Supporting Information

Tumor Microenvironment - responsive Polydopamine-based Core /shell Nanoplatform for Synergetic Theranostics

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1. Results and Discussion

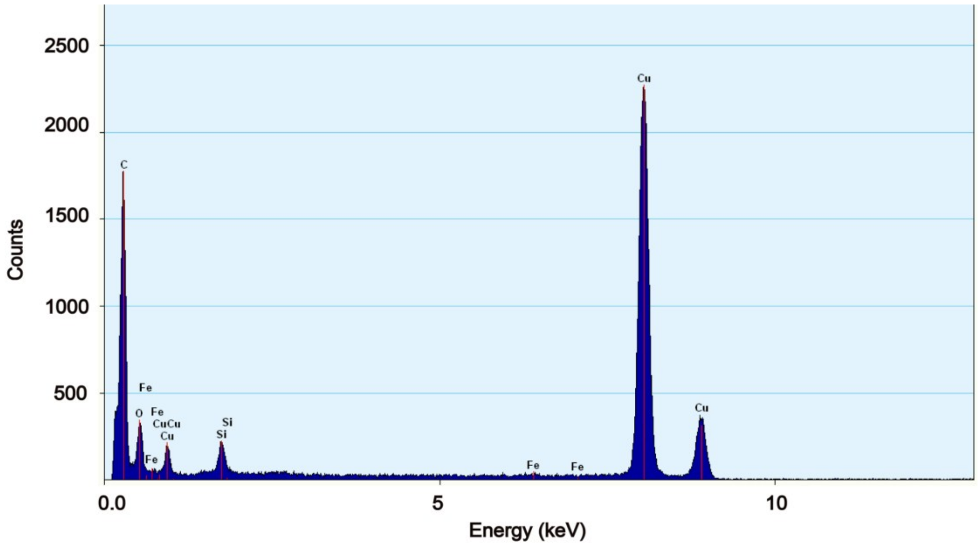

Figure S1. EDS result of PDA@TA-Fe.

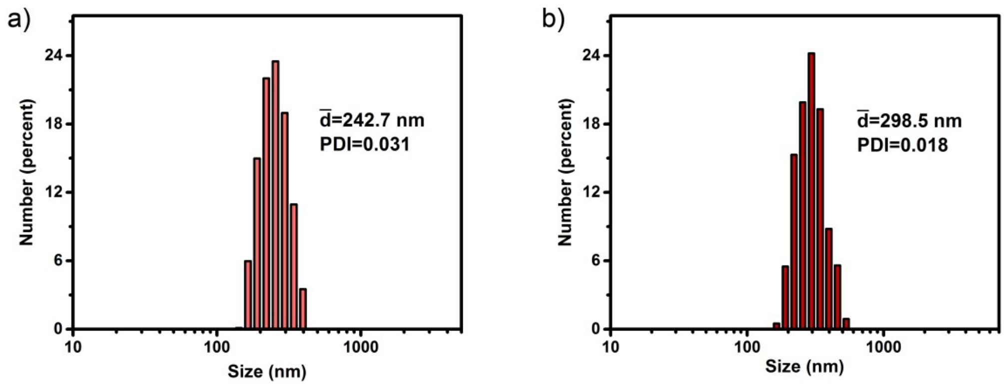

Figure S2. Hydrodynamic size distribution of PDA a) and PDA@TA-Fe b).

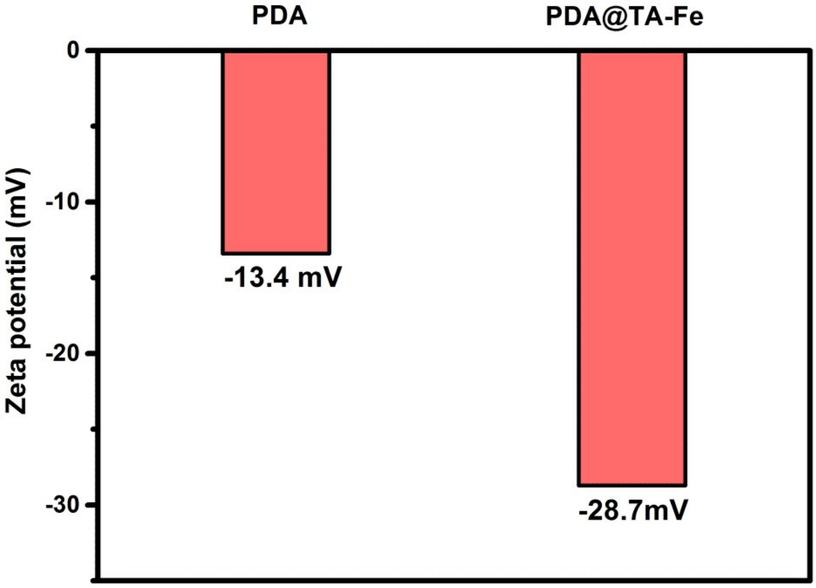

Figure S3. Average ξ-potential of PDA and PDA@TA-Fe.

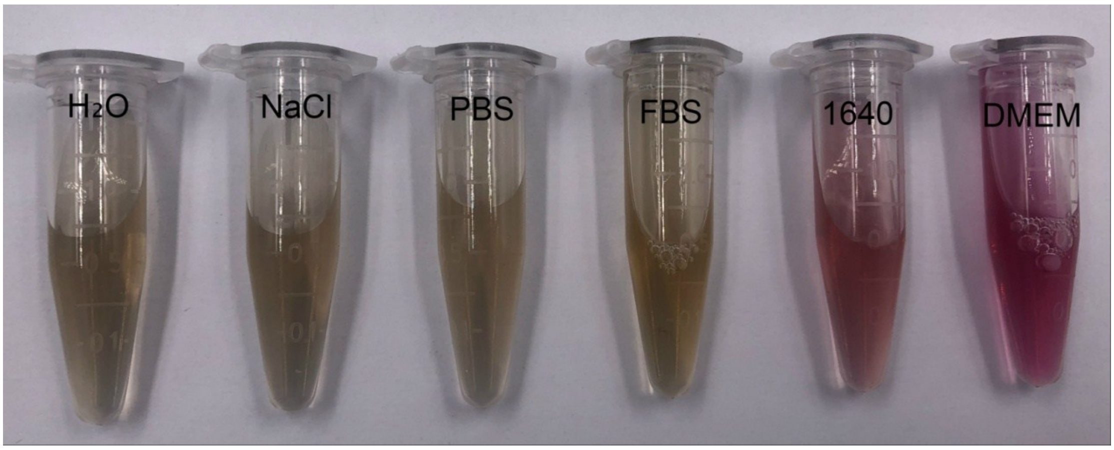

Figure S4. Solution stability of PDA@TA-Fe.

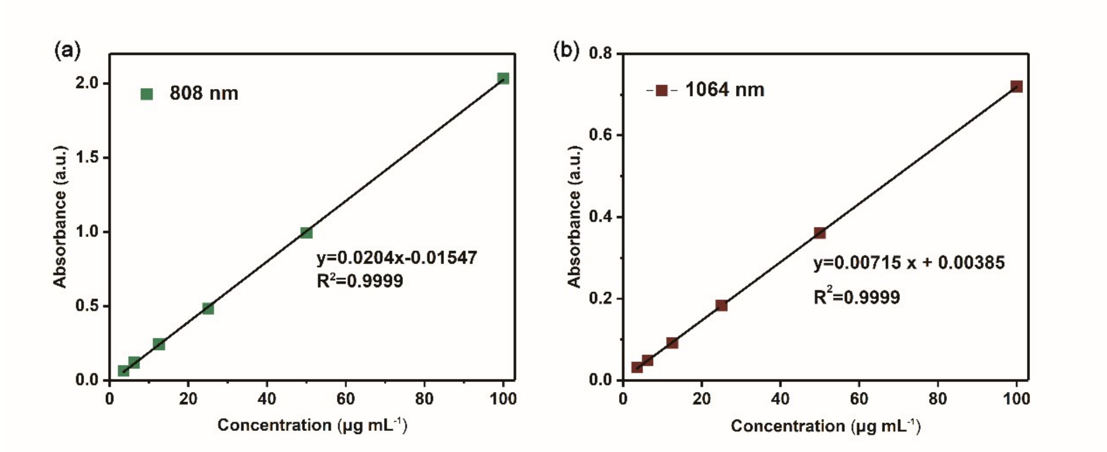

Figure S5. The linear fitting of the absorbance at 808 nm a) and 1064 nm b) versus concentration.

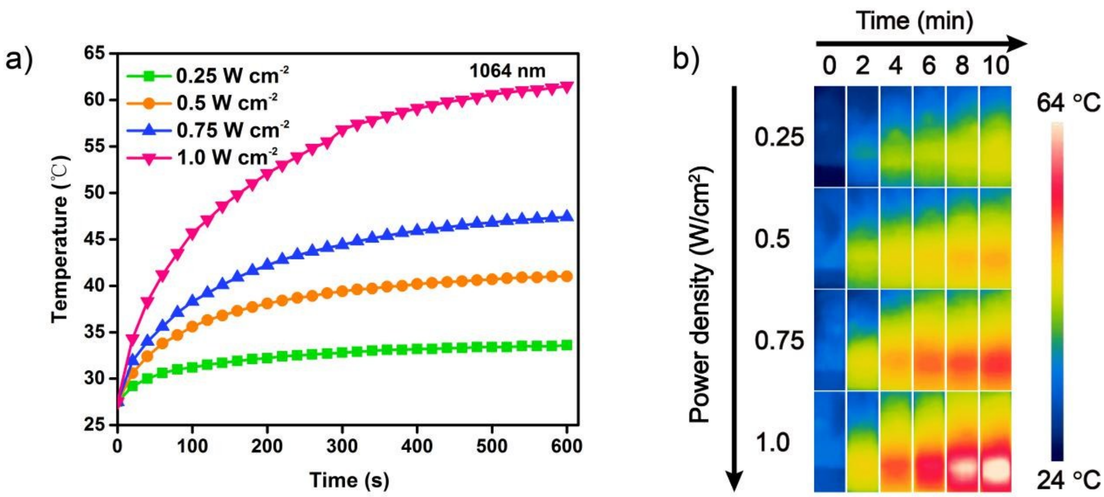

Figure S6. a) The photothermal heating curves of different laser power under a 1064 nm laser. b) The infrared thermal images of different PDA@TA-Fe concentrations.

Calculation of photothermal conversion efficiency of PDA@TA-Fe

The photothermal conversion efficiency (η) of PDA@TA-Fe was calculated according to the following equations:

$$\sum_i m_i C_{p,i} \frac{dT}{dt} = Q_{in,np} + Q_{in,surr} - Q_{out} \qquad (1)$$

where m represents the mass of solvent (water) and cuvette, C_p is the heat capacity of solvent (water) and cuvette, T is the solution temperature. $Q_{in,np}$ is the photothermal energy input from the PDA@TA-Fe. $Q_{in,surr}$ is the heat absorbed by the solvent (water), which was measured independently to be 25.1mW. Q_{out} is the heat lost to the surroundings.

$$Q_{in,np} = I\,(1-10^{(-A_{808/1064})})\eta \qquad (2)$$

where I is laser power. $A_{808/1064}$ is the absorbance of PDA@TA-Fe at the excitation wavelength of 808 nm or 1064 nm.

$$Q_{out} = hA(T-T_{surr}) \qquad (3)$$

where h is the heat transfer coefficient, A represents the surface area of the container. T_{surr} is the surrounding temperature.

When the system temperature rises to a maximum steady-state, the rate of heat input is equal to the rate of heat lost to the surrounding.

$$Q_{in,np} + Q_{in,surr} = Q_{out} = hA(T_{max}-T_{surr}) = I\,(1-10^{(-A_{808/1064})})\eta + Q_{in,surr} \qquad (4)$$

Rearranging eq(4) :

$$\eta = \frac{hA\,(T_{max} - T_{surr}) - Q_{in,surr}}{I\,(1-10^{-(A_{808/1064})})} \qquad (5)$$

In equal (5), only hA is unknown for calculating η.

In order to get the hA, θ as a dimensionless driving force temperature is introduced:

$$\theta = \frac{T - T_{surr}}{T_{max} - T_{surr}} \qquad (6)$$

In the absence of any laser excitation, eq (1) becomes

$$\sum_i m_i C_{p,i} \frac{dT}{dt} = -Q_{out} = -hA(T - Tsurr) \qquad (7)$$

τ_s is introduced as a sample system constant:

$$\tau_s = -\frac{\sum_i m_i C_{p,i}}{hA} \qquad (8)$$

Integrating eq (6), (7) and (8):

$$t = -\frac{\sum_i m_i C_{p,i}}{hA} \ln\theta \qquad (9)$$

After irradiation by 808 nm laser for 10 min, the τ_s of PDA@TA-Fe was 293.88.

hA = ($\Sigma m_i C_{p,i}$) ， τ_s= 18.26 mW ° C^{-1}

Q_{dis} = hA ´ ($T(H_2O)_{max}$ - T_{surr}) = 67.56 mW

η = [hA ´ (T_{max} - T_{surr}) - Q_{dis}] ， [I ´ (1 - 10^{-A808})] ´ 100%= 29%

After irradiation by 1064 nm laser for 10 min, the τ_s of PDA@TA-Fe was 370.57.

hA = ($\Sigma m_i C_{p,i}$) ÷ τ_s= 15.91 mW °C^{-1}

Q_{dis} = hA × ($T(H_2O)_{max}$ - T_{surr}) = 63.64 mW

η = [hA × (T_{max} - T_{surr}) - Q_{dis}] ÷ [I × (1 - 10^{-A1064})] × 100% = 41%

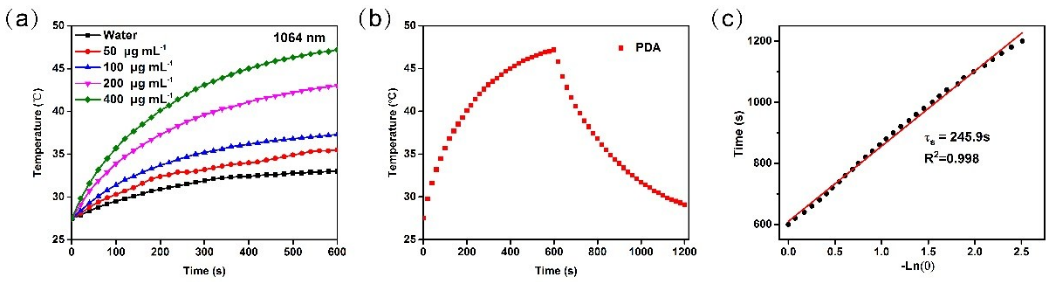

Fig S7. a) The photothermal heating curves of different PDA concentrations under a 1064 nm laser (1.0 W cm^{-2}). b) The PDA solution was irradiated by a 1064 nm laser for 10 min, followed by turning off the laser for 10 min. c) Linear time data is plotted *versus* -lnθ obtained from a cooling stage.

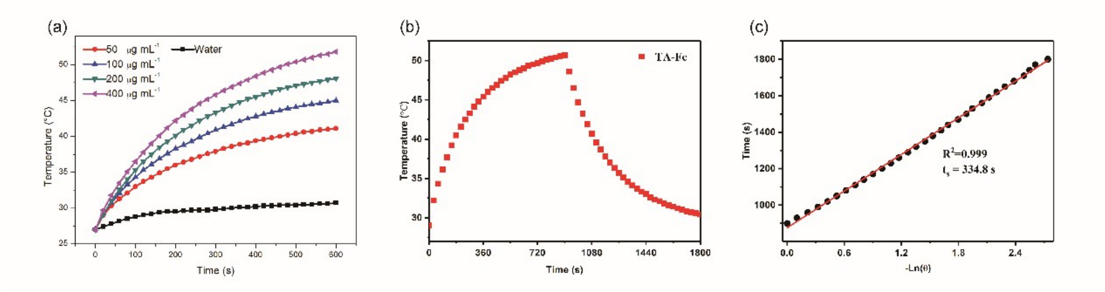

Fig S8. a) The photothermal heating curves of different TA-Fe concentrations under a 1064 nm laser (1.0 W cm^{-2}). b) The TA-Fe solution was irradiated by a 1064 nm laser for 15 min, followed by turning off the laser for 15 min. c) Linear time data is plotted *versus* -lnθ obtained from a cooling stage.

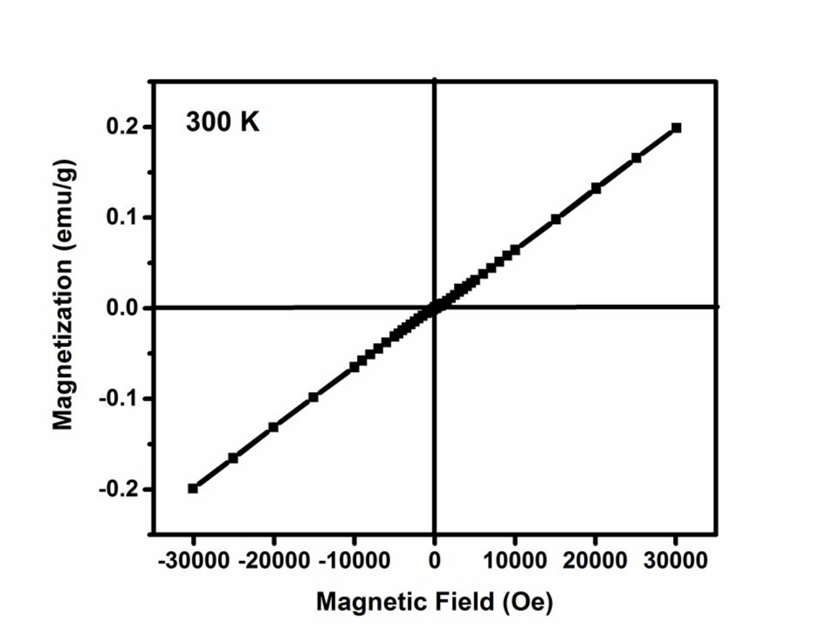

Fig S9. Magnetic hysteresis loop of the PDA@TA-Fe.

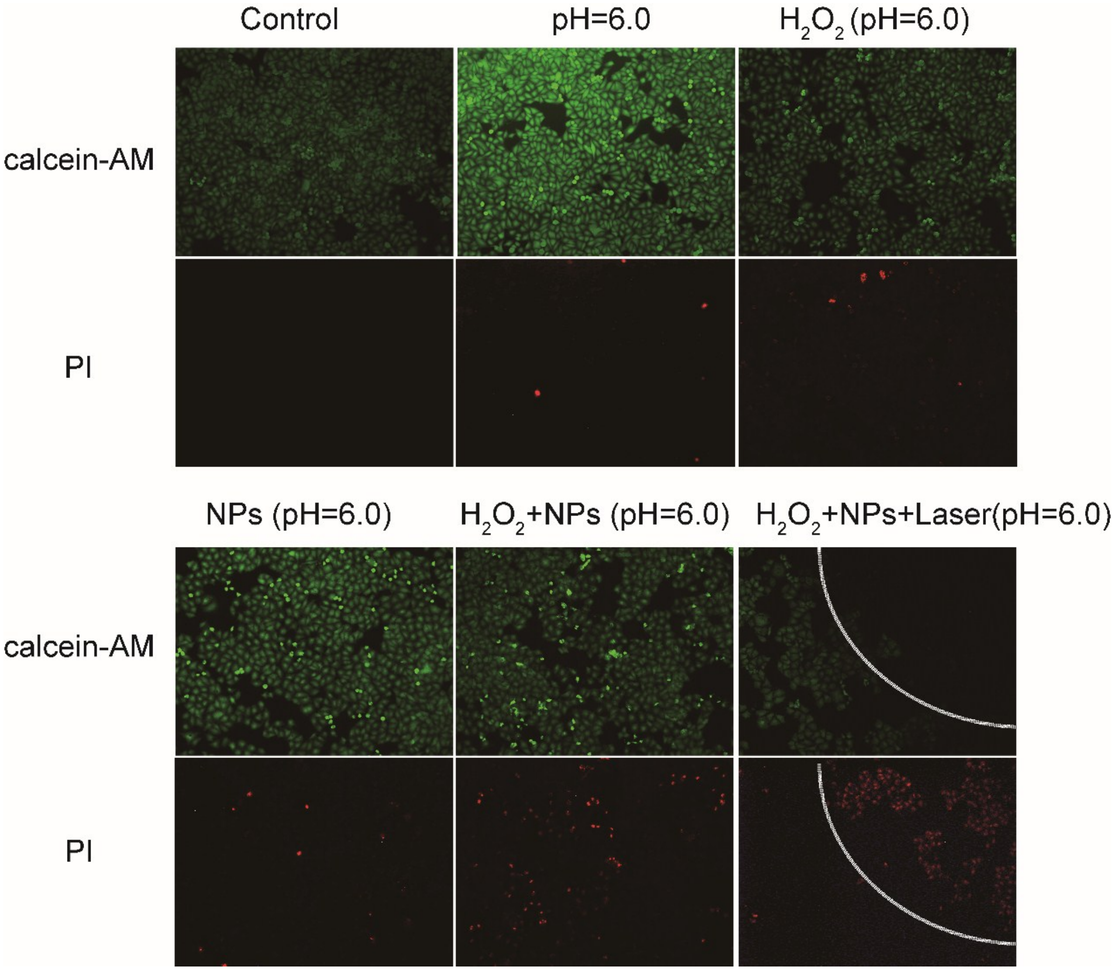

Figure S10. The optical microscopy images of HeLa cells after different treatments (co-stained with PI and calcein-AM).

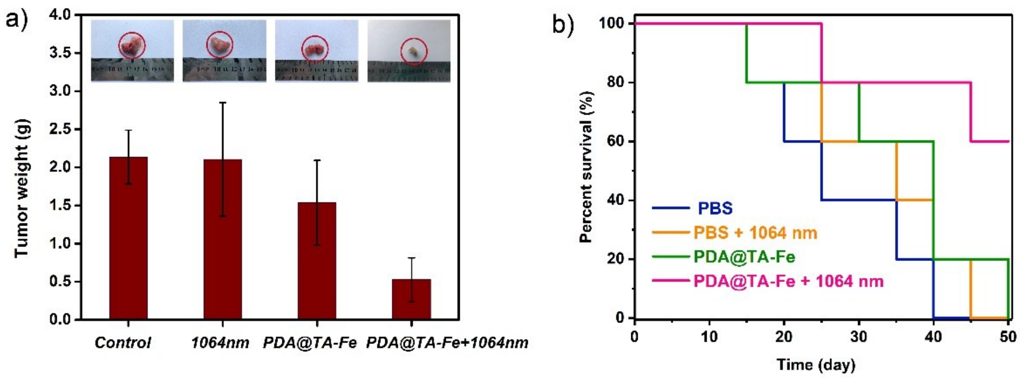

Figure S11. a) The tumor weight after various treatments. The picture on the top is tumors extracted from the different treatment groups. b) survival rates of the mice after treatment.

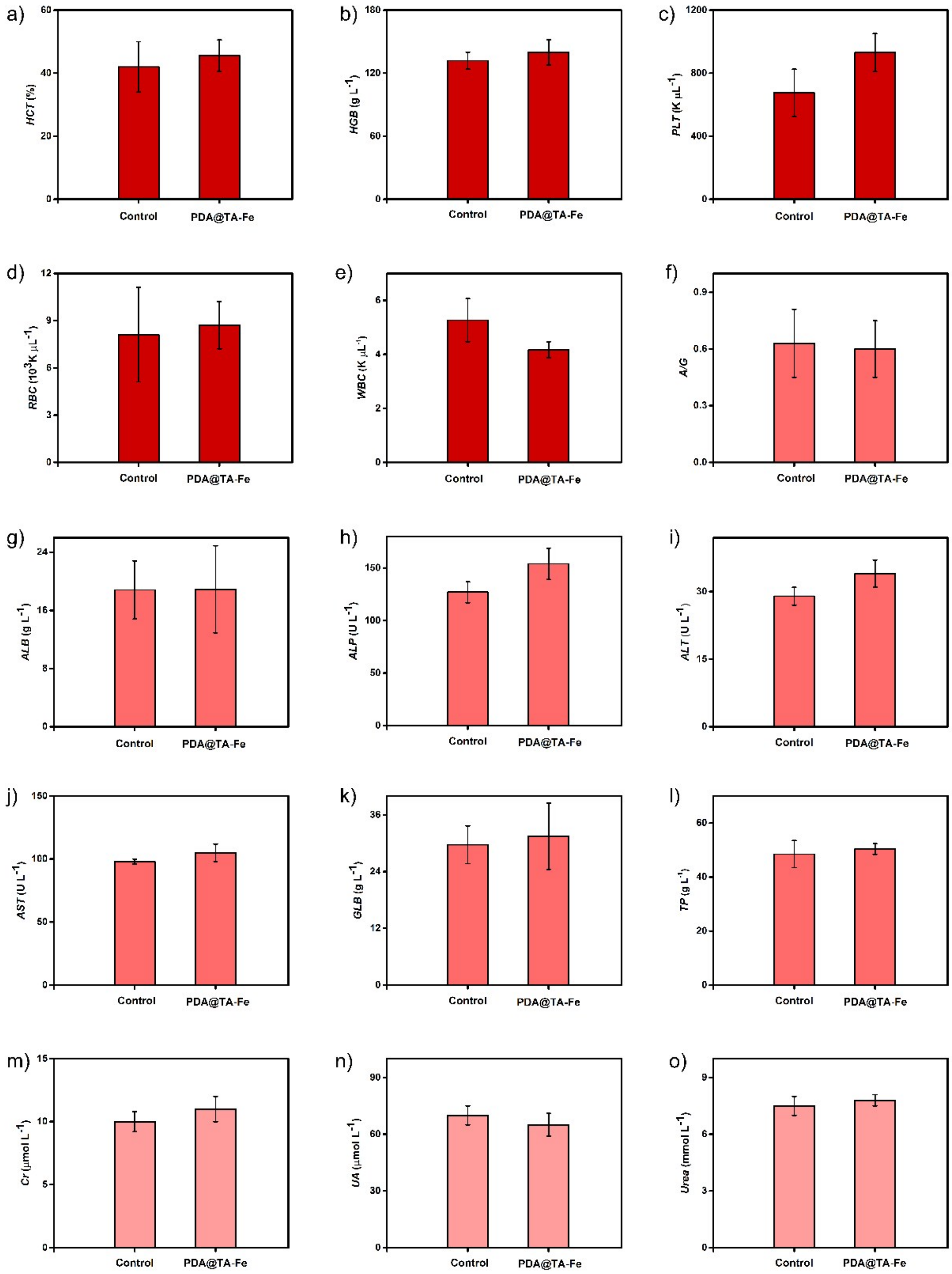

Fig S12. Blood analysis. (a–e) Hematology analysis and (f–o) serum biochemistry detection after intravenous injection of PDA@TA-Fe at 30 d.