Electronic Supplementary Information

Enhanced radiosensitization of ternary Cu_3BiSe_3 nanoparticles by photo-induced hyperthermia at the second near-infrared biological window

Jiangfeng Du,[a,b‡] Xin Wang,[b,c‡] Xinghua Dong,[b,c] Chenyang Zhang,[b,c] Linqiang Mei,[b] Yuan Zang,[b] Liang Yan,[*b,c] Hui Zhang,[*a] Zhanjun Gu[*b,c]

[a] Department of Medical Imaging, First Clinical Medical College, Shanxi Medical University, Taiyuan, Shanxi 030001, P. R. China

[b] CAS Key Laboratory for Biomedical Effects of Nanomaterials and Nanosafety, Institute of High Energy Physics, Chinese Academy of Sciences, Beijing 100049, P. R. China

[c] University of Chinese Academy of Sciences, Beijing 101408, China

E-mail: yanliang@ihep.ac.cn; zhanghui_mr@163.com; zjgu@ihep.ac.cn

‡ These authors contributed equally.

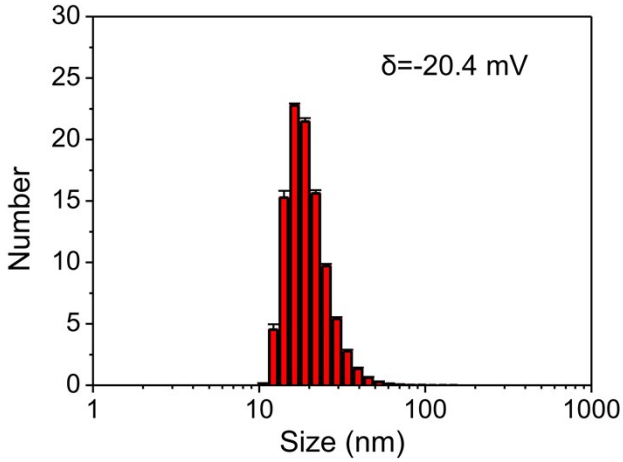

Fig. S1 Size distribution and Zeta potential of PVP-Cu_3BiSe_3 NPs.

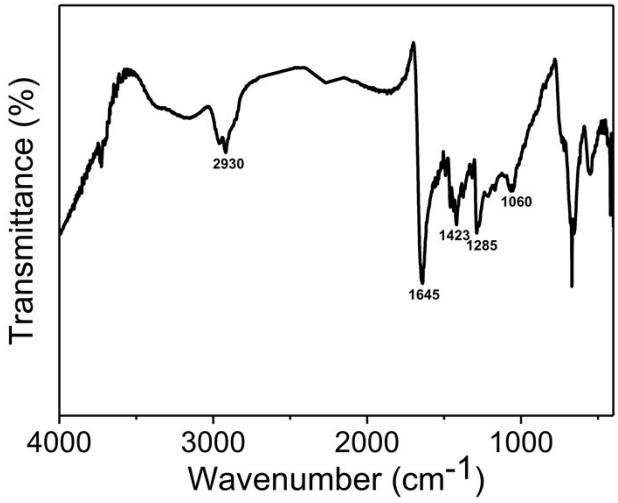

Fig. S2 FT-IR spectrum of PVP-Cu_3BiSe_3 NPs.

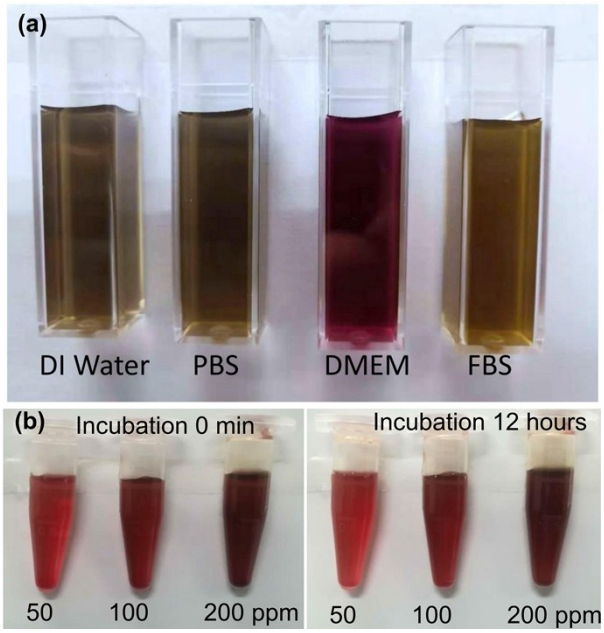

Fig. S3 (a) Photographs of the dispersion of PVP-Cu_3BiSe_3 NPs in deionized (DI) water, PBS, DMEM, and FBS (200 μg/mL). (b) Photographs of the dispersion of PVP-Cu_3BiSe_3 NPs in the blood.

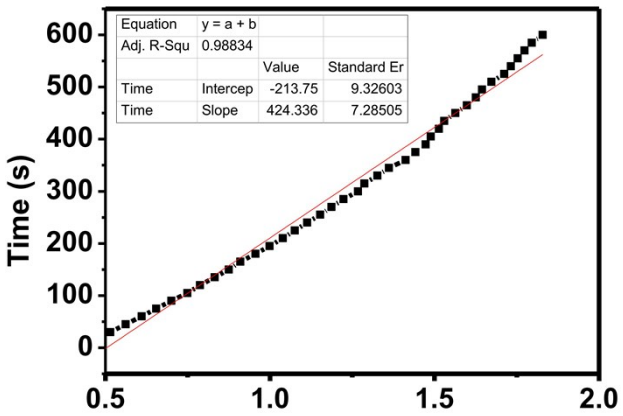

Fig. S4 Plot of cooling time versus negative natural logarithm of the temperature driving force which is obtained from the cooling stage. Time constant for heat transfer from the system is determined to be τ_s = 424.336

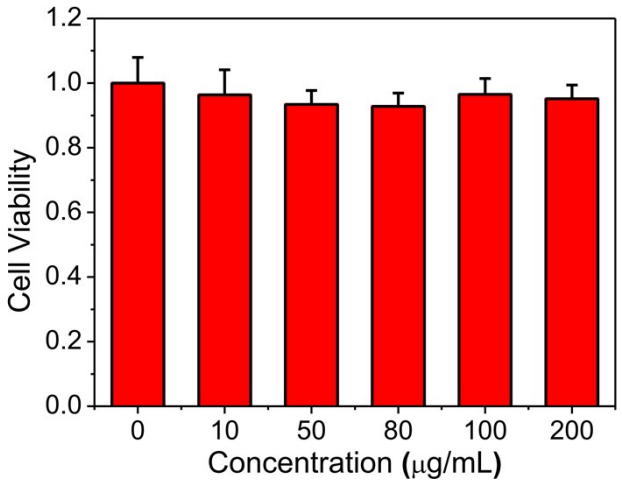

Fig. S5 Cell viability of Hela cells after cultured with various concentrations PVP-Cu_3BiSe_3 NPs for 24 h.

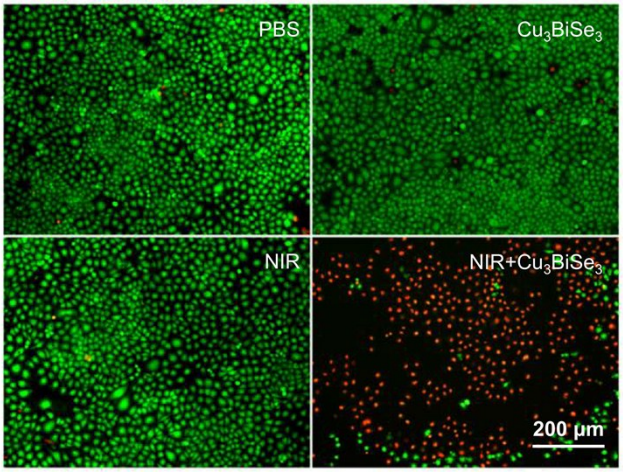

Fig. S6 *In vitro* photothermal effect. Live-dead staining of Hela cells. Hela cells were incubated with 100 μg/mL of PVP-Cu_3BiSe_3 NPs for 24 h and irradiated for 10 min using a 1064 nm laser with 0.75 W/cm^2 of power densities.

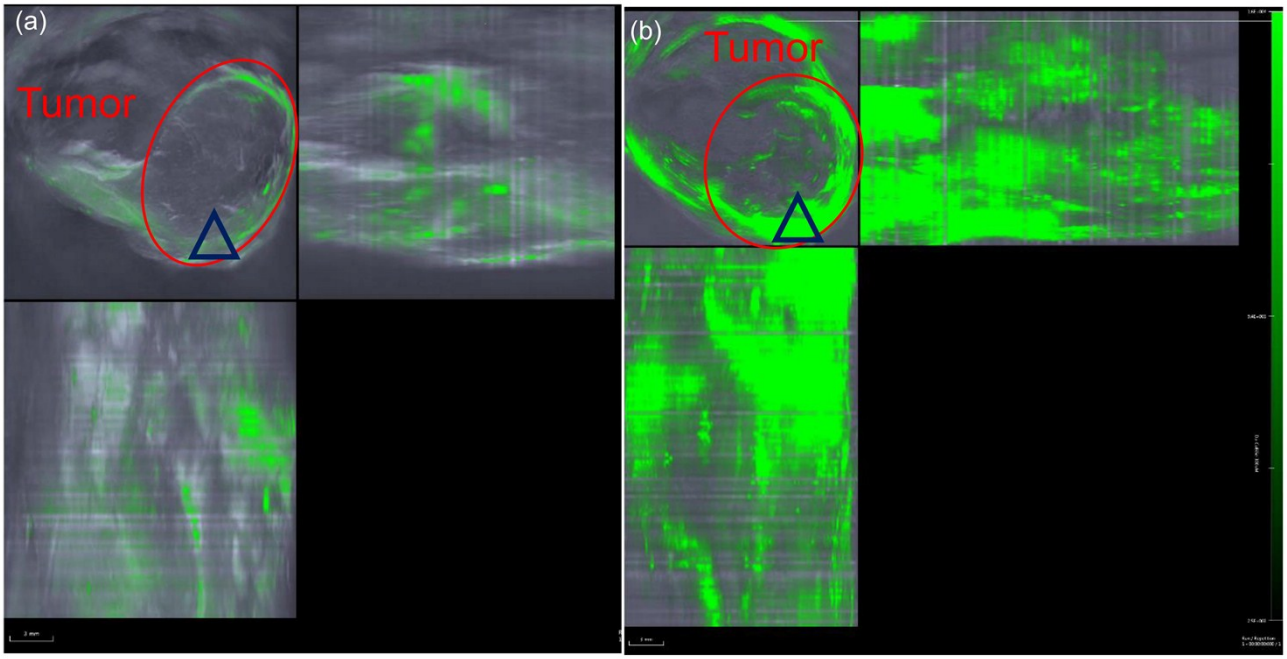

Fig. S7 (a-b) *In vivo* different dimensions of PAT imaging of a tumor-bearing mouse before (a) and after (b) Injection with PVP-Cu_3BiSe_3 NPs. (laser light range: 750-850 nm for *in vivo* imaging)

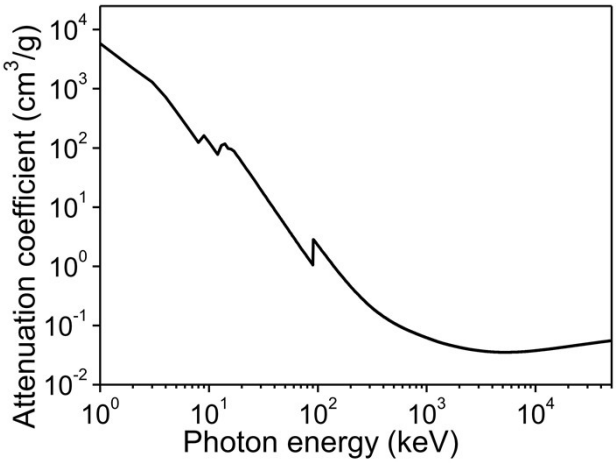

Fig. S8 The X-ray absorption cofficient of Cu_3BiSe_3 NPs versus the X-ray energy was calculated by XMuDat computer program.

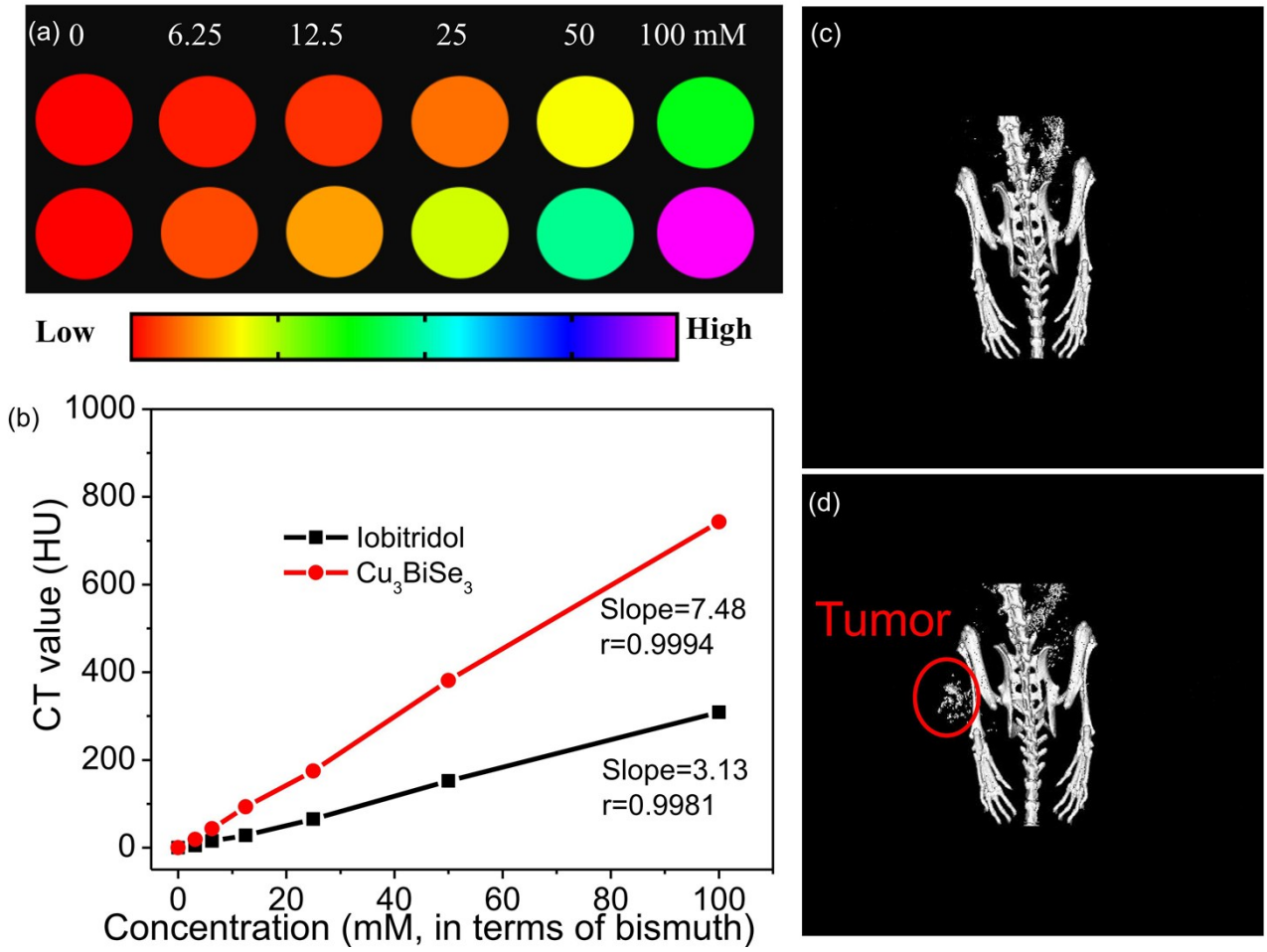

Fig. S9 (a) CT phantom images of PVP-Cu_3BiSe_3 NPs (upper) and iopromide (bottom) with different concentrations. (b) Plot of HU values of PVP-Cu_3BiSe_3 NPs and iopromide versus the sample concentrations. (c-d) CT image of mice before injection of PVP-Cu_3BiSe_3 NPs (c) and after intratumoral injection of PVP-Cu_3BiSe_3 NPs for 3 h (d).

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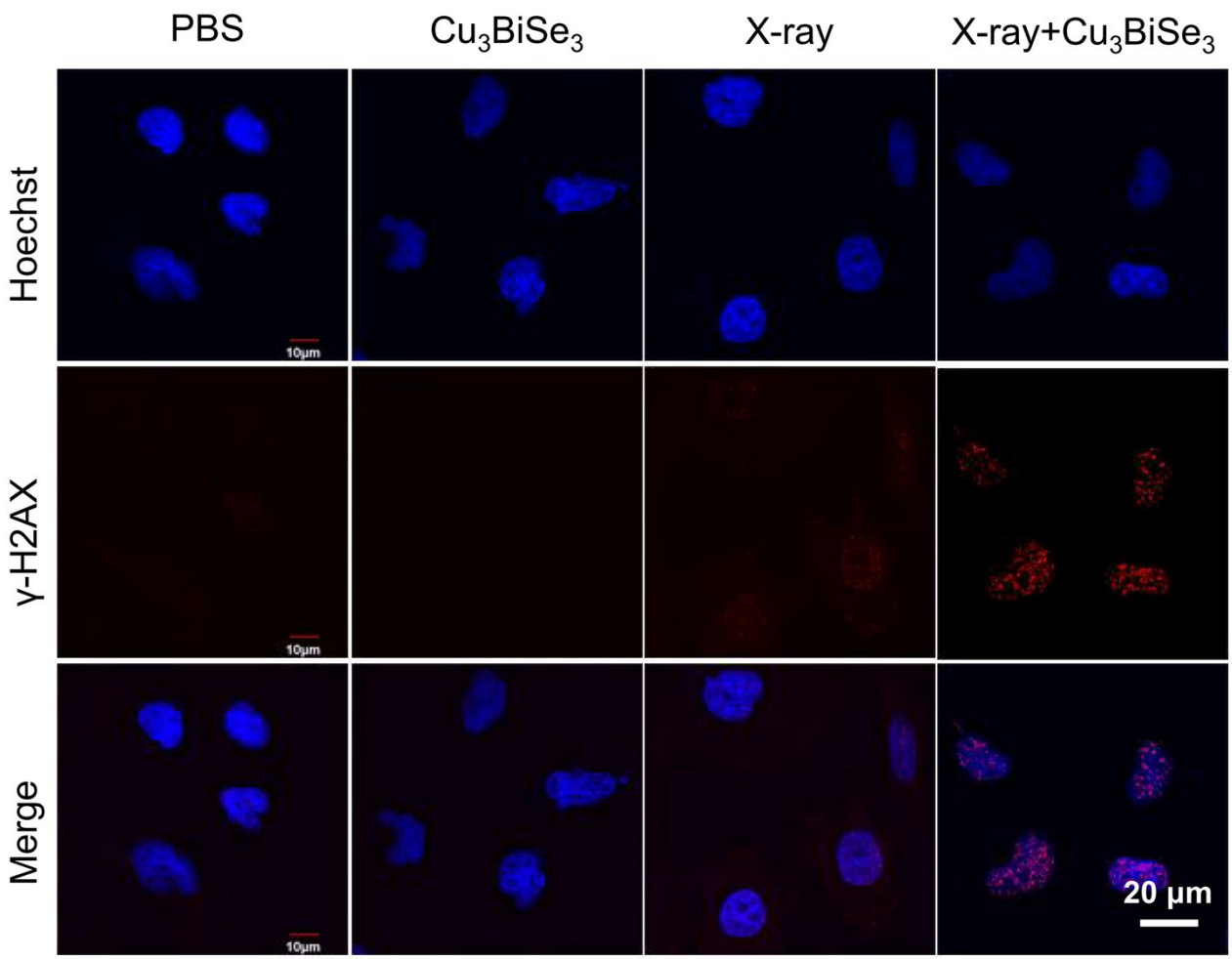

Fig. S10 Representative fluorescence images of DNA fragmentation and nuclear condensation induced by PVP-Cu_3BiSe_3 NPs (100 ppm, 2 mL) or/and X-ray radiation (6 Gy), stained with DAPI and γ-H2AX for nuclear visualization and DNA fragmentation, respectively.

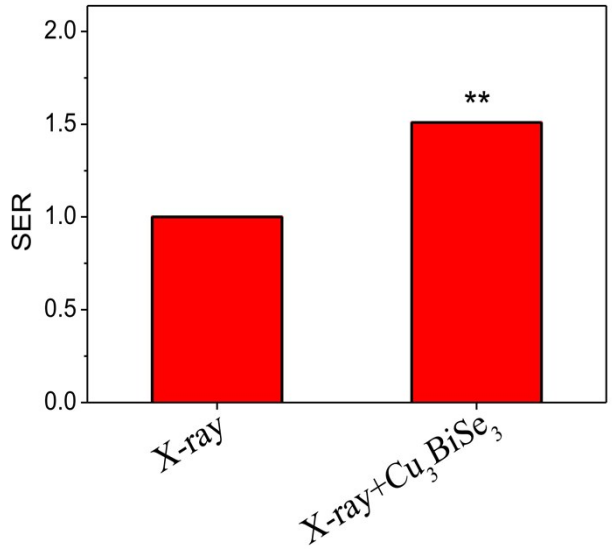

Fig. S11 Produce 63% biological effects of the sensitizer enhancement ratio (SER) of PVP-Cu_3BiSe_3 NPs. P values were calculated by *t* test: ** P<0.01.

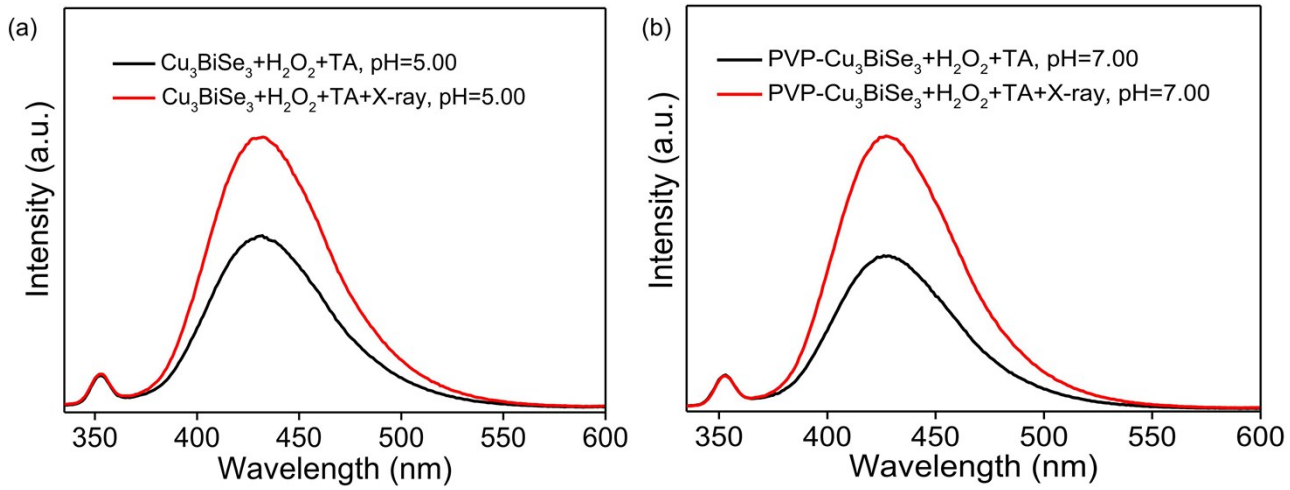

Fig. S12 Determination of the formation of HO• using TA as a fluorescent probe. Fluorescence intensity with or without X-ray irradiation in the presence of PVP-Cu_3BiSe_3 NPs under pH=5.00 (a) and pH=7.00 (b).

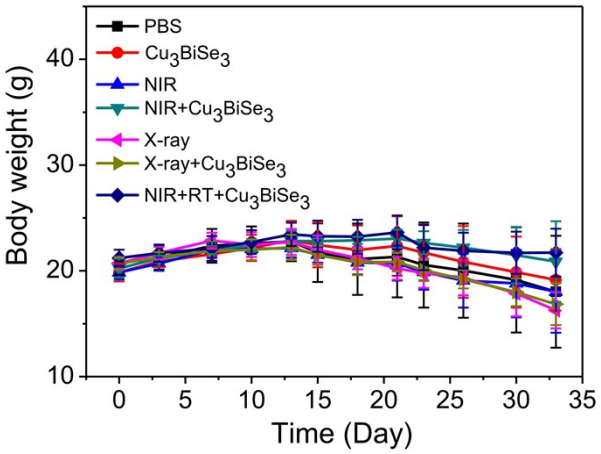

Fig. S13 The weight of Hela tumor-bearing mice in our observation period. Error bars correspond to mean ± standard deviations

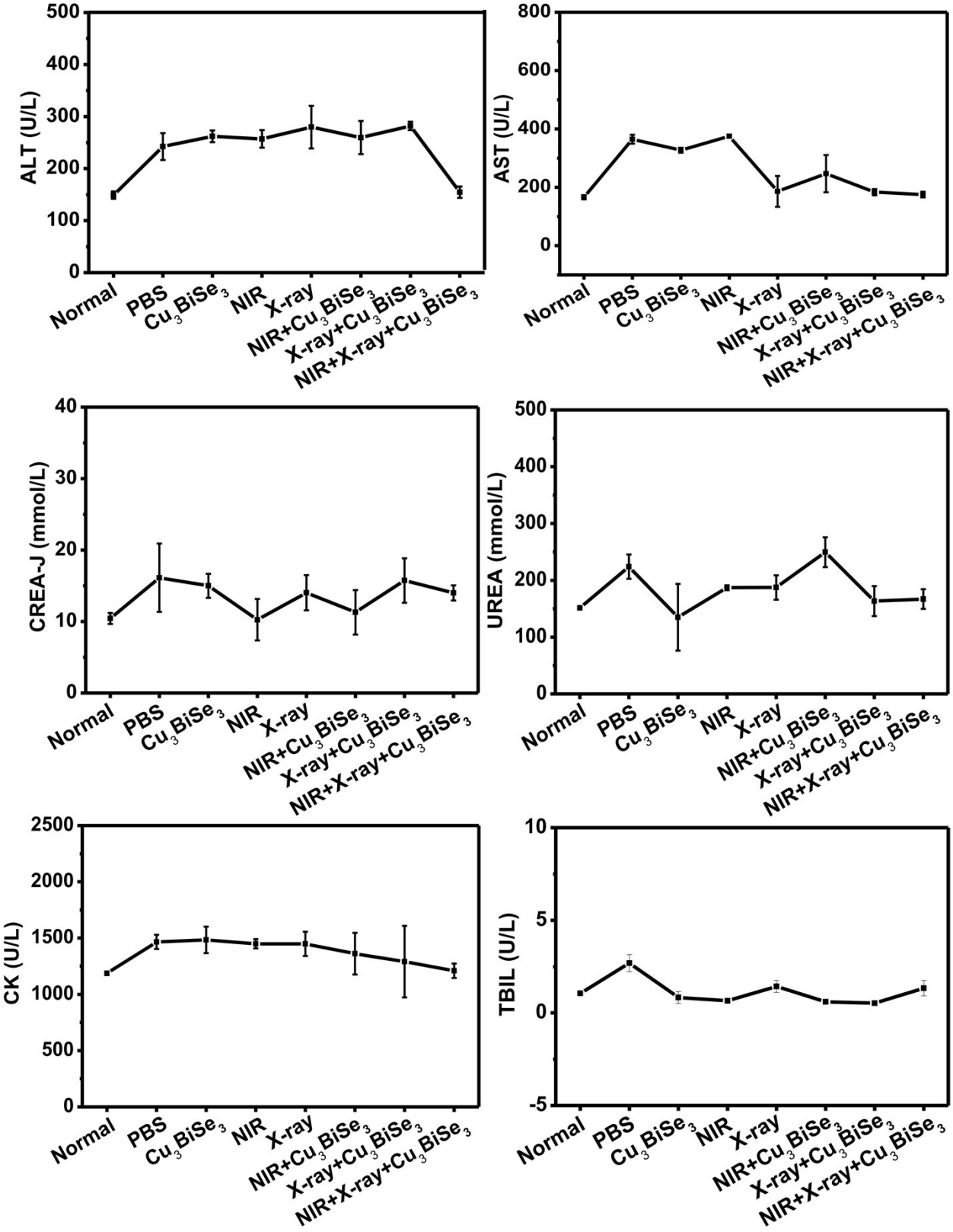

Fig S14. Blood biochemistry analysis of the mice treated with PVP-Cu_3BiSe_3 NPs. The result exhibit mean and standard deviation of alanine aminotransferase (ALT), aspartate aminotransferase (AST), creatinine (CREA-J), UREA, creatine kinase (CK). All of the results indicated the contain PVP-Cu_3BiSe_3 NPs groups could decrease to different degree dysfunction of hepatic and renal dysfunction.

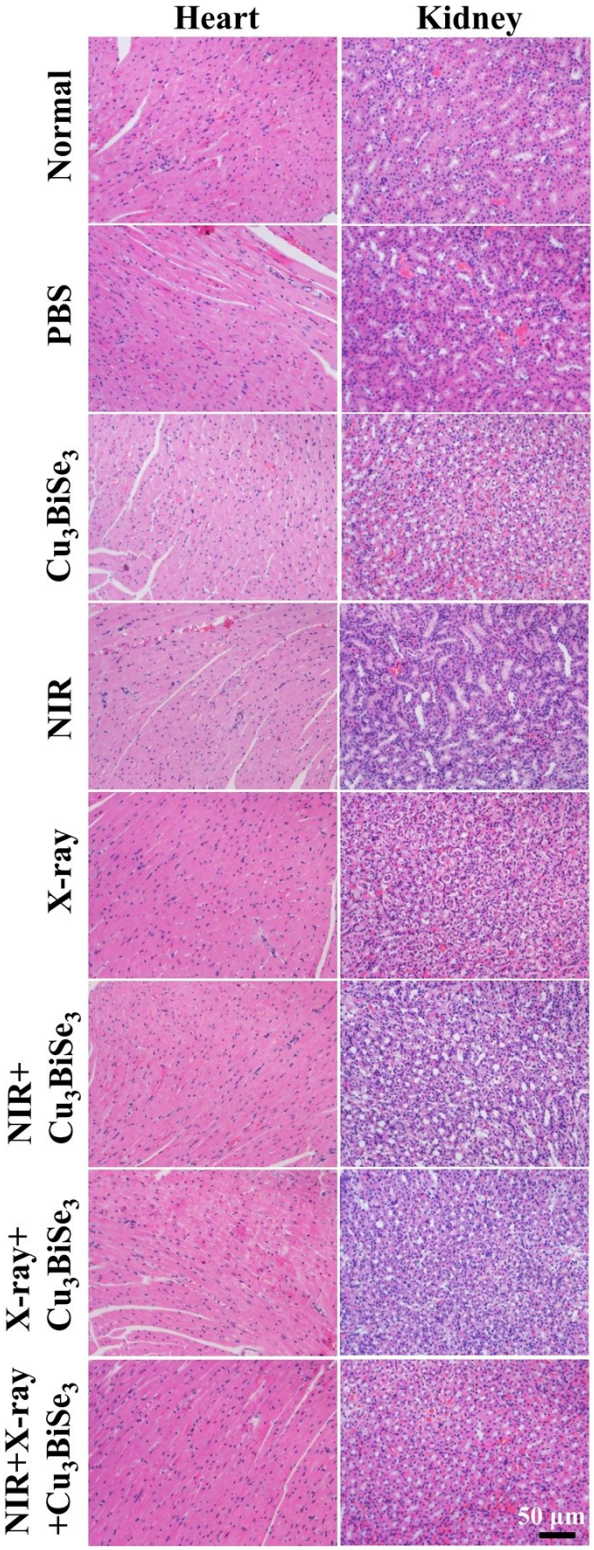

Fig S15. Hematoxylin and Eosin stained tissue sections from the mice to monitor the histological changes in heart and kidney of the mice 33 days after with different administration.

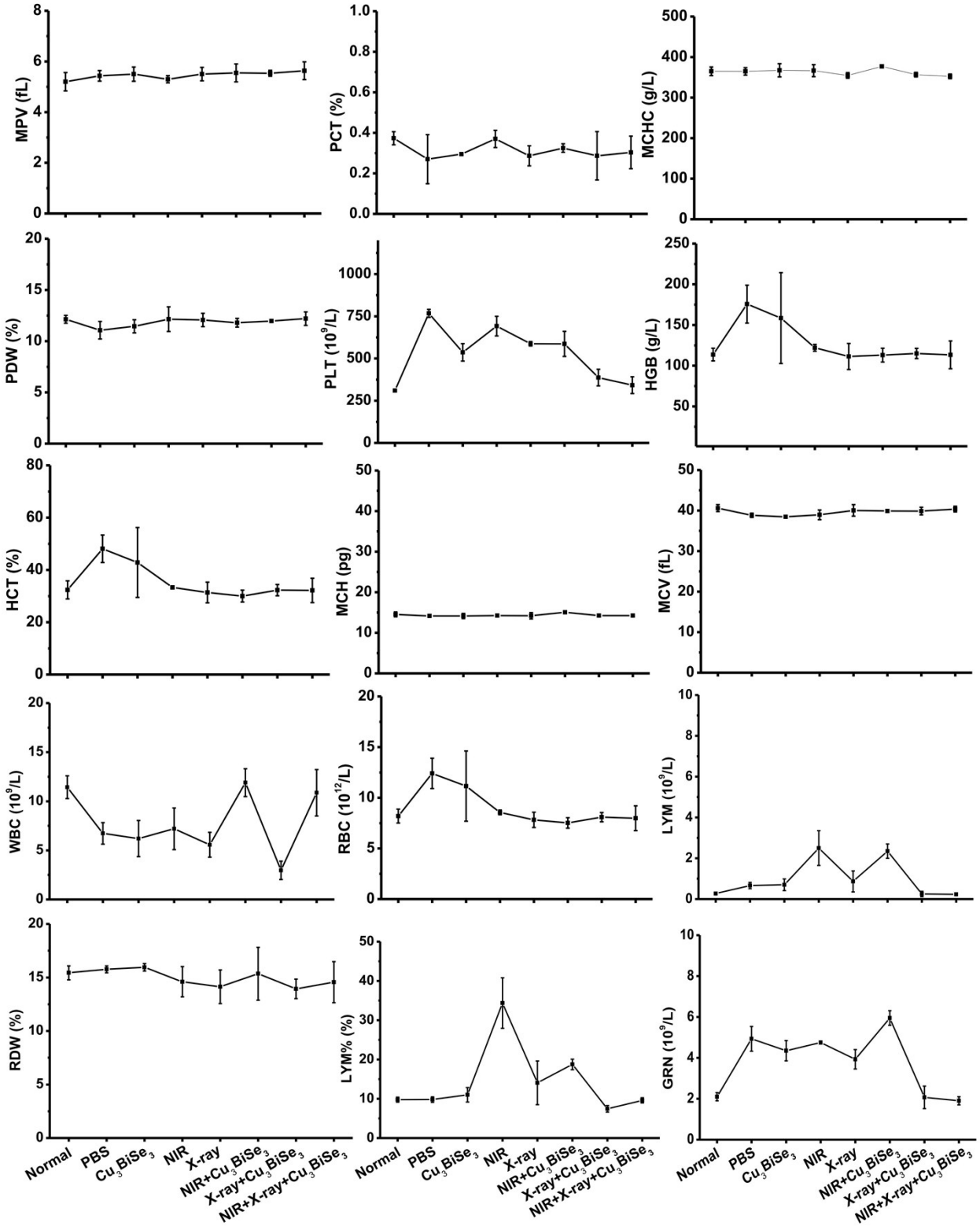

Fig S16. Blood routine analysis of the mice treated with PVP-Cu_3BiSe_3 NPs.