Supplementary Information

Stepwise photothermal therapy and chemotherapy by composite scaffolds of gold nanoparticles, BP nanosheets and gelatin immobilized with doxorubicin-loaded thermosensitive liposomes

Huajian Chen[a,b], Rui Sun[a,b], Tianjiao Zeng[a,b], Jing Zheng[a,b], Toru Yoshitomu[a], Naoki Kawazoea, Yingnan Yang[c], Guoping Chen[*a,b]

[a.] Research Center for Functional Materials, National Institute for Materials Science, 1-1 Namiki, Tsukuba, Ibaraki 305-0044, Japan.
[b.] Department of Materials Science and Engineering, Graduate School of Pure and Applied Sciences, University of Tsukuba, 1-1-1 Tennodai, Tsukuba, Ibaraki 305-8577, Japan
[c.] Graduate School of Life and Environmental Science, University of Tsukuba, 1-1-1 Tennodai, Tsukuba, Ibaraki 305-8572, Japan
* Corresponding author: Prof. Guoping Chen, E-mail: Guoping.CHEN@nims.go.jp; Tel: 81-29-860-4496, Fax: 81-29-860-4673

Heating-cooling curve and calculation of the photothermal conversion efficiency

A heating-cooling circulation of the Dox-lipo/BP/Au/Gel/PGA composite scaffolds during NIR laser irradiation for 10 min at an intensity of 1.6 W/cm^2 and the following cooling process was measured for calculation of the photothermal conversion efficiency. At first, the Dox-lipo/BP/Au/Gel/PGA composite scaffolds were cut into discs (Φ 6 mm × H 1 mm) and hydrated with 30 μL Milli-Q water. Then, the composite scaffold discs were irradiated by an 805 nm laser at an intensity of 1.6 W/cm^2 and the temperature of the scaffold discs was recorded by an electronic thermometer every 10 sec. After 10 min irradiation, the temperature of the scaffold discs reached a plateau and the laser was turned off. The scaffold discs were cooled down by the ambient atmosphere. During the cooling period, the temperature of the scaffold discs was also recorded every 10 sec until the temperature returned to the initial temperature. The linear fitting correlation curve of time and -ln(θ) was calculated based on the cooling curve of the composite scaffold discs. The value θ was calculated by dividing the temperature change at each time point by the maximum temperature change. The photothermal conversion efficiency (η) was calculated by using the following formulas [1]:

$$\eta = \frac{\mathrm{h}S(T_{max} - T_{surr}) - Q_{Dis}}{I(1 - 10^{-A_{850nm}})}$$

In this formula, h represents the heat transfer coefficient; S represents the surface area of the container; T_{max} represents the maximum temperature of the composite scaffolds after reaching the temperature plateau during NIR laser irradiation; T_{surr} represents the ambient environment temperature; Q_{Dis} represents the heat dissipated from the laser mediated by the solvent and container; *I* is the laser power and A_{805nm} represents the absorbance at 805 nm of the composite scaffolds in Milli-Q water.

$$hS = \frac{mC}{\tau_s}$$

In this formula, m represents the mass of the solution with materials; C represents the specific heat capacity of the solution; τ_s represents the associated time constant.

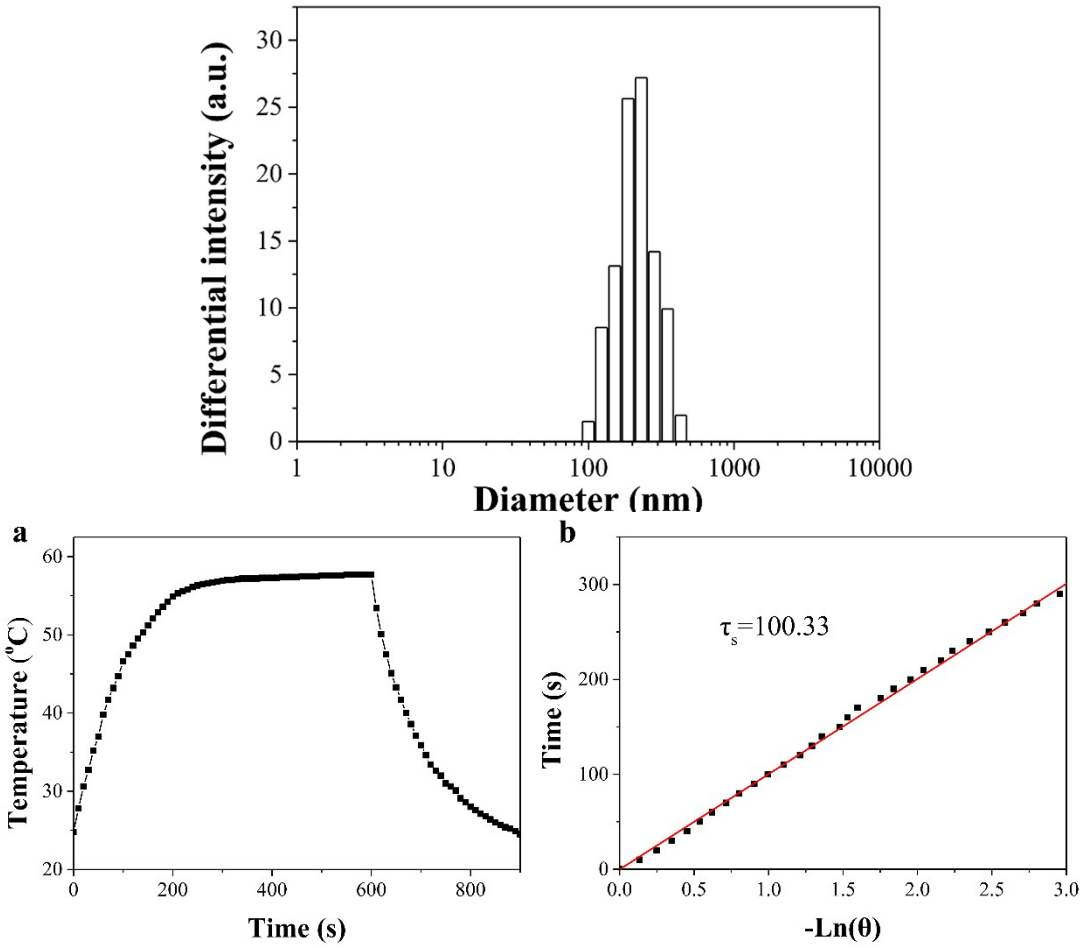

Figure S2 a) Photothermal heating-cooling curve of the Dox-lipo/BP/Au/Gel/PGA composite scaffold during NIR laser irradiation for 10 min at an intensity of 1.6 W/cm^2 and following cooling process. b) Linear fitting correlation curve of time and -ln(θ) according to the cooling period of the composite scaffolds after NIR laser irradiation.

Reference

1. J. Li, J. Wang, J. Zhang, T. Han, X. Hu, MMS. Lee, D. Wang, B. Tang, A Facile Strategy of Boosting Photothermal Conversion Efficiency through State Transformation for Cancer Therapy, Adv Mater, 2021, 33(51), e2105999.