## Electronic Supplementary Information for

## A targeted and efficient CDT system with photocatalytic supplement

## of H<sub>2</sub>O<sub>2</sub> and hydroxyl radical production at a neutral pH

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**Figure S1.** Absorption spectral changes of NADH (200  $\mu$ M in water) in the presence of Ru1 (2  $\mu$ M) (A) or Ru2 (2  $\mu$ M) (B) under light irradiation (470 nm, 22.5 mW cm<sup>-2</sup>). Inset is the result of H<sub>2</sub>O<sub>2</sub> paper test after irradiation for 12 min.



**Figure S2.** (A) Absorbance changes of NADH in water at 340 nm upon irradiation in the presence of Ru1-Ru3. (B) TOF values of Ru1-Ru3 at different times.





**Figure S3.** <sup>1</sup>H NMR spectra of Ru3, NADH, NAD<sup>+</sup>, and the mixture of Ru3 and NADH in  $D_2O/CD_3OD$  (50/50, v/v) in the dark or after light irradiation.



Figure S4. pH changes of the aqueous solution of NADH and Ru3 upon irradiation.



**Figure S5.** Stern-Volmer luminescence quenching curves of Ru1-Ru3 by NADH under an argon atmosphere.  $I_0$  and I are the emission intensities in the absence and presence of NADH, respectively.



**Figure S6.** Emission lifetimes of Ru1-Ru3 in the presence of varied concentrations of NADH under an argon atmosphere.



**Figure S7.** <sup>1</sup>H NMR spectral changes of Ru3 in  $D_2O/CD_3OD$  (50/50, v/v) upon addition of different concentrations of NADH.



**Figure S8.** <sup>1</sup>H NMR spectral changes of **Ru1** in  $D_2O/CD_3OD$  (50/50, v/v) upon addition of different concentrations of NADH.



**Figure S9.** Absorption spectral changes of NADH (200  $\mu$ M) in Ar-saturated water in the presence of Ru1(2  $\mu$ M) (A), Ru2 (2  $\mu$ M) (B) or Ru3 (2  $\mu$ M) under light irradiation (470 nm, 22.5 mW cm<sup>-2</sup>).



**Figure S10.**  ${}^{1}O_{2}$  generation of Ru(bpy) ${}_{3}^{2+}$  (A), Ru1 (B), Ru2 (C), and Ru3 (D) in water upon 470 nm light irradiation (22.5 mW/cm<sup>2</sup>), using 9,10-ABDA (50  $\mu$ M) as a chemical trap.



Figure S11. EDS spectrum of BSA@Fe/Ru.



Figure S12. DLS results of BSA@Fe/Ru (A), BSA@Ru (B) and BSA@Fe (C).



Figure S13. (A) Absorption spectra of Ru3 and BSA@Ru NPs. (B) Absorption spectra of  $Fe(tpy)Cl_3$  and BSA@Fe.



**Figure S14.** •OH generation ability of BSA@Fe (10  $\mu$ M based on Fe(tpy)Cl<sub>3</sub>) at pH 7.4 in the absence or presence of H<sub>2</sub>O<sub>2</sub>, using DMPO (20 mM) as a spin trapping agent.



**Figure S15.** Absorption spectral changes of NADH (200  $\mu$ M) in water in the presence of BSA@Ru (2  $\mu$ M based on Ru3) under light irradiation (470 nm, 22.5 mW cm<sup>-2</sup>). Inset is the result of H<sub>2</sub>O<sub>2</sub> paper test after irradiation for 30 min.



**Figure S16.** Absorption spectral changes of NADH (200  $\mu$ M) in water in the presence of BSA@Fe (10  $\mu$ M based on Fe(tpy)Cl<sub>3</sub>) under light irradiation (470 nm, 22.5 mW cm<sup>-2</sup>). Inset is the result of H<sub>2</sub>O<sub>2</sub> paper test after irradiation for 30 min.



**Figure S17.** •OH generation in different conditions using DMPO (20 mM) as a spin trapping agent. Solution pH 7.4; nanoparticle concentrations, 2  $\mu$ M based on Ru3 or 10  $\mu$ M based on Fe(tpy)Cl<sub>3</sub>; NADH concentration, 200  $\mu$ M; light irradiation, 470 nm, 22.5 mW cm<sup>-2</sup>.



**Figure S18.** Absorption spectral changes of methylene blue (MB) under different conditions. Concentration: nanoparticles, 2  $\mu$ M based on Ru3 or 10  $\mu$ M based on Fe(tpy)Cl<sub>3</sub>; MB, 20  $\mu$ M; H<sub>2</sub>O<sub>2</sub>, 10 mM; NADH, 200  $\mu$ M. Light irradiation, 470 nm, 22.5 mW cm<sup>-2</sup>.



**Figure S19.** Intracellular ROS levels of A549 cells treated by PBS or different nanoparticles (10  $\mu$ g/mL) in the dark.



**Figure S20.** Cytotoxicity of BSA@Fe/Ru, BSA@Ru and BSA@Fe towards A549 and HeLa cells in the dark or upon 470 nm light irradiation for 30 min (22.5 mW/cm<sup>2</sup>).



**Figure S21.** Cell viability of the BSA@Fe/Ru treated L-O2, A549 and HeLa cells in the dark or upon 470 nm light irradiation for 30 min (22.5 mW/cm<sup>2</sup>).



Figure S22. Images of the A549 cells treated with BSA@Fe/Ru, BSA@Ru and BSA@Fe (30  $\mu$ g/mL) with or without irradiation (470 nm, 22.5 mW/cm<sup>2</sup> for 30 min) by staining with Calcein-AM and PI.



**Figure S23.** H&E staining images of heart, liver, spleen, lung, and kidney after different treatments for 14 days. (i) PBS + Light, (ii) BSA@Fe, (iii) BSA@Ru, (iv) BSA@Ru + Light, (v) BSA@Fe/Ru, (iv) BSA@Fe/Ru + Light. Scale bars, 200 µm.