# Supporting information for:

# Hybrid Mesoporous Gadolinium Oxide Nanorods: A Platform for Multimodal Imaging and Enhanced Insoluble Anticancer Drug Delivery with Low Systemic Toxicity

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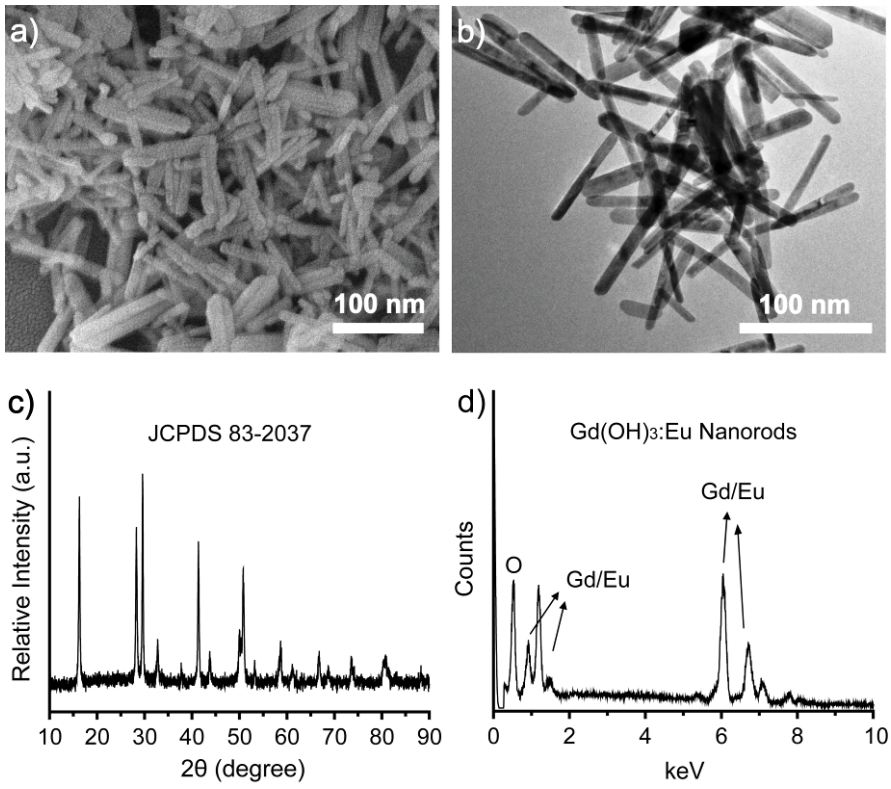


**Fig. S1.** SEM image (a), TEM image (b), wide-angle XRD pattern (c), as well as EDS spectrum (d) of the precursor $Gd(OH)_3$:Eu nanorods.

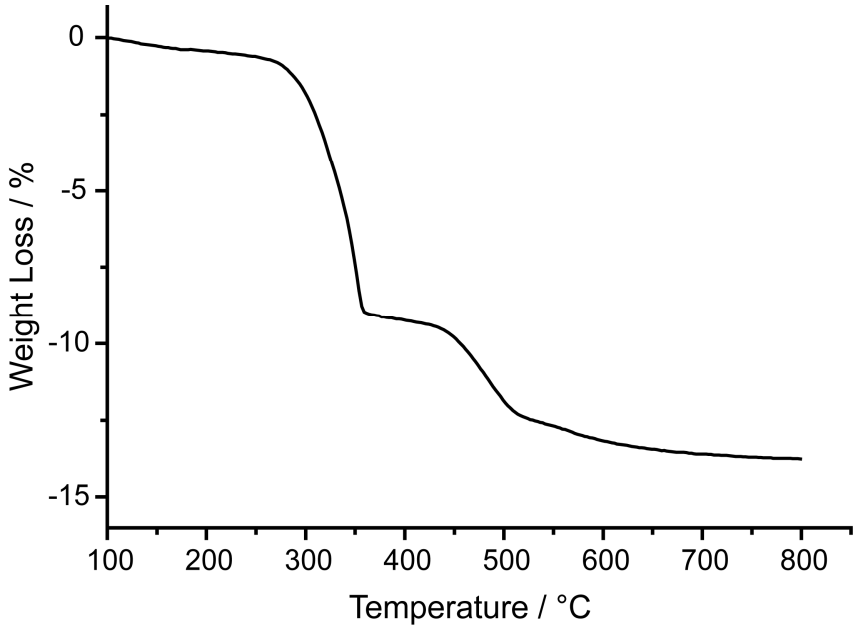


**Fig. S2.** Thermogravimetric analysis curve of the precursor $Gd(OH)_3$:Eu nanorods in air.

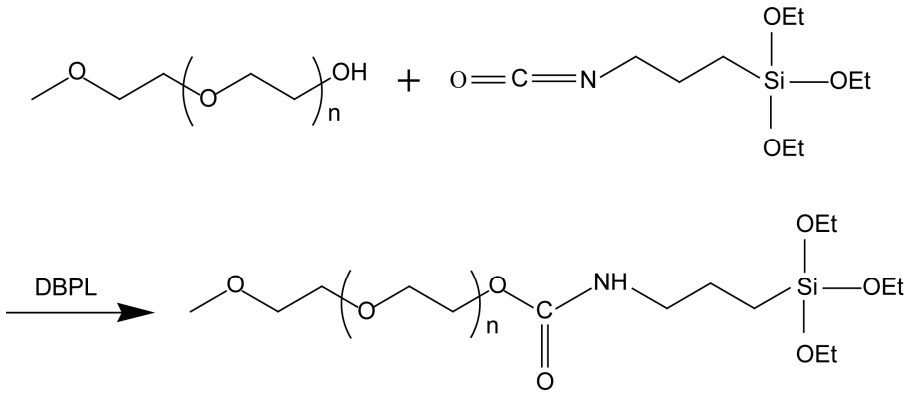


**Fig. S3.** Synthesis of silanated m-PEG from m-PEG and 3-isocyanatopropyltriethoxysilane (IPTS) using dibutyltin dilaurate (DBTL) as a catalyst.

**Fig. S4.** Photo of power of PEG-$Gd_2O_3$:Eu nanorods. The sample was totally dried and placed in one 4cm dish. The precursor $Gd(OH)_3$:Eu nanorods were synthesized in two Teflon-lined stainless-steel autoclaves (50 mL).

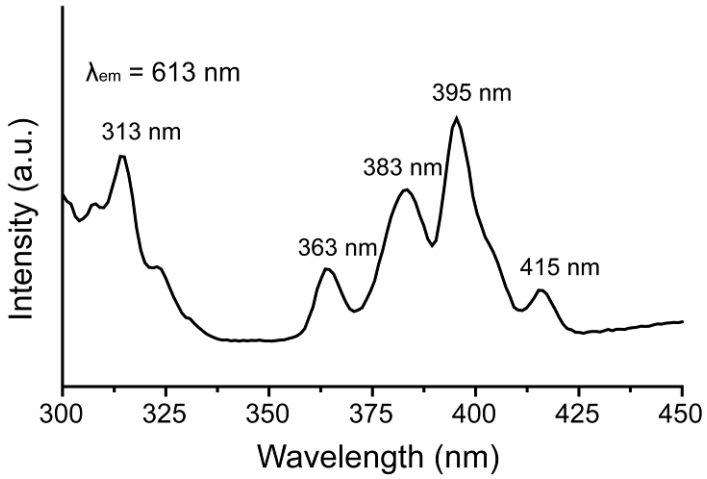


**Fig. S5.** Detailed room-temperature excitation spectrum (300-450 nm) of PEG-$Gd_2O_3$:Eu nanorods upon a related emission wavelength of 613 nm.

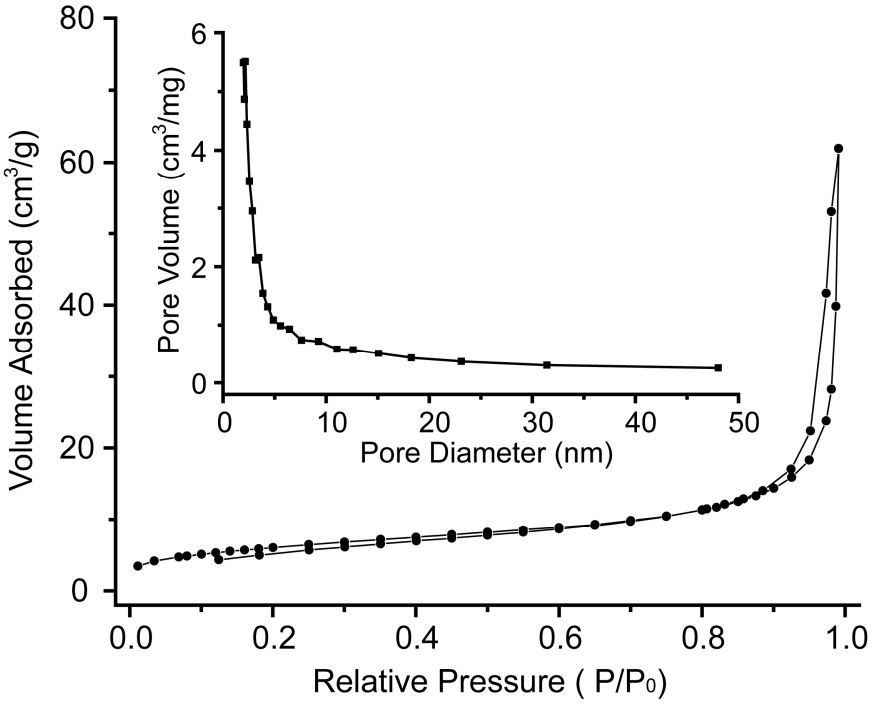


**Fig. S6.** Nitrogen adsorption-desorption isotherm of PEG-$Gd_2O_3$:Eu nanorods. The inset shows the corresponding pore size distribution curve obtained from the adsorption data.

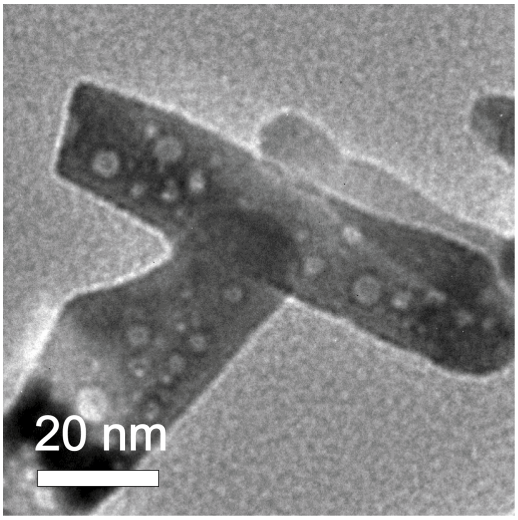


**Fig. S7.** TEM image upon a single PEG-$Gd_2O_3$:Eu nanorods with high magnification.

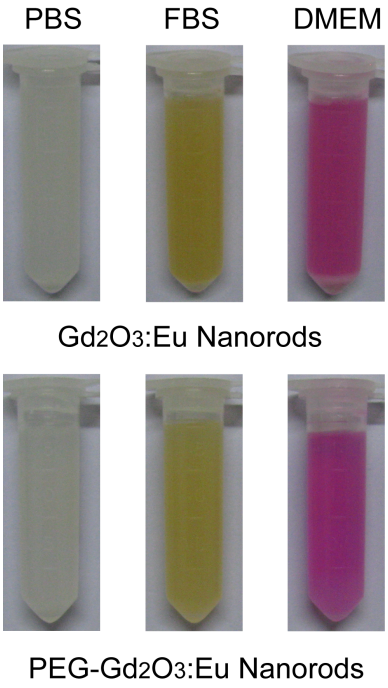


**Fig. S8.** Photos of $Gd_2O_3$:Eu nanorods (1 mg/mL) and PEG-$Gd_2O_3$:Eu nanorods (1 mg/mL) in various solutions including phosphate buffered saline (PBS), fetal bovine serum (FBS), and DMEM cell medium. PEG-$Gd_2O_3$:Eu exhibited excellent stability in various physiological solutions without showing any noticeable aggregation.

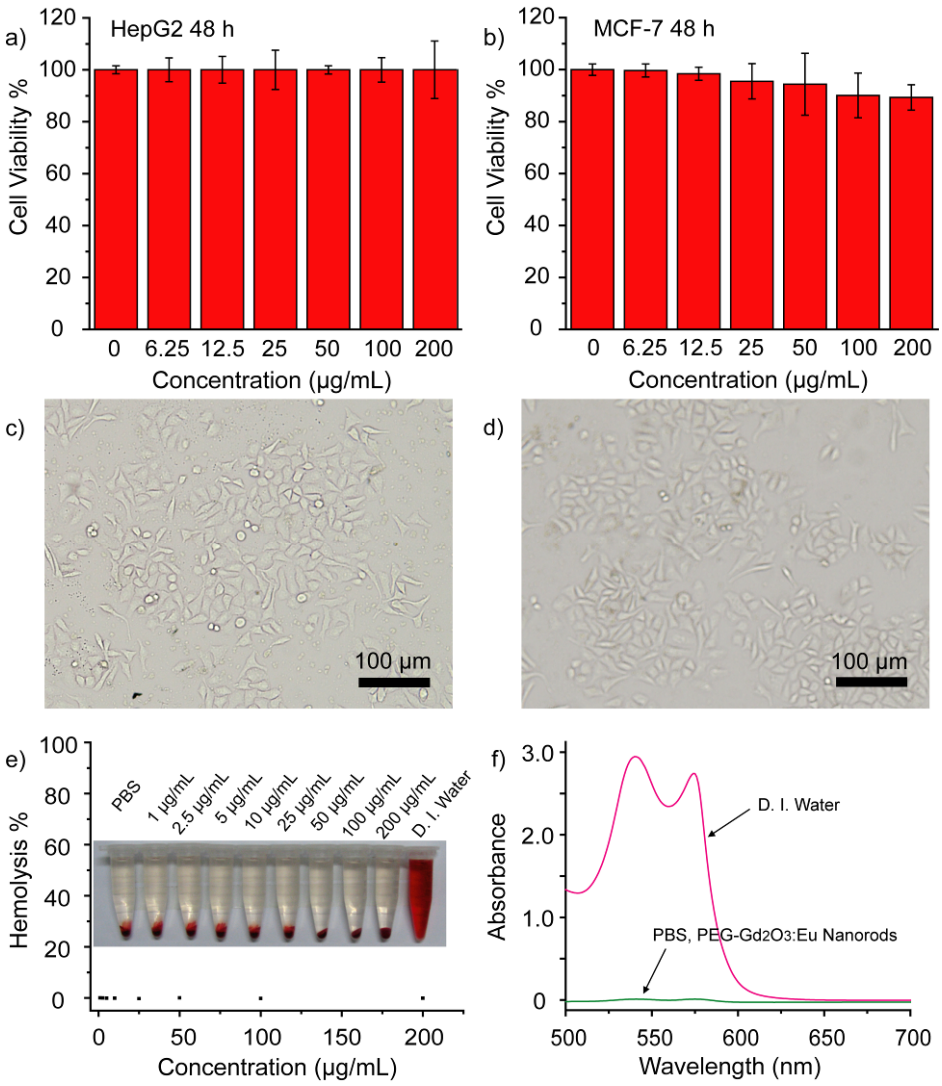


**Fig. S9.** Effect of mesoporous PEG-$Gd_2O_3$:Eu nanorods on the viability of HepG2 and MCF-7 cells, as measured by MTT assay (a, b). Microscopic images of HepG2 cells incubated without (c) and with (d) the nanorods for 48 h. Concentration-dependent hemolysis of the nanorods (e). Inset: photographic images for direct observation of hemolysis by the nanostructures. UV-vis absorption spectra to detect the presence of hemoglobin in the supernatant of nanostructures by using D.I. water and PBS as the positive and negative controls (f).

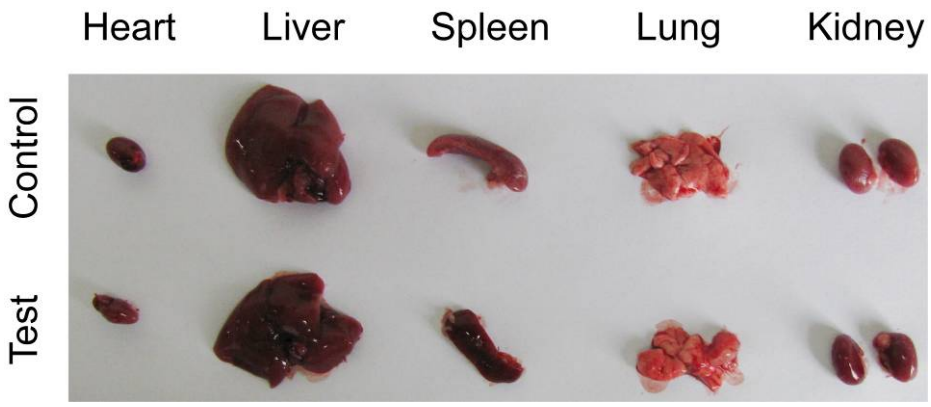


**Fig. S10.** Organ changes of the mouse after intravenous injection of a single dose of PEG-$Gd_2O_3$:Eu nanorods solution. These organs were harvested from heart, spleen, liver, lung, as well as kidneys.

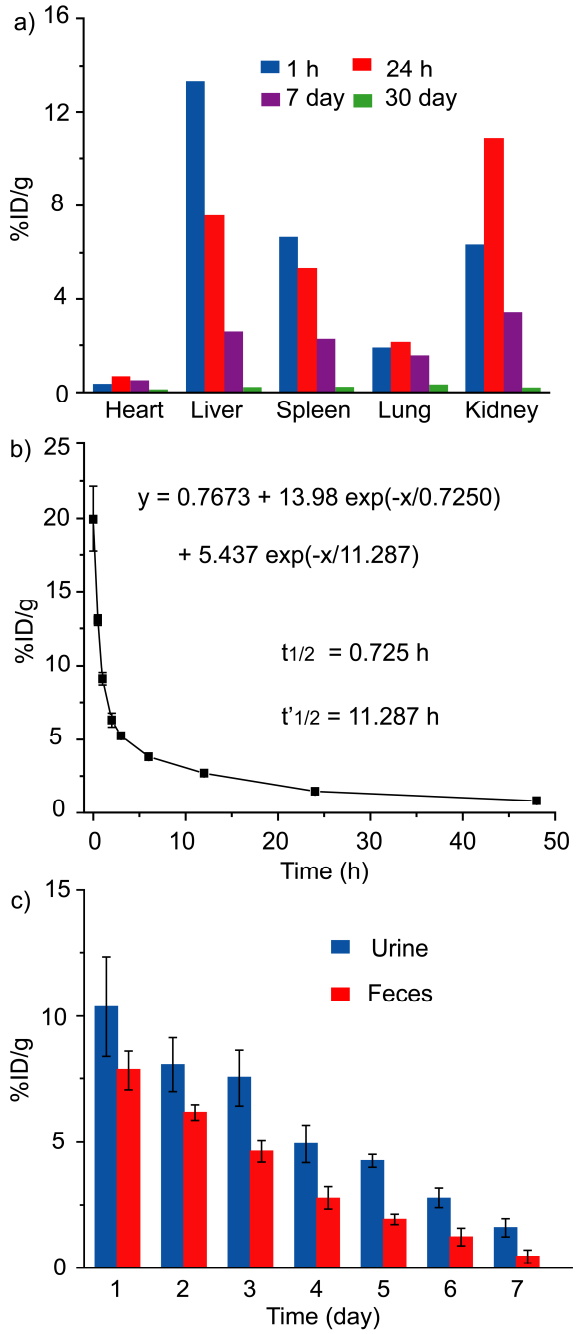


**Fig. S11.** ICP analysis of PEG-$Gd_2O_3$:Eu nanorod biodistribution in mouse organs that were surgically removed at fifferent time points (a). Pharmacokinetic profile of PEG-$Gd_2O_3$:Eu nanorods followed a two-compartment model (b). $Gd^{3+}$ ions levels in urine and feces at different time points after injection (c).

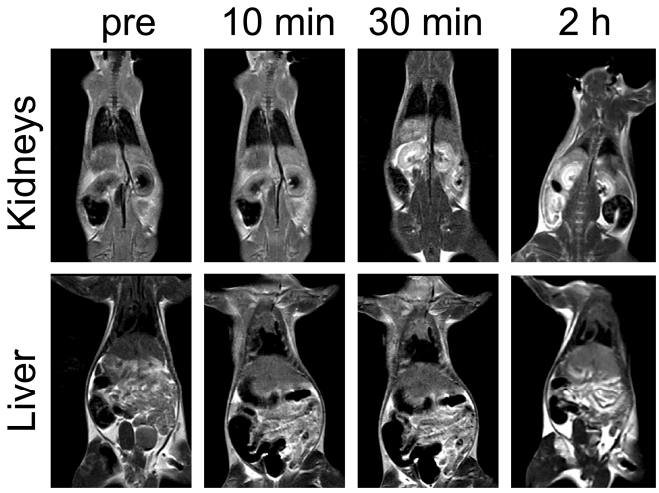


**Fig. S12.** In vivo MRI of rats after intravenous injection of PEG-$Gd_2O_3$:Eu nanorods at timed intervals.

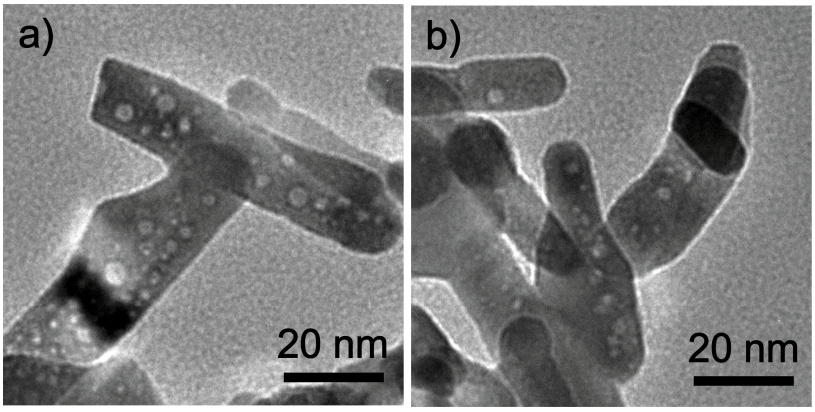


**Fig. S13.** TEM image of the nanorod before (a) and after (b) loading CPT nanocrystal.

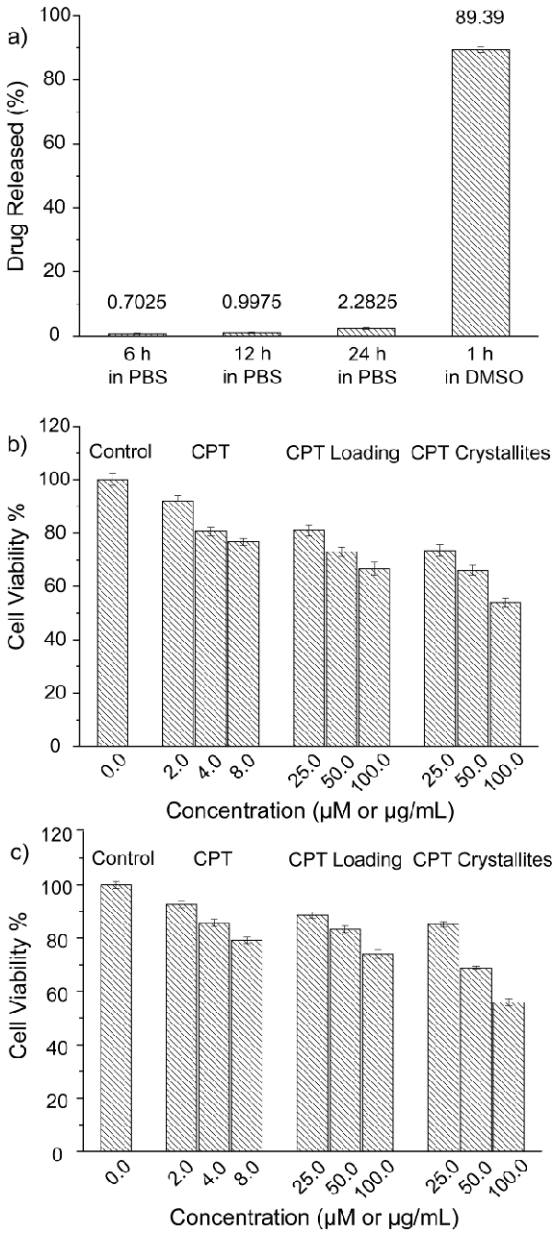


**Fig. S14.** Release amounts of CPT from mesoporous PEG-$Gd_2O_3$:Eu nanorods measured by UV-vis absorption when CPT nanocrystallite-loaded nanorods were dispersed in PBS and DMSO (a). Cell viabilities of HepG2 cells (b) and MCF-7 cells (c) incubated with free CPT, CPT-loaded nanorods, and CPT nanocrystallite-loaded nanorods at different concentrations for 24 h. Concentration: μM for free CPT, μg/mL for CPT-loaded nanorods and CPT nanocrystallite-loaded nanorods.

| Test | Unit | Control group (mean±sd) | Treatment group (mean±sd) |
|---|---|---|---|
| blood cell count (WBC) | $\times 10^9$/L | 9.3±2.4 | 9.5±2.6 |
| red cell count (RBC) | $\times 10^{12}$/L | 10.3±1.7 | 9.8±2.1 |
| hemoglobin (HGB) | g/L | 156.7±29.5 | 163±22.4 |
| mean corpuscular hemoglobin (MCH) | pg | 16.3±1.4 | 16.8±0.9 |
| mean corpuscular hemoglobin concentration (MCHC) | g/L | 320±20.4 | 325±19.2 |
| alanine aminotransferase (ALT) | U/L | 40.5±6.7 | 56.3±11.4 |
| aspartate aminotransferase (AST) | U/L | 150.8±26.5 | 187.2±22.3 |
| blood urea nitrogen (BUN) | $\times 10^6/\mu$L | 8.7±2.3 | 7.5±1.9 |
| plasma creatinine (CRE) | $\times 10^3/\mu$L | 21.3±2.6 | 19.7±1.1 |

**Table S1.** Hematology analysis and blood biochemical assay

| Time interval | Released amount (%) pH=5.0 | Released amount (%) pH=7.4 |
|---|---|---|
| 6 h | 1.4355 | 0.7025 |
| 12 h | 2.2433 | 0.9975 |
| 24 h | 4.5685 | 2.2825 |

**Table S2.** drug released amount upon different pH values and time interval.