Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting Information

Urchin-like Tungsten Suboxide for Photoacoustic Imaging-Guided Photothermal and Photodynamic Cancer Combination Therapy

Fei Wang, [a,b] Wei Guo,[a,b] Chuanqi Song,[a,b] Dandan Ding,[a,b] Yan Gao,[b] Mei Yan, [a, b]* Chongshen Guo [a,b] *

[a] *Key Lab of Microsystem and Microstructure Manufacturing (Ministry of Education), Academy of Fundmental and Interdisciplinary Sciences, Harbin Institute of Technology, Harbin 150080, China.*
[b] *School of Life Science and Technology, Harbin Institute of Technology, Harbin 150080, China.*

† E-mail: chongshenguo@hit.edu.cn; Fax: +86 451 86403493

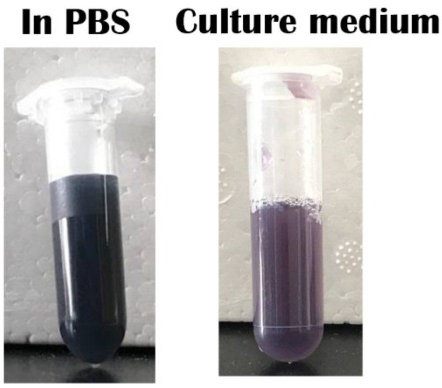

Figure. S1 Photographs of $W_{18}O_{49}$ dispersed in PBS solution and culture medium.

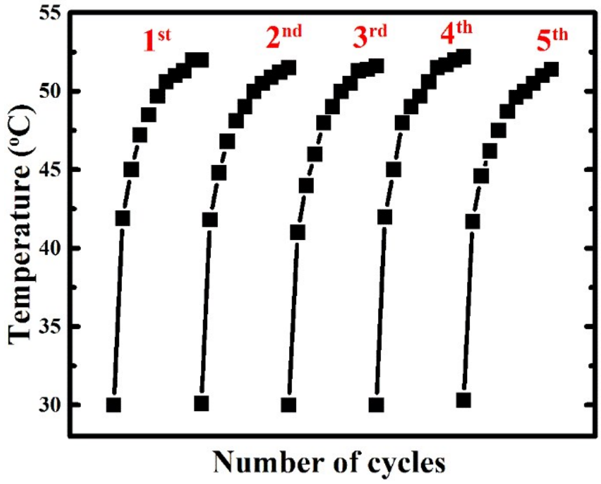

Figure S2 Cycling stability test of the photothermal conversion for 5 cycles.

The photothermal conversion efficiency, η, can be determined by following equation:

$$\eta = [hS\,(T_{max} - T_{surr}) - Q_{dis}] / I(1-10^{-A_{1064}}) \quad \text{Eqn.S1}$$

where h is heat transfer coefficient; S is the surface area of the container; Tmax is the equilibrium temperature; T_{surr} is ambient temperature of the surroundings;

Q_{dis} is heat dissipated from light absorbed by the quartz sample cell itself (it was measured independently to be 13.25 mW using a quartz cell containing pure water;

I is incident laser power (2 W/cm^2)

A_{1064} is the optical absorbance of nanocubes at 1064 nm, which to be 0.95 in this work.

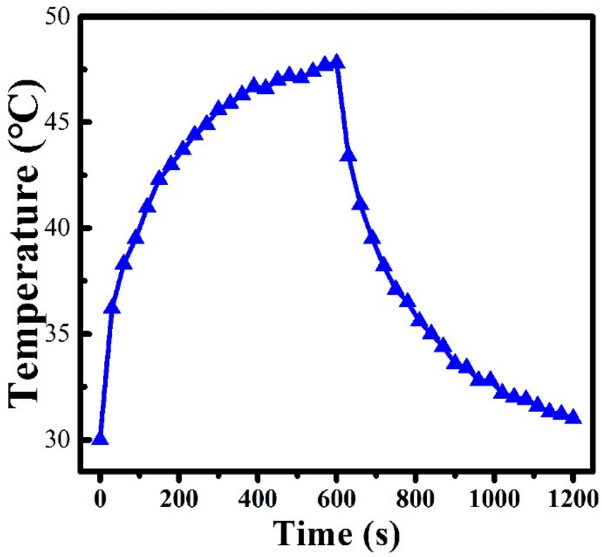

Figure S3. Temperature variations of solution containing 0.5 mg/ml tungsten suboxide with 2 W/cm^2 laser irradiation. The NIR laser irradiation lasted 10 min and then was turned off.

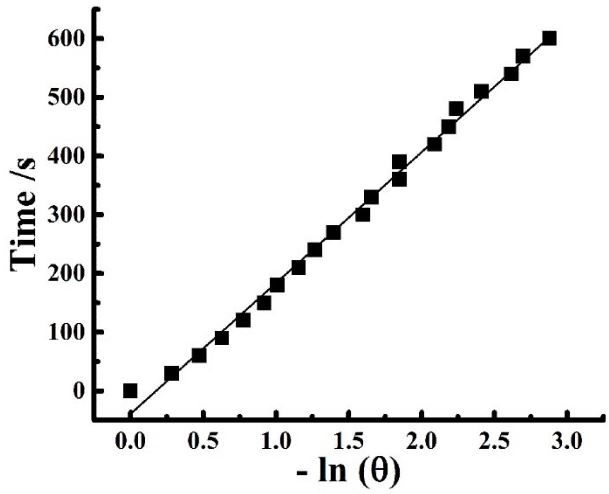

Figure S4. Linear relation between the t and lnθ.

It easily found that only the hS remains unknown for calculating η. To obtain the value of hS, a dimensionless driving force temperature, θ is introduced using the maximum system temperature.

$$\Theta = (T - T_{surr})/(T_{max} - T_{surr}) \qquad \textbf{Eqn.S2}$$

At the cooling stage of the aqueous dispersion, the cooling time t and θ abide by the following equation;

$$t = -\tau_s \ln(\Theta) \qquad \textbf{Eqn.S3}$$

Time constant for heat transfer from the system could be determined by plotting linear time data from the cooling period against negative natural logarithm of driving force temperature. The τ_s is calculated to be 223s.

$$hS = \Sigma m_i C_{p,\,\mathrm{I}} / \tau_s \qquad \textbf{Eqn.S4}$$

Where m, Cp, τ_s are the mass, heat capacity of water and time constant, respectively.
The m is 3 g and C is 4.2 J/g. The hS is determined to 56.5 mW/ ^{o}C according to Equ.S4. Substituting hS = 56.5 mW/ ^{o}C into Equ.S1 produces **η = 49.5 %**.

Secondly, the photo-stability was investigated by applying 5 heating cycles on 1 mg/ml tungsten suboxide under 2W/cm^2 laser irradiation. As shown in Figure. R4, there was no obvious change on temperature rise after 5 cycles, indicating a good photostability of tungsten suboxide.

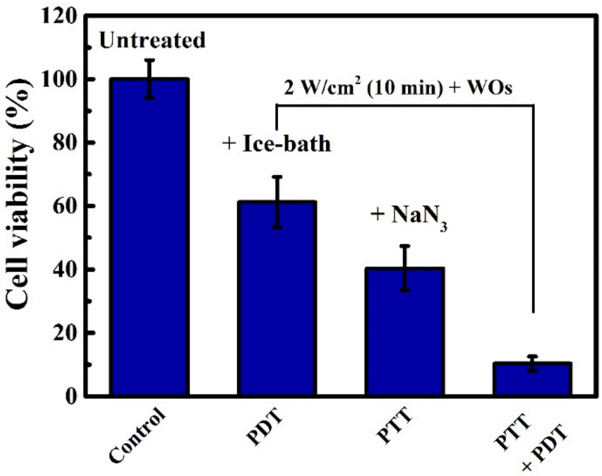

Figure S5 Cell viability after different treatments.

The therapeutic effect in each group was reflected by a MTT method. For internalizing WOs, cells were seeded in 96-well plate and incubated with BSA-MoS_2 for 24 h. After removing the excessive WOs by PBS washing, cells were irradiated with a 1064 nm laser for 10 min, resulting in a combined PTT/PDT treatment effect. As to PDT group, the cells were set at a chamber temperature of 4 °C during the NIR irradiation. For PTT experiments, 50 μL of sodium azide (10 μM) was added into the cells that had been incubated with BSA-MoS_2.

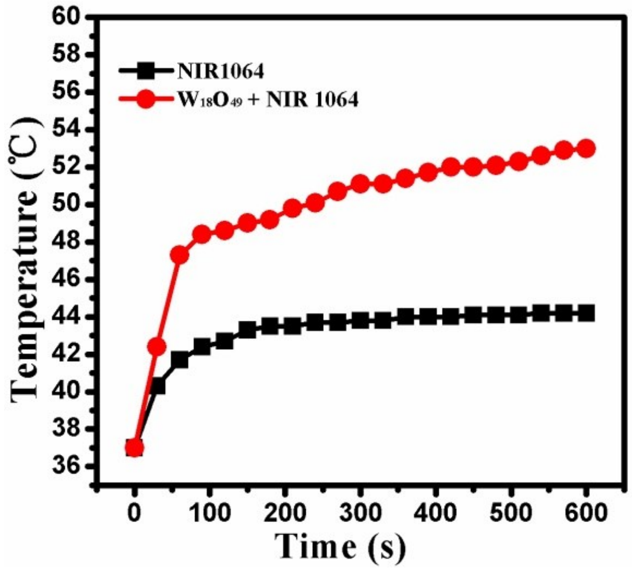

Figure S6 Temperature evaluation of tumors intratumorally injected with 100 μL of PBS or WOs (1 mg/mL) recorded by an IR thermal camera under irradiation of NIR 1064 nm laser.

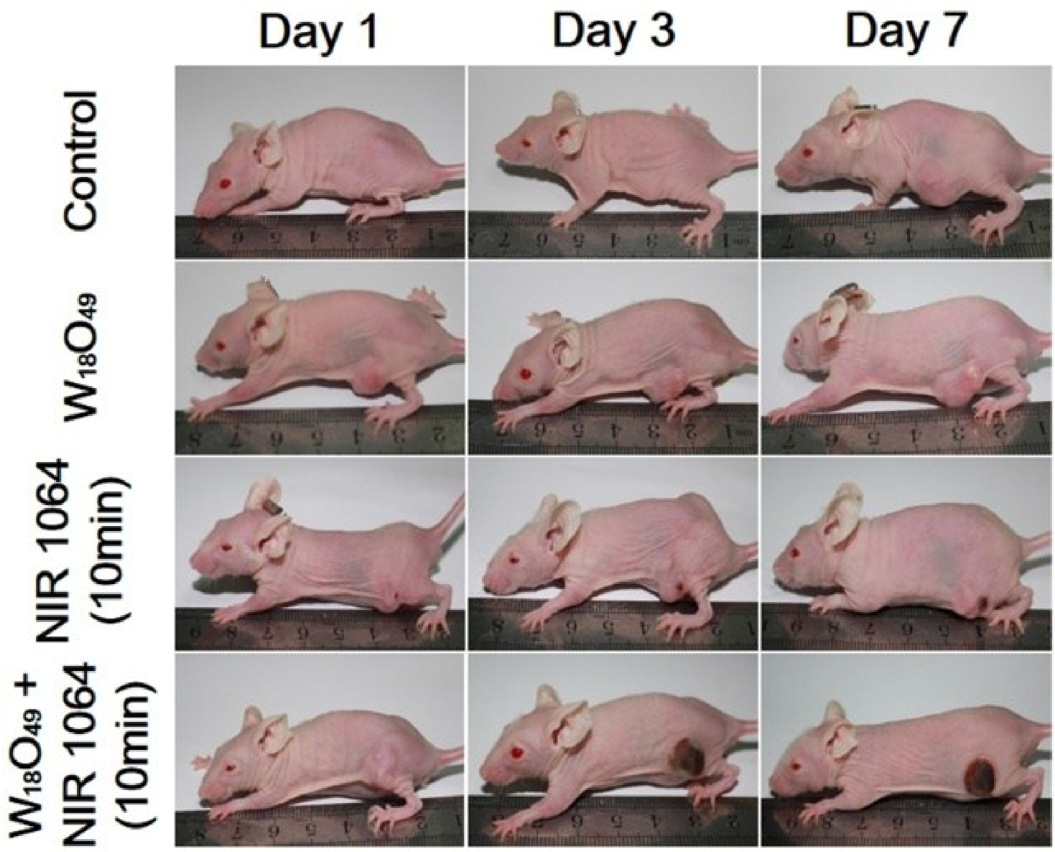

Figure S7 Representative photographs of mice taken before treatment (day 1), at day 3 and day 7 after various treatments.

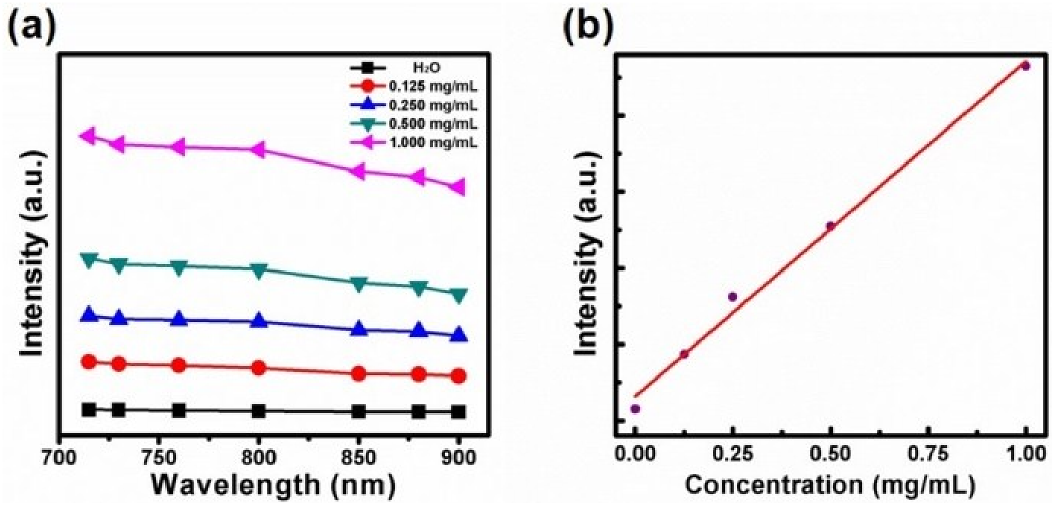

Figure S8 (a) PA signal of WOs solutions of various concentrations. (b) Plot of PA signal at 880 nm versus WOs concentrations.

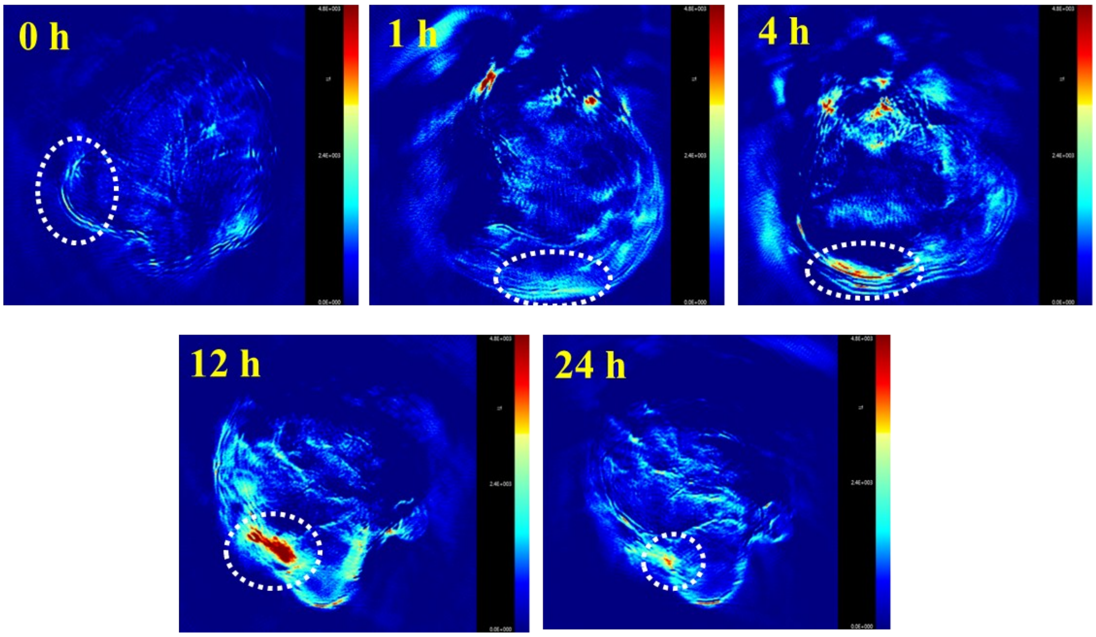

Figure S9 In vivo PA imaging of HeLa tumor-bearing mice before and after intravenous injection of WOs for varied time.