Supplementary Information

Facile synthesis of black phosphorus-Au nanocomoposites for enhanced photothermal cancer therapy and surface-enhanced Raman scattering analysis

Guangcun Yang,† Zhiming Liu,† Yi Li, Yuqing Hou, Xixi Fei, Chengkang Su, Songmao Wang, Zhengfei Zhuang* and Zhouyi Guo*

MOE Key Laboratory of Laser Life Science & SATCM Third Grade Laboratory of Chinese Medicine and Photonics Technology, College of Biophotonics, South China Normal University, Guangzhou 510631, Guangdong, China.

† These authors contributed equally to this work.
*Corresponding to: Dr. Zhengfei Zhuang and Prof. Zhouyi Guo
Telephone and fax: 86-20-85211428
E-mail: zhuangzf@scnu.edu.cn (Dr. Z.F. Zhuang); ann@scnu.edu.cn (Prof. Z.Y. Guo)

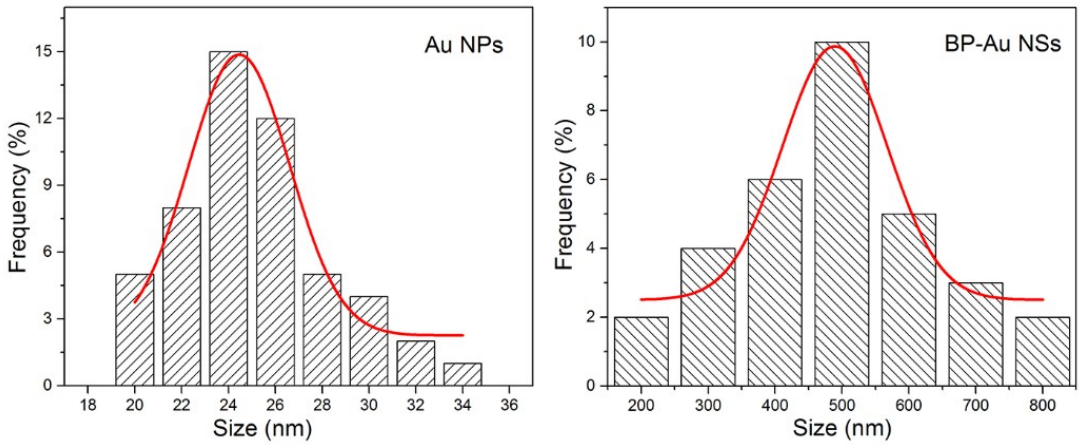

Fig. S1 The size distribution of BP-Au NSs and deposited Au NPs.

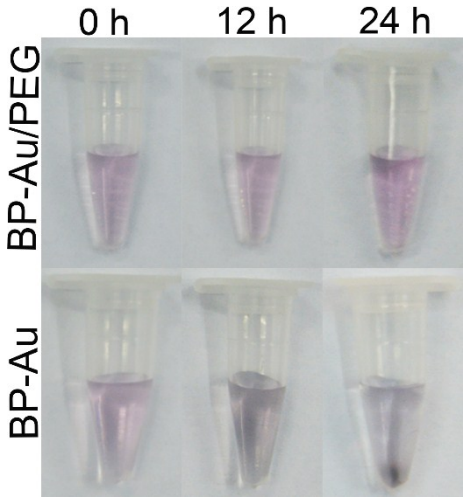

Fig. S2 The stability BP-Au nanosheets with and without PEG functionalization in physiological PBS solution.

The photothermal conversion efficiency (η) was calculated using the following Eqs.[1]

$$\eta = hS\,(T_{max} - T_{max,\,water}) / I\,(1 - 10^{-A}) \quad (1)$$

$$hS = \sum mC_p / \tau_s \quad (2)$$

$$\tau_s = -t / \ln\theta \quad (3)$$

$$\theta = (T_{amb} - T) / (T_{amb} - T_{max}) \quad (4)$$

where h is the heat transfer coefficient, S is the surface area of the container, m is the mass of products (m = 1g), τ_s is a system time constant, C_p is specific heat capacity of solvent ($C_{p,\ water}$ = 4.2 J/mol), I is incident laser power (2.0 W/cm^2), η is the photothermal conversion efficiency, A indicates the absorbance of BP-Au NSs (A_{808} = 1.04) and BP NSs at 808 nm (A_{808} = 0.88), T_{amb} is ambient temperature of the surroundings, T_{max} and $T_{max,\ water}$ are the equilibrium temperature of BP-Au NSs solution and water, respectively.

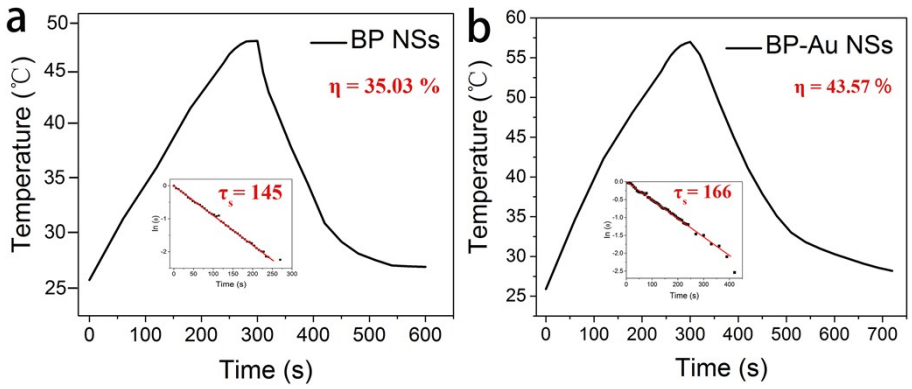

Fig. S3 Photothermal properties of BP NSs and BP-Au NSs. (a, b) Plots of the temperature vs time for the BP NSs (1g, OD_{808} = 0.88) and BP-Au NSs (1g, OD_{808} = 1.04) during laser irradiation (808 nm, 2 W/cm^2) and cooling (laser off). The insert plots show the cooling time vs -ln θ. On the basis of the linear regression analysis, the time constant for heat transfer τ_s (the slope of the plot) was determined to be 145 s and 166 s, respectively.

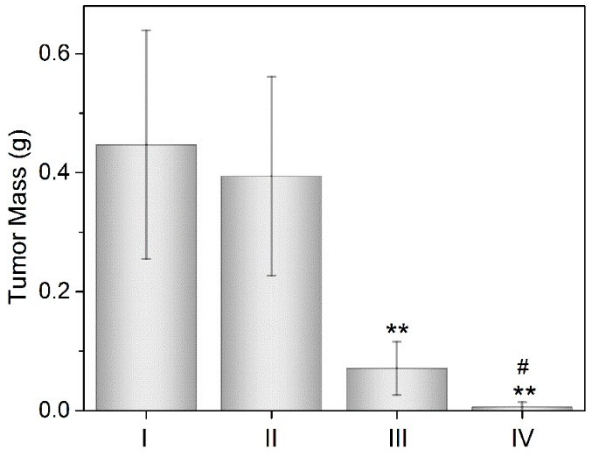

Fig S4 Average weights of tumors collected from different groups of mice. (group I: PBS with laser; group II: BP-Au NSs without laser; group III: BP NSs with laser; group IV: BP-Au NSs with laser). Data are presented as mean ± SD. ** indicates $P < 0.01$ versus group I, and # indicates $P < 0.05$ versus group III.

References:

1 C. Sun, L. Wen, J. Zeng, Y. Wang, Q. Sun, L. Deng, C. Zhao and Z. Li, *Biomaterials*, 2016, **91**, 81-89.