Surface engineered vanadium nitride nanosheets for imaging-guided photothermal/photodynamic platform of cancer treatment

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Experimental

Calculation of the photothermal conversion efficiency

The photothermal conversion efficiency ($\eta$) of VNPBs nanosheets was calculated according to the established method.

$$\eta = \frac{hA(T_{\text{max}} - T_{\text{surr}}) - Q_{\text{dis}}}{I(1 - 10^{-\lambda A})}$$  
\text{Equation S1}

In the Equation S1, $T_{\text{max}}$ and $T_{\text{surr}}$ are the equilibrium and ambient temperature, respectively. $h$ is the heat transfer coefficient, $A$ is the surface area of the quartz tube, $Q_{\text{dis}}$ represents heat dissipation from the sample dispersion in quartz cell to the surroundings, $I$ is power of incident laser, $A_\lambda$ is the absorbance of VNPBs solution at 1064 nm. Thus, only the $hA$ remains unknown.

To obtain $hA$, it introduced a dimensionless driving force temperature ($\theta$). The cooling time $t$ and $\theta$ abide by the following Equation S2 and S3 at the cooling stage of VNPBs solution. Hence, time constant ($\tau_s$) for heat transfer could be determined and the value of $hA$ is obtained according to Equation S4.

$$\theta = \frac{T - T_{\text{surr}}}{T_{\text{max}} - T_{\text{surr}}}$$  
\text{Equation S2}

$$t = -\tau_s \ln(\theta)$$  
\text{Equation S3}

$$hA = \frac{\sum mD C D}{\tau_s}$$  
\text{Equation S4}

Where $m_D$ is the mass of water and $C_D$ means the heat capacity of water.
Fig. S1 Zeta potentials of VN, VNPs, VNPBs nanosheets.

Fig. S2 Photographs of VNPBs nanosheets dispersed in deionized water, DMEM, PBS and FBS, respectively.
**Fig. S3** Plot of temperature change ($\Delta T$) versus the different concentrations of VNPBs nanosheets during the period of 10 min irradiation.

**Fig. S4** Absorption spectra of DPBF in deionized water and VNPBs nanosheets with/without Vc after various irradiation times.
**Fig. S5** ESR spectra of VNPBs nanosheets with TEMP probes under 10 min irradiation.

**Fig. S6** Detection for mitochondrial membrane potential after different treatments by JC-1 staining. (Scale bar = 100 μm.)
Fig. S7 Variation of relative body weight of mice after different treatments during 14 days.

Fig. S8 The hematological analyse for different treatment groups of mice at 14\textsuperscript{th} day.