

## Electronic Supplementary Information

### ATP-responsive Near-Infrared Fluorescence Nanoparticles for Synergistic Chemotherapy and Starvation Therapy

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**Synthesis of Compound RhI.** RhI was conveniently synthesized by two steps according to the synthetic route depicted in Fig. S1.

**Compound Rh.** Cyclohexanone (12.8 mmol, 1.32 mL) was added dropwise to concentrated H<sub>2</sub>SO<sub>4</sub> (20.0 mL) and cooled down to 0 °C. Then, 2-(4-diethylamino-2-hydroxybenzoyl) benzoic acid (6.4 mmol, 2.00 g) was added under stirring. The reaction mixture was heated at 90 °C for 1.5 h. The obtained solution was quickly poured onto ice and 2 mL of HClO<sub>4</sub> were added. After vacuum filtration and washing with cold water, an orange solid product was obtained. Yield: 2.7 g (91%). <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ 8.13 (d, J = 8.0 Hz, 1H), 7.79 (t, J = 7.6 Hz, 1H), 7.70 (t, J = 7.6 Hz, 1H), 7.25 (d, J = 7.6 Hz, 2H), 7.02-6.96 (m, 2H), 3.58-3.53 (m, 4H), 3.00 (s, 2H), 2.03 (t, J = 5.6 Hz, 2H), 1.80 (s, 2H), 1.65-1.57 (m, 2H), 1.24 (t, J = 6.8 Hz, 6H). MS (TOF, m/z) calcd: 376.2, found: 376.3.

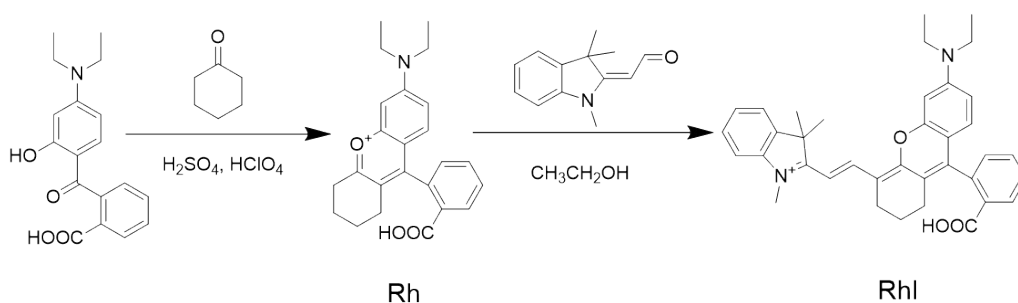
**Compound RhI.** Compound Rh (0.28 g, 0.6 mmol), 1,3,3-trimethyl-2-(formyl methylene) indoline (0.11 g, 0.5 mmol) were dissolved in anhydrous acetic acid (8 mL). The mixture was stirred at 50 °C for 1.5 h. Then, 8 mL water was added to quench the reaction. After the removal of solvent under reduced pressure, the resulted residue was subjected to silica gel column chromatography for purification with CH<sub>2</sub>Cl<sub>2</sub>/CH<sub>3</sub>CH<sub>2</sub>OH (20:1) as the eluent to afford a dark-green solid product. Yield: 0.09 g (26%). <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ 8.48 (d, J = 14.4 Hz, 1H), 8.11 (d, J = 7.6 Hz, 1H), 7.77-7.73 (m, 1H), 7.63 (t, J = 6.4 Hz, 2H), 7.42 (d, J = 4 Hz, 2H), 7.26 (d, J = 7.2 Hz, 2H), 6.79-6.74 (m, 1H), 6.66 (s, 1H), 6.19 (d, J = 14.4 Hz, 1H), 4.20 (t, J = 6.4 Hz, 1H), 3.67 (s, 3H), 3.14 (q, J = 7.6 Hz, 16.4 Hz, 4H), 2.62 (t, J = 6.5 Hz, 4H), 1.76-1.69 (m, 8H), 1.14 (t, J = 6.8 Hz, 6H). MS (TOF, m/z) calcd2: 559.3, found: 559.3. Elem. Anal. (%) calcd for C<sub>37</sub>H<sub>39</sub>ClN<sub>2</sub>O<sub>7</sub>: C, 67.42; H, 5.76; N, 4.25. Found: C, 67.44; H, 5.75; N, 4.26.

**Synthesis of ZIF-90 Nanoparticles.** A DMF solution (2 mL) of zinc acetate dihydrate (0.2 M) was poured into a DMF solution (2 mL) of 2-ICA (0.4 M) under vigorous stirring at room temperature. After 5 min, DMF (6 mL) was added into the reaction mixture to

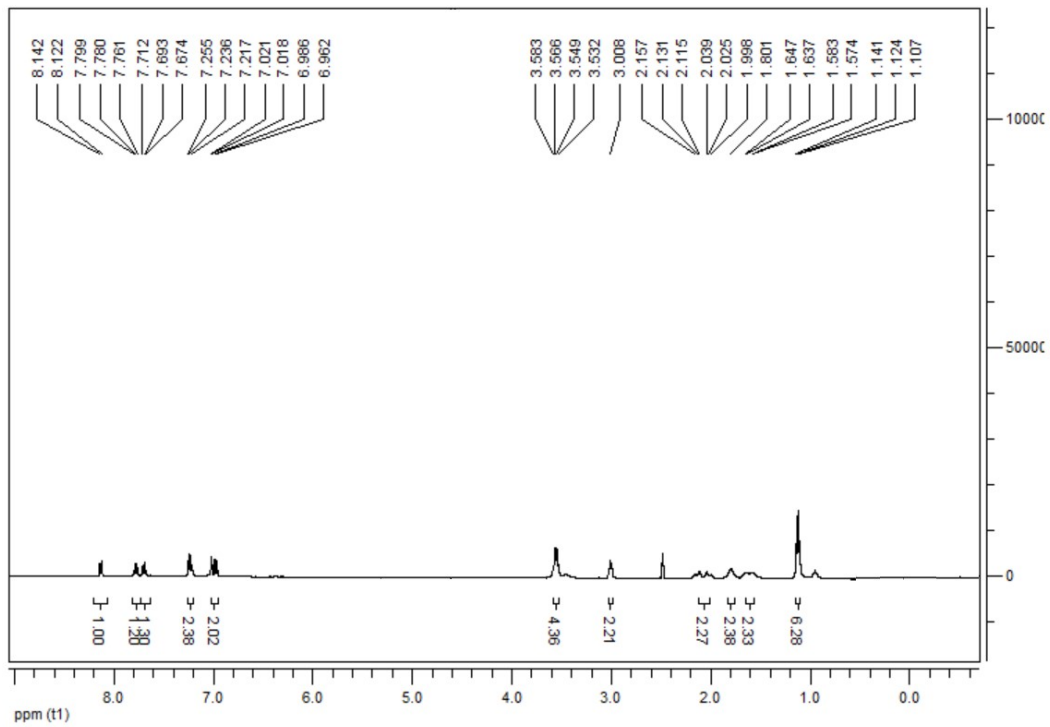
stabilize the ZIF-90 nanoparticles. The resulting ZIF-90 nanoparticles were then purified by centrifugation (10 000 rpm, 5 min) and washed with DMF once and ethanol in turn for several times. ZIF-90 nanoparticles were then collected and dried under vacuum at room temperature for 24 h.

**Synthesis of RhI@ZIF-90 Nanoparticles.** A DMF solution (2 mL) of zinc acetate dihydrate (0.2 M) was poured into a DMF solution (2 mL) of 2-ICA (0.4 M) containing RhI (2 mg) under vigorous stirring at room temperature. After 5 min, DMF (6 mL) was added into the reaction mixture to stabilize the spheres. The resulting nanoparticles were then purified by centrifugation (10 000 rpm, 5 min) and washed with DMF once and ethanol in turn for several times. The nanoparticles were then collected and dried under vacuum at room temperature for 24 h.

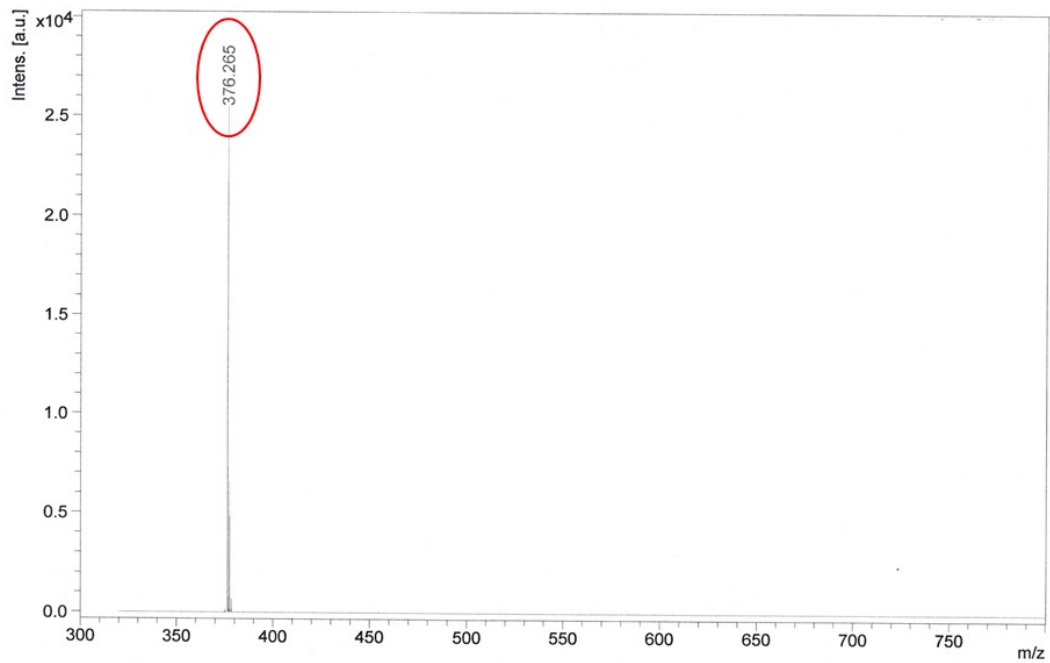
**Synthesis of RhI-DOX@ZIF-90 Nanoparticles.** A DMF solution (2 mL) of zinc acetate dihydrate (0.2 M) was poured into a DMF solution (2 mL) of 2-ICA (0.4 M) containing DOX (2 mg) and RhI (2 mg) under vigorous stirring at room temperature. After 5 minutes, DMF (6 mL) was added into the reaction mixture to stabilize the spheres. The resulting nanoparticles were then purified by centrifugation (10 000 rpm, 5 min) and washed with DMF once and ethanol in turn for several times. The nanoparticles were then collected and dried under vacuum at room temperature for 24 h.



**Fig. S1** Synthetic route for RhI.



**Fig. S2**  $^1\text{H}$  NMR spectra of compound Rh in  $\text{DMSO-d}_6$ .



**Fig. S3** Mass spectra of compound Rh.

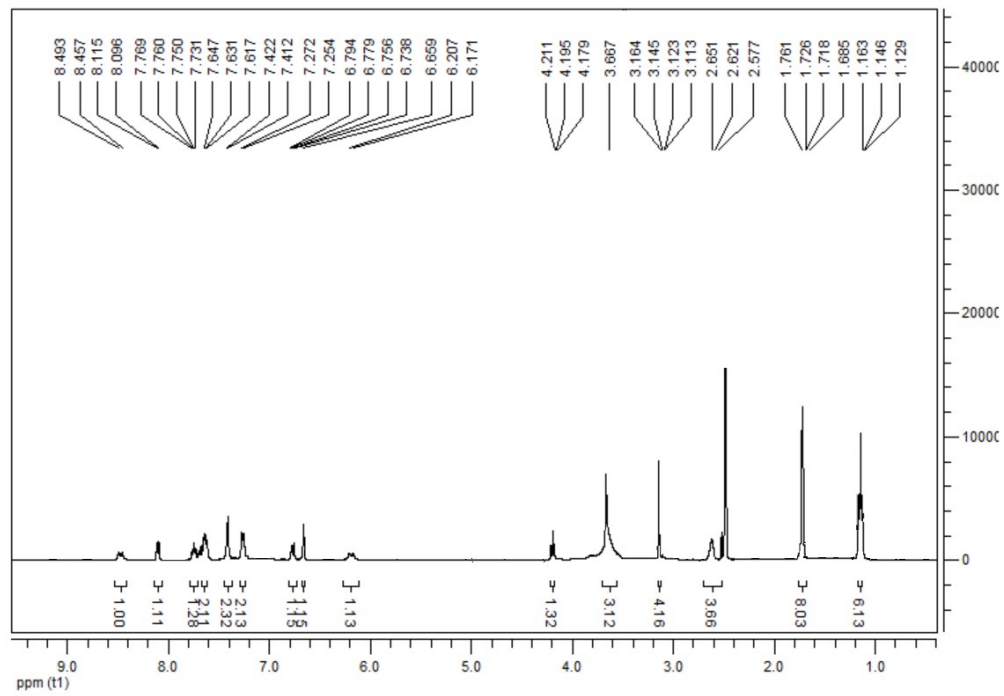


Fig. S4  $^1\text{H}$  NMR spectra of compound RhI in DMSO- $\text{d}_6$ .

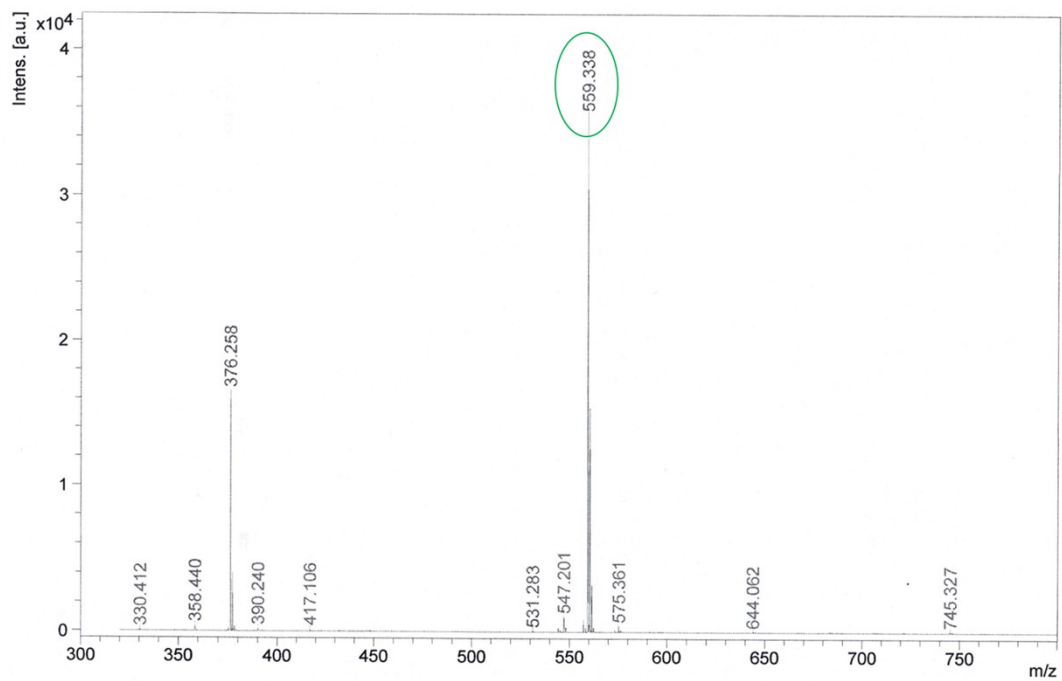
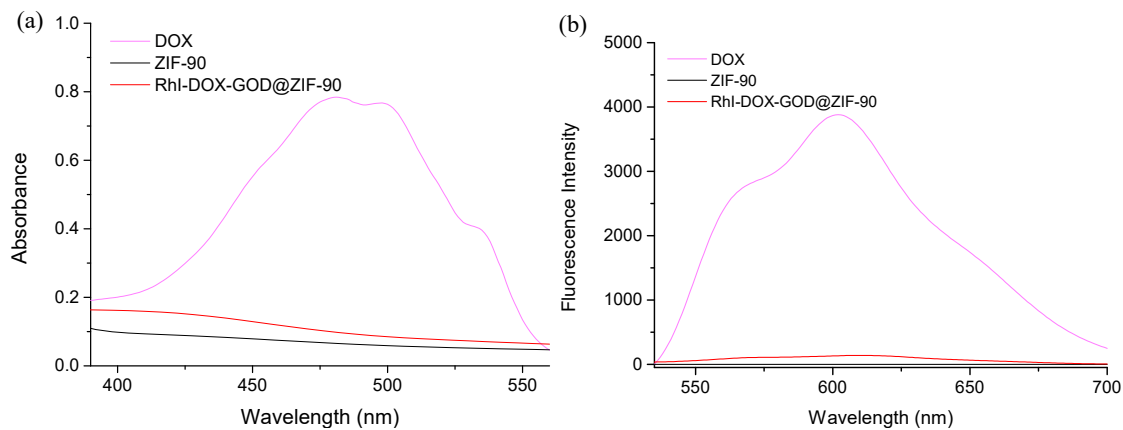
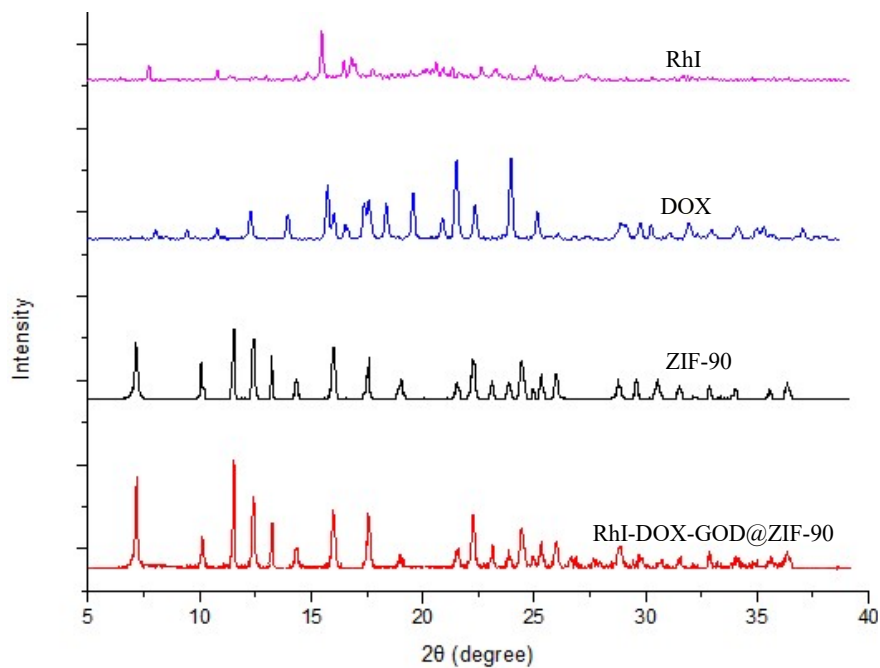


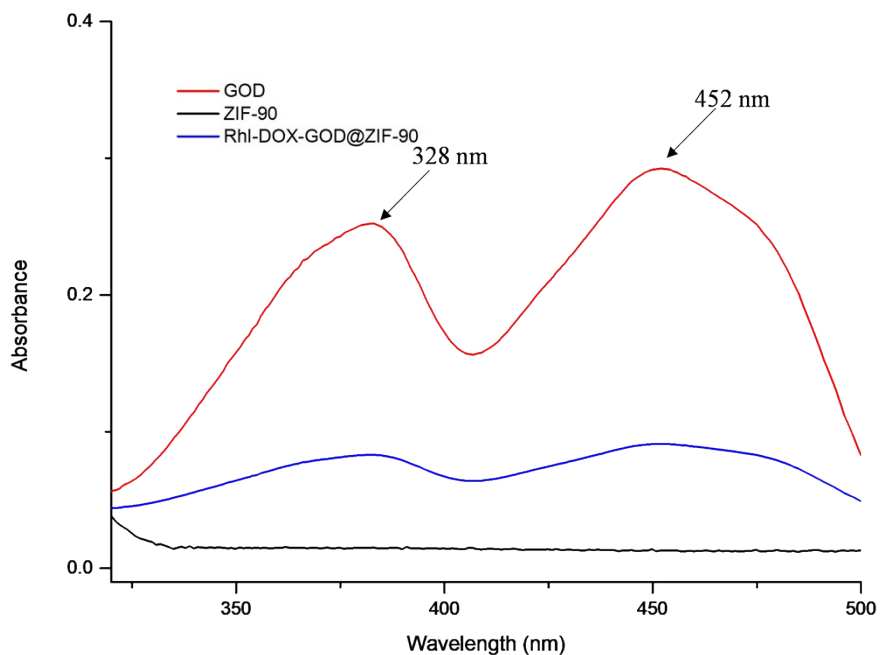
Fig. S5 Mass spectra of compound RhI.



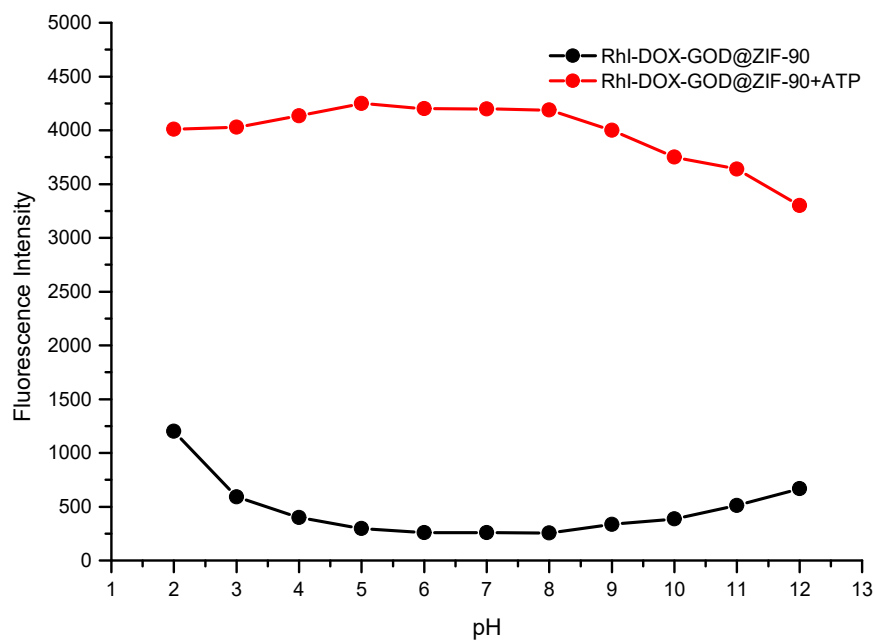
**Fig. S6** (a) Absorption spectra and (b) fluorescence spectra of of DOX, ZIF-90 and RhI-DOX-GOD@ZIF-90.  $\lambda_{ex} = 480$  nm.



**Fig. S7** PXRD patterns of RhI, DOX, ZIF-90, and RhI-DOX-GOD@ZIF-90.

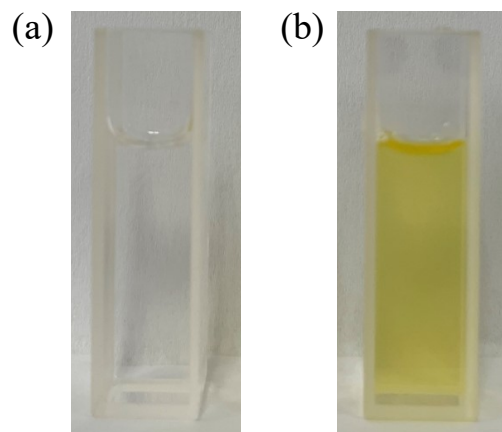


**Fig. S8** Absorption spectra of GOD, ZIF-90 and RhI-DOX-GOD@ZIF-90.

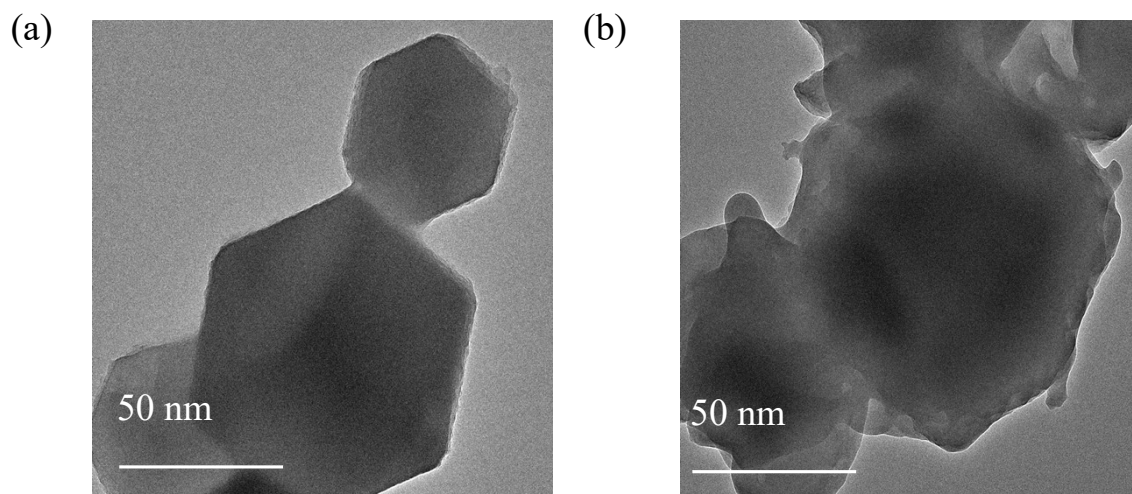


**Fig. S9** Effect of pH on the fluorescence of RhI-DOX-GOD@ZIF-90 nanoparticles (4 mg/mL) before and after reaction with ATP (10 mM).  $\lambda_{ex}/\lambda_{em} = 690/750$  nm.

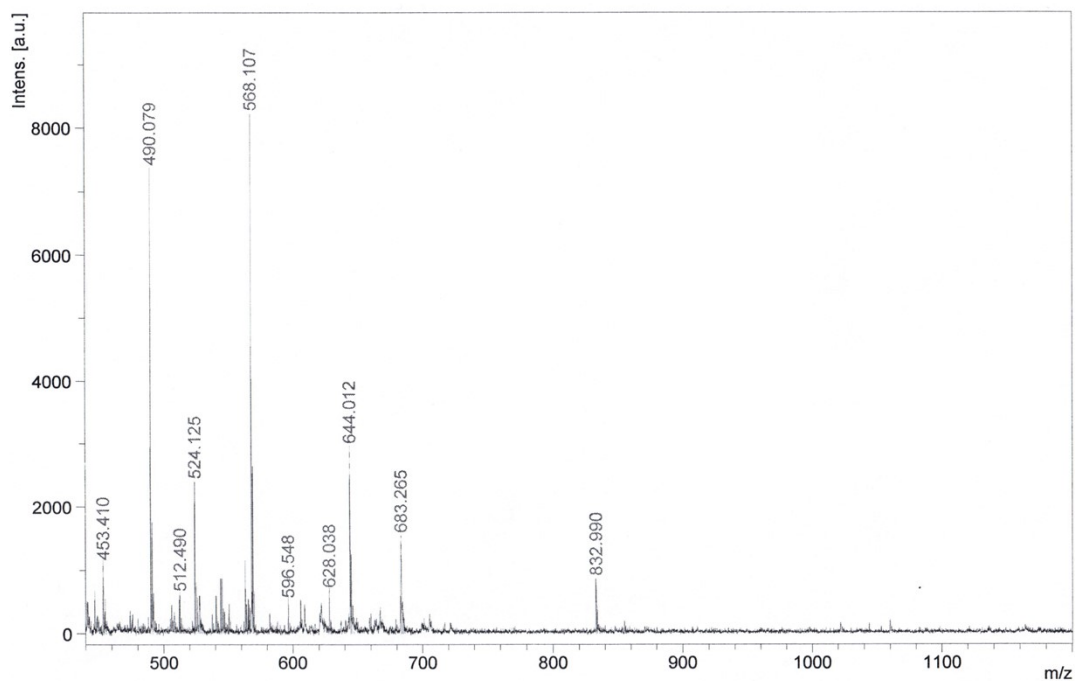




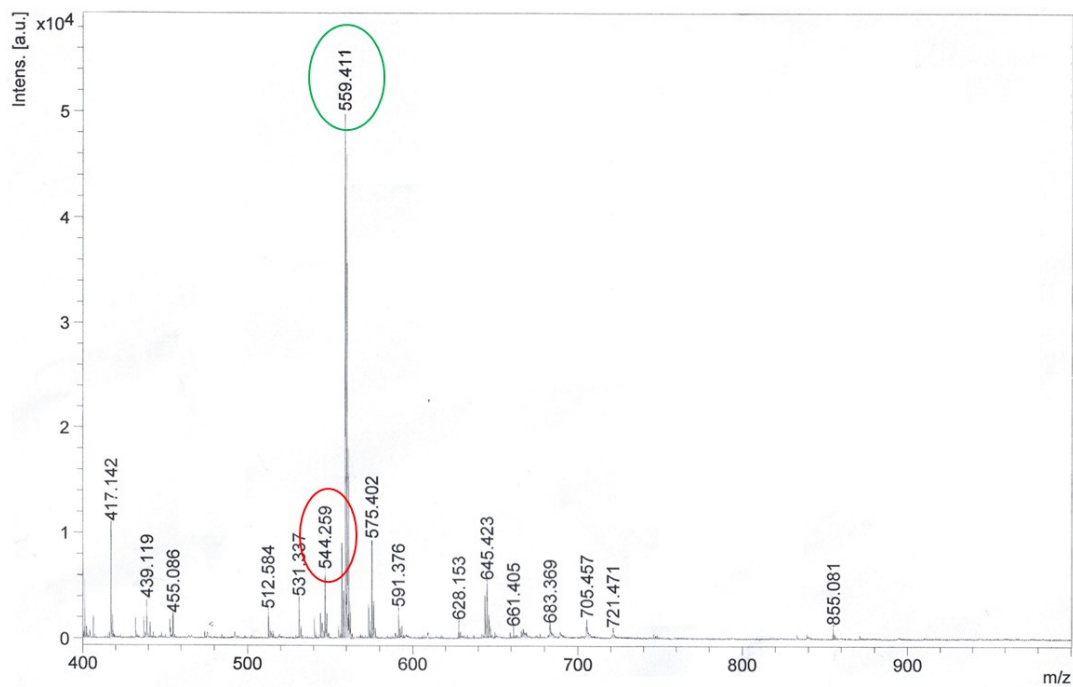
**Fig. S10** Catalytic activity of RhI-DOX-GOD@ZIF-90 (4 mg/mL) upon the addition of ATP (10 mM) before (a) and after (b) the reaction with D-glucose (2 mg/mL) by colorimetric assay. A yellow color was produced of  $\text{H}_2\text{O}_2$  in the sample.



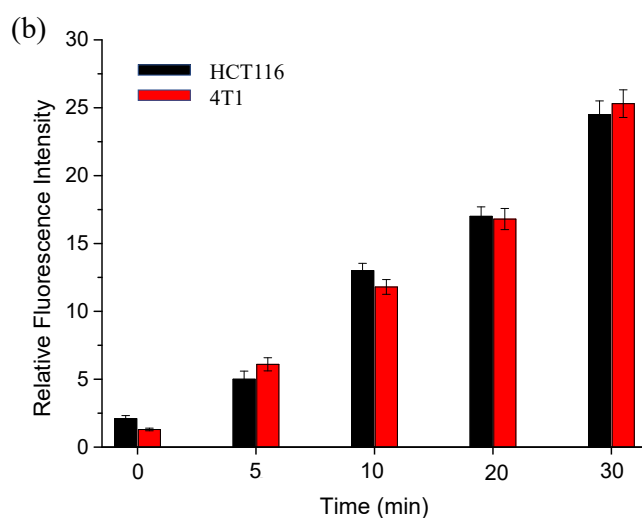
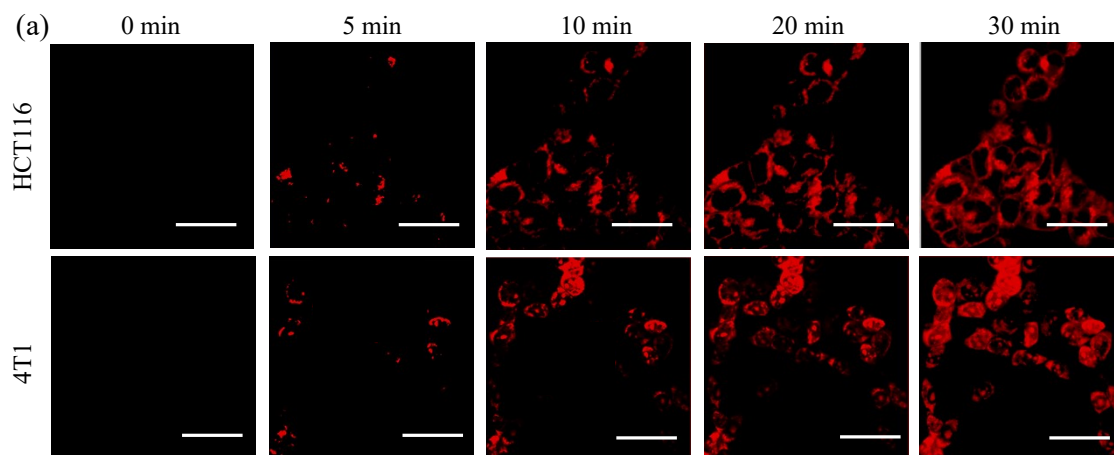
**Fig. S11** TEM images of (a) RhI-DOX-GOD@ZIF-90 nanoparticles and (b) RhI-DOX-GOD@ZIF-90 nanoparticles reacting with ATP.



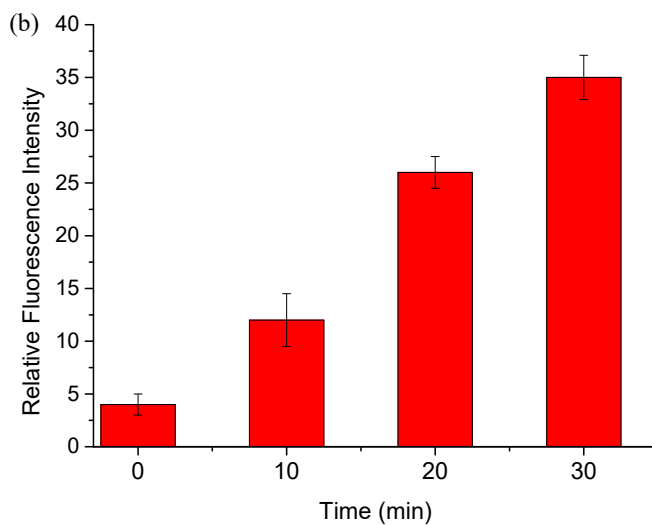
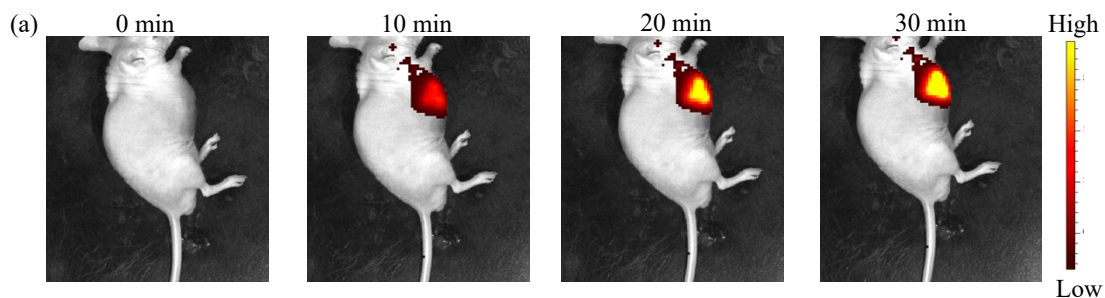
**Fig. S12** Mass spectra of RhI-DOX-GOD@ZIF-90 nanoparticles.



**Fig. S13** Mass spectra of RhI-DOX-GOD@ZIF-90 nanoparticles reacted with ATP.



**Fig. S14** (a) The time-dependent fluorescence imaging of HCT116 and 4T1 cells treated with RhI-DOX-GOD@ZIF-90 nanoparticles (4 mg/mL). (b) Relative fluorescence intensity.  $\lambda_{\text{ex}} = 640 \text{ nm}$ ,  $\lambda_{\text{em}} = 660\text{-}740 \text{ nm}$ . Scale bar: 50  $\mu\text{m}$ .



**Fig. S15** (a) The time-dependent fluorescence imaging in tumor-bearing mice with intravenous injection of RhI-DOX-GOD@-ZIF-90 nanoparticles (4 mg/mL, 10  $\mu$ L). (b) Relative fluorescence intensity.  $\lambda_{\text{ex}} = 640 \text{ nm}$ ,  $\lambda_{\text{em}} = 660\text{-}760 \text{ nm}$