Supplementary information:

Optimum morphology of gold nanorods for light-induced hyperthermia

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HEATING OF GOLD NANORODS UNDER DIFFERENT POWER AND DIFFERENT CONCENTRATIONS

Temperature behavior of suspension #2 (**Table 1**) was further studied under different experimental conditions: different laser powers (150 mW, 300 mW, 450 mW and 600 mW) with fixed AuNRs concentration (0.5 nM), and fixed laser power (300 mW) with different AuNRs concentrations (0.1 nM, 0.17 nM, 0.5 nM and 1 nM), at constant exposure time (10 min.).

When illuminating a AuNRs suspension, the time evolution of the temperature change as well as the maximum reached temperature depends on both laser power and molar concentration of the suspension[1]. In **Figure 5**, we plot the influence of these parameters for a 12 nm x 38 nm AuNRs suspension (sample #2 in **Table 1**). This behavior depended in a complex fashion on the experimental conditions as seen in **Figure S1**.

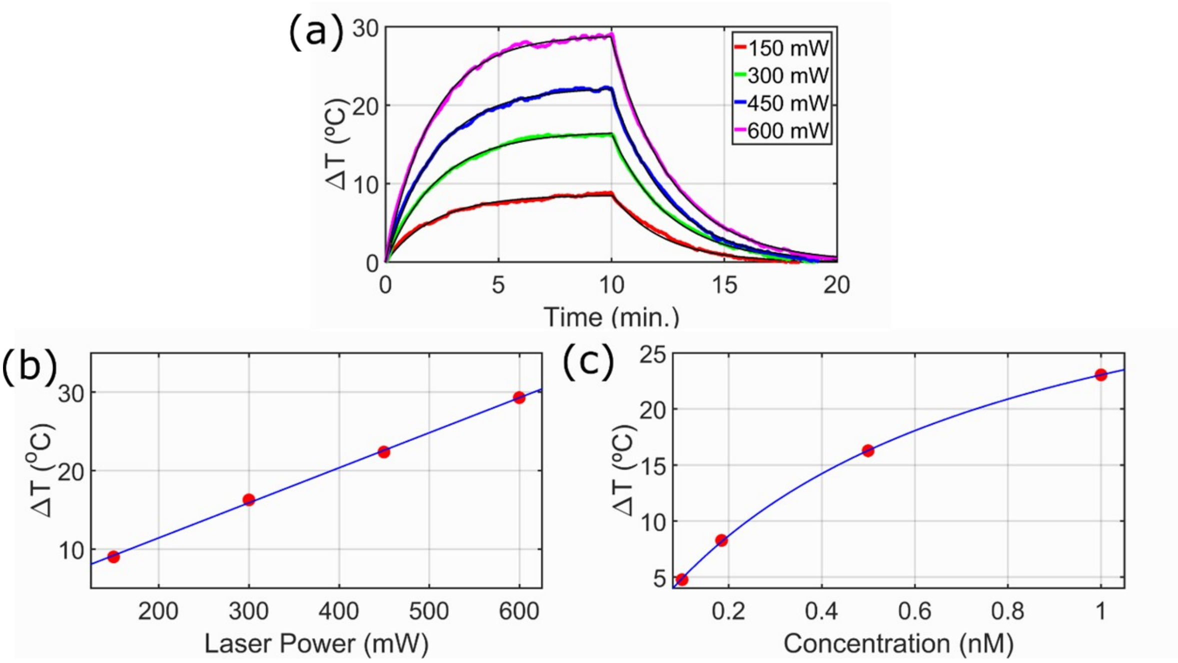

Figure S1. Temperature variation of a 12 nm x 38 nm AuNRs suspension (sample #2 in **Table 1**) upon illumination for different experimental conditions. (a) Temporal plots of the temperature variation of the AuNR suspension #2, respect to the initial temperature, illuminated with different laser powers. (b) Maximum temperature increase after ten minutes of laser light exposure on suspension #2 at different powers of the laser (150 mW, 300 mW, 450 mW and 600 mW), with a linear fitting with an intersection at $\Delta T=0$. (c) Maximum temperature increase after 10 minutes of laser light exposure on suspension #2 at different molar concentrations of each suspension, with a Michaelis–Menten kinetics fitting model as a function of the concentration.

While the maximum temperature reached after laser illumination, in **Figure S1(a)**, showed a linear behavior for increasing power of the laser, in **Figure S1(b)**, the maximum temperature for the same illumination condition increased with the suspension concentration following a Michaelis-Menten kinetics model, **Figure S1(c)**. This implies that the dependence of temperature on the laser irradiance as well as the time required to reach the equilibrium temperature have to be measured for each new sample. This said, the observed trends, such as linear relationship of irradiance and temperature or Michaelis-Menten kinetics model dependence of temperature on concentration, would generally always remain valid.

For general interest, the theoretical characteristic temperature equilibrium time could be easily calculated assuming 1 cm path length of the cuvette and $k = 1.43 \cdot 10^{-7}\ m^2s^{-1}$ the thermal diffusivity coefficient of water. This experimental time leads to be $\tau = R^2/k \sim 4$ min., close to the experimentally τ shown equilibrium time of the heated solution, in **Figure S1(a)**. This time mainly depends on both the size of the heating and the thermal diffusivity of the environment[2,3].

DIAMETER AND LENGTH DETERMINATION OF GOLD NANORODS

The dispersion size the AuNRs in the suspension were estimated to 15% by systematic transmission electron microscopy (TEM) images measurements of length and diameter on about a hundred of individual AuNRs for each solution. One representative histogram of particle number #9 in **Table 1** is shown as an example (**Figure S2**). Moreover, three TEM images of AuNRs from the group with fixed diameter but different aspect ratio (sample #2, #7 and #8 in **Table 1**) are included in **Figure S3**.

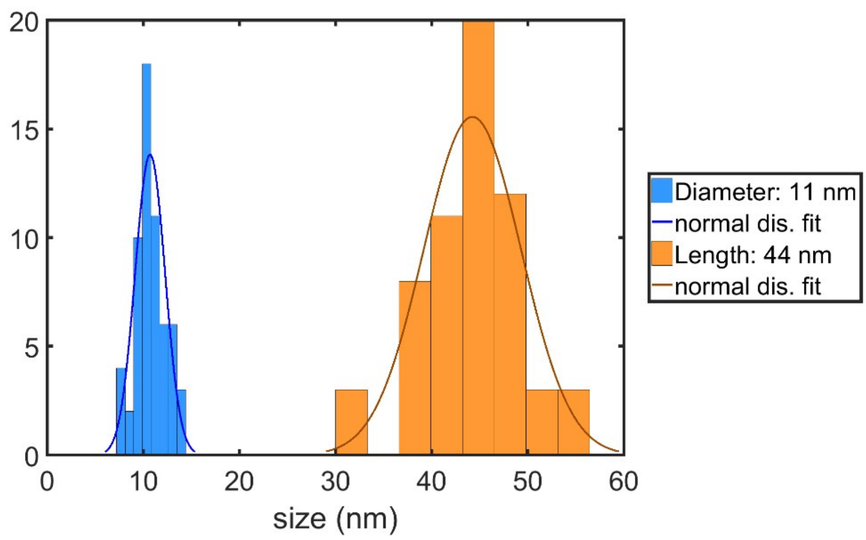

Figure S2. Histogram of diameter and length for solution number #9 in **Table 1**, measured by

TEM imaging. The solid line is the normal distribution fitting used to determine the mean values of their diameter (Diameter: 11 nm) and length (Length: 44 nm), respectively.

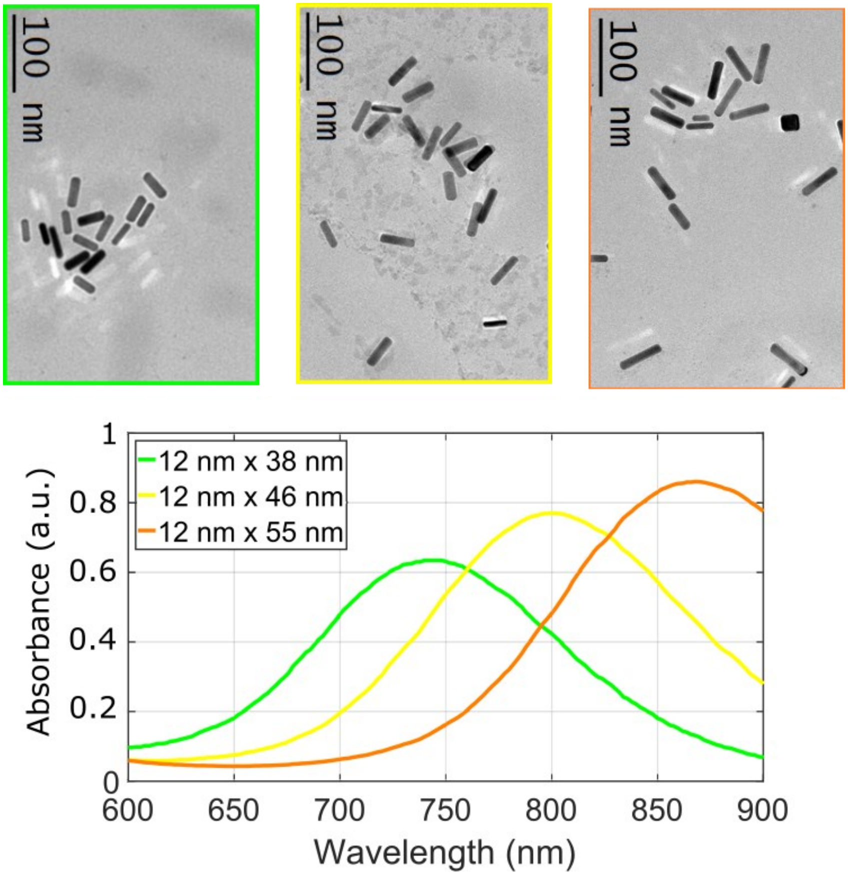

Figure S3. TEM images and absorbance spectrum of AuNRs number #2, #7 and #8 with 12-nm diameter and different aspect ratio. Scale bar is 100 nm.

BIBLIOGRAPHY

(1) Feng, W.; Chen, L.; Qin, M.; Zhou, X.; Zhang, Q.; Miao, Y.; Qiu, K.; Zhang, Y.; He, C. Flower-like PEGylated MoS2 Nanoflakes for near-Infrared Photothermal Cancer Therapy. *Sci. Rep.* **2015**, *5*, 17422.

(2) Donner, J. S.; Baffou, G.; McCloskey, D.; Quidant, R. Plasmon-Assisted Optofluidics. *ACS Nano* **2011**, *5*, 5457–5462.

(3) Baffou, G.; Quidant, R.; de Abajo, F. J. Nanoscale Control of Optical Heating in

Complex Plasmonic Systems. *ACS Nano* **2010**, *4*, 709–716.