

Figure S13 The influence of salt ion concentration on fluorescence intensity of EDTA-Zn-RCDs (n=6)

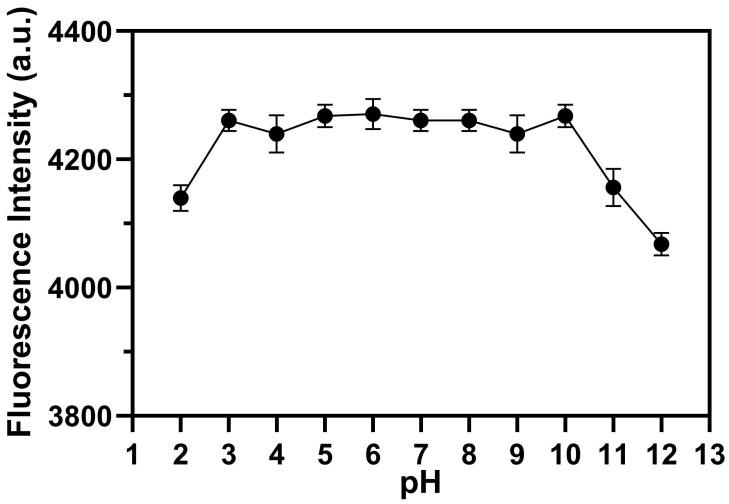

Figure S14 The influence of pH on fluorescence intensity of EDTA-Zn-RCDs (n=6)

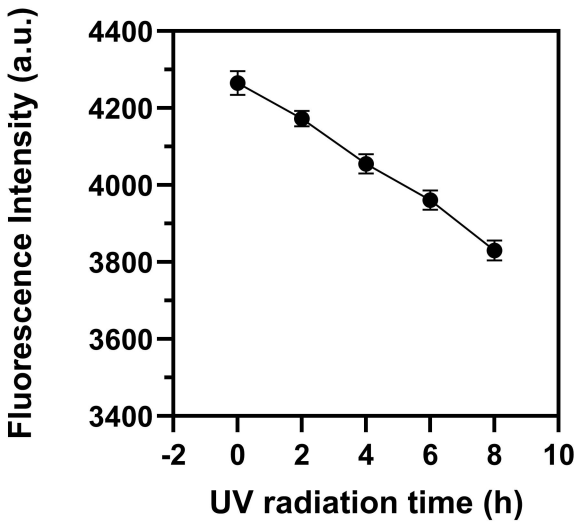

Figure S15 the influence of UV radiation time on fluorescence intensity of EDTA-Zn-RCDs (n=6)

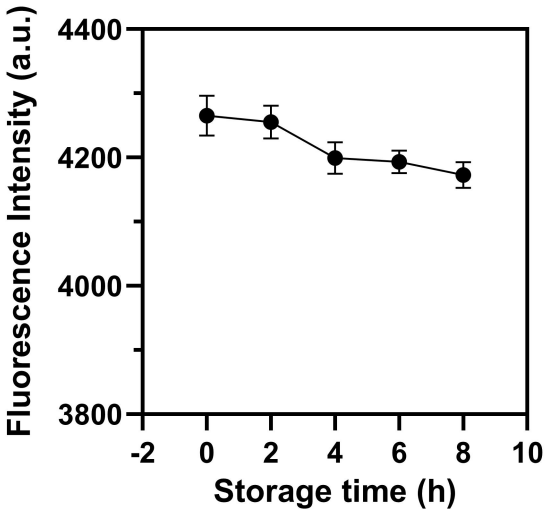

Figure S16 the influence of storage time on fluorescence intensity of EDTA-Zn-RCDs (n=6)

Table S1 The advantages and disadvantages for synergistic treatment

	Advantages	Disadvantages
EDTA-Zn-RCDs+Blue Light Synergistic treatment	1. Simple and economical preparation method of CDs 2. Raw materials are cheap and easy to get 3. High security and biocompatibility 4. High catalytic oxidation efficiency and high ROS production efficiency 5. Provide a new idea and method for researchers to prepare highly efficient and low toxic metal doped CDs 6. More than 90% bactericidal efficiency in vitro and in vivo 7. No antibiotics and no bacterial resistance was developed 8. Its stock solution can be used for the subsequent treatment of deep bacterial infection	1. The freeze-dried powder is used only for topical treatment