Supplementary Material

NIR-II femtosecond laser ignites MXene as photoacoustic bombs for continuous high-precision tumor blasting

Jie Mi[a,b], Dandan Cui[a,b], Zhenhui Zhang[a,b], Gen Mu[a,b], Yujiao Shi*[a,b]

[a] MOE Key Laboratory of Laser Life Science & Institute of Laser Life Science, College of Biophotonics, South China Normal University, Guangzhou 510631, China

[b] Guangdong Provincial Key Laboratory of Laser Life Science, College of Biophotonics, South China Normal University, Guangzhou 510631, China

✉ **Corresponding author:** Yujiao Shi, shiyuj@scnu.edu.cn

Other co-authors' Emails: Jie Mi, Email: mijie423125@163.com; Dan dan Cui, Email: qazasdeszplm@163.com; Zhenhui Zhang, Email: zhangbeioo@126.com; Gen Mu, Email: morgan_phy@163.com.

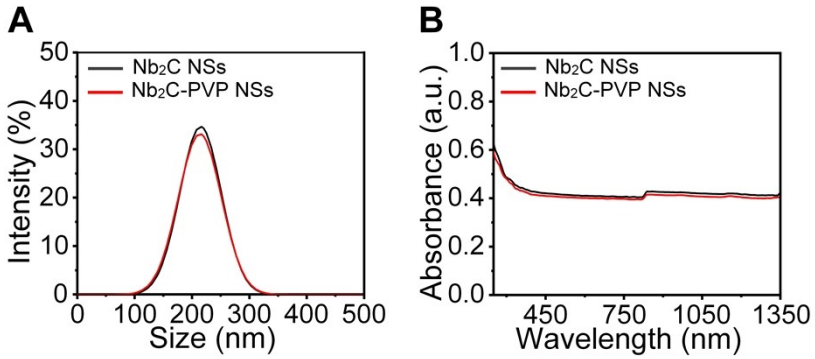

Figure S1. **A)** Particle size of Nb_2C NSs and Nb_2C-PVP NSs dispersed in water. **B)** UV-vis-NIR spectra of Nb_2C NSs and Nb_2C-PVP NSs dispersed in water.

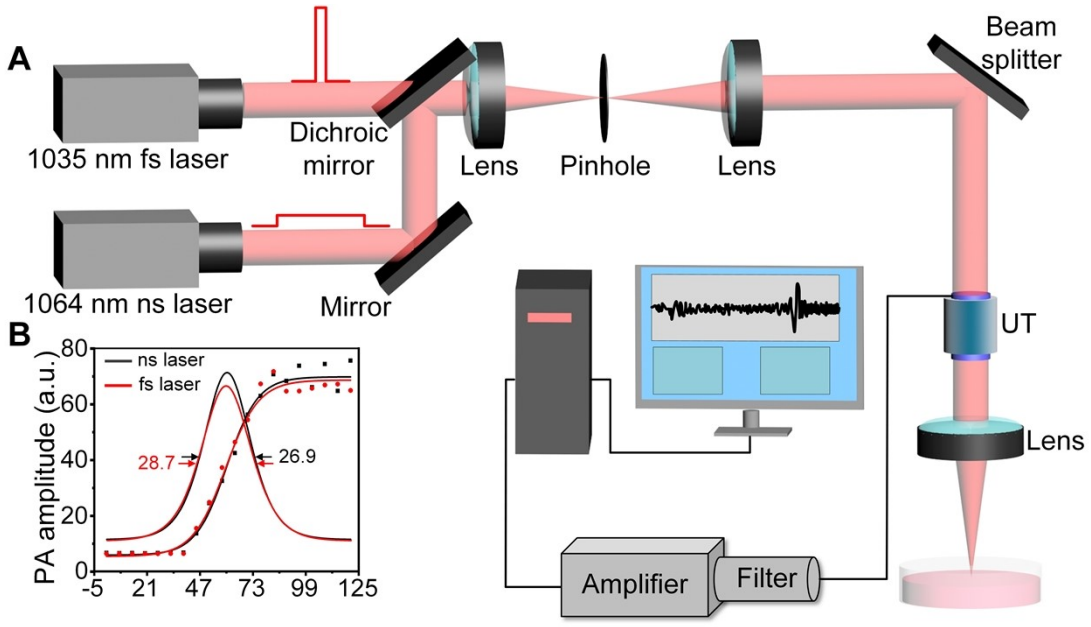

Figure S2. Schematic diagram of the experimental system. **A)** A 500 fs pulsed laser is used as the excitation source of ultrafast PA cavitation, and a 10 ns pulsed laser is used as comparison study. UT: Ultrasonic transducer. **B)** The lateral resolution of the system.

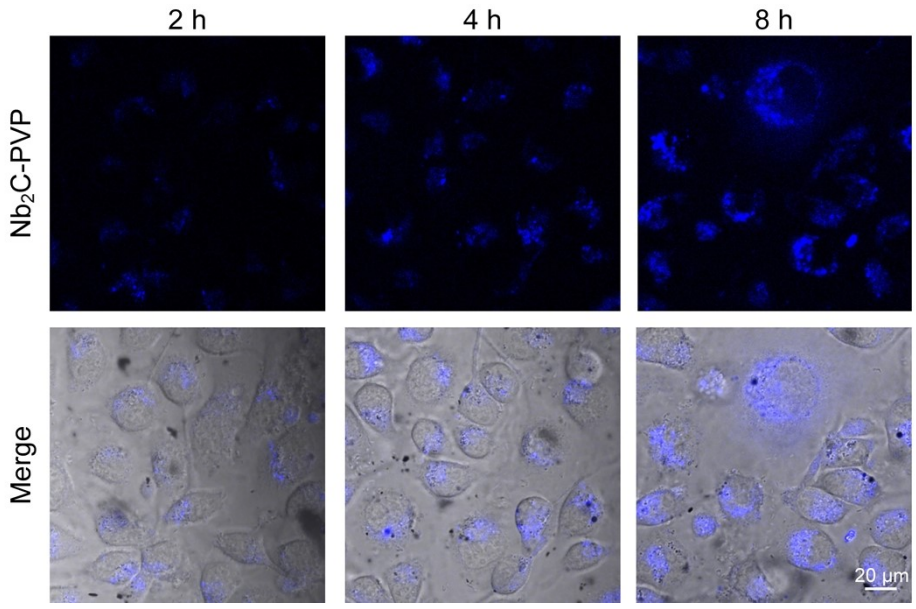

Figure S3. CLSM imaging of EMT6 cells upon incubation with Nb_2C-PVP NSs for different durations (2h, 4h and 8h).

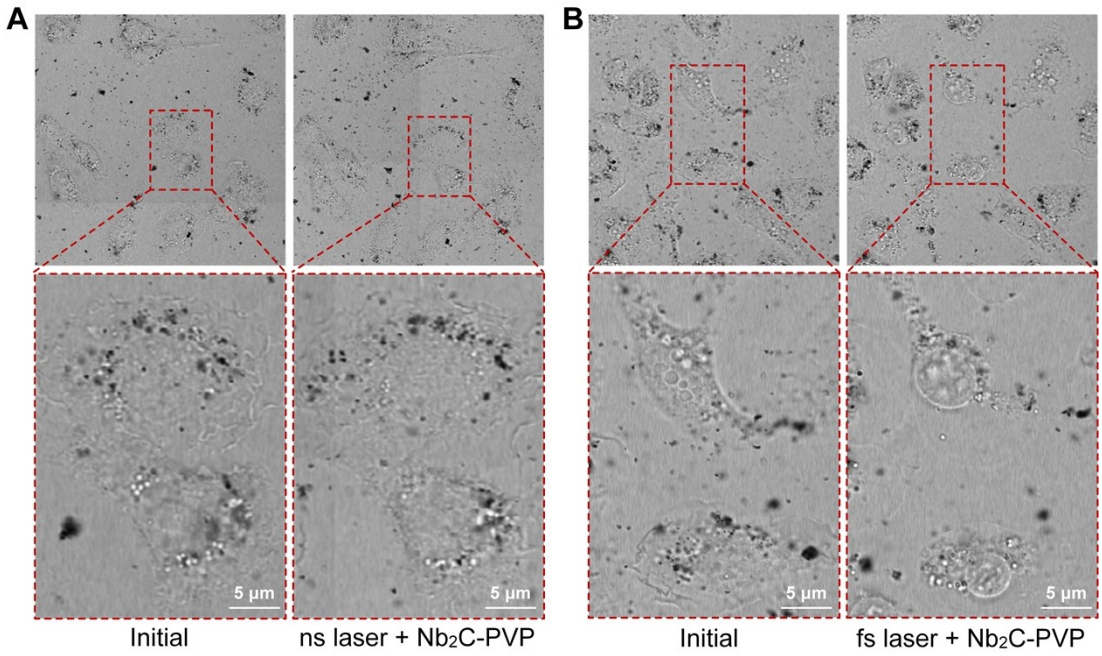

Figure S4. Confocal brightfield images of EMT6 cells co-incubated with Nb_2C-PVP NSs before and after **A)** ns laser or **B)** fs laser irradiation under the same energy density, respectively.

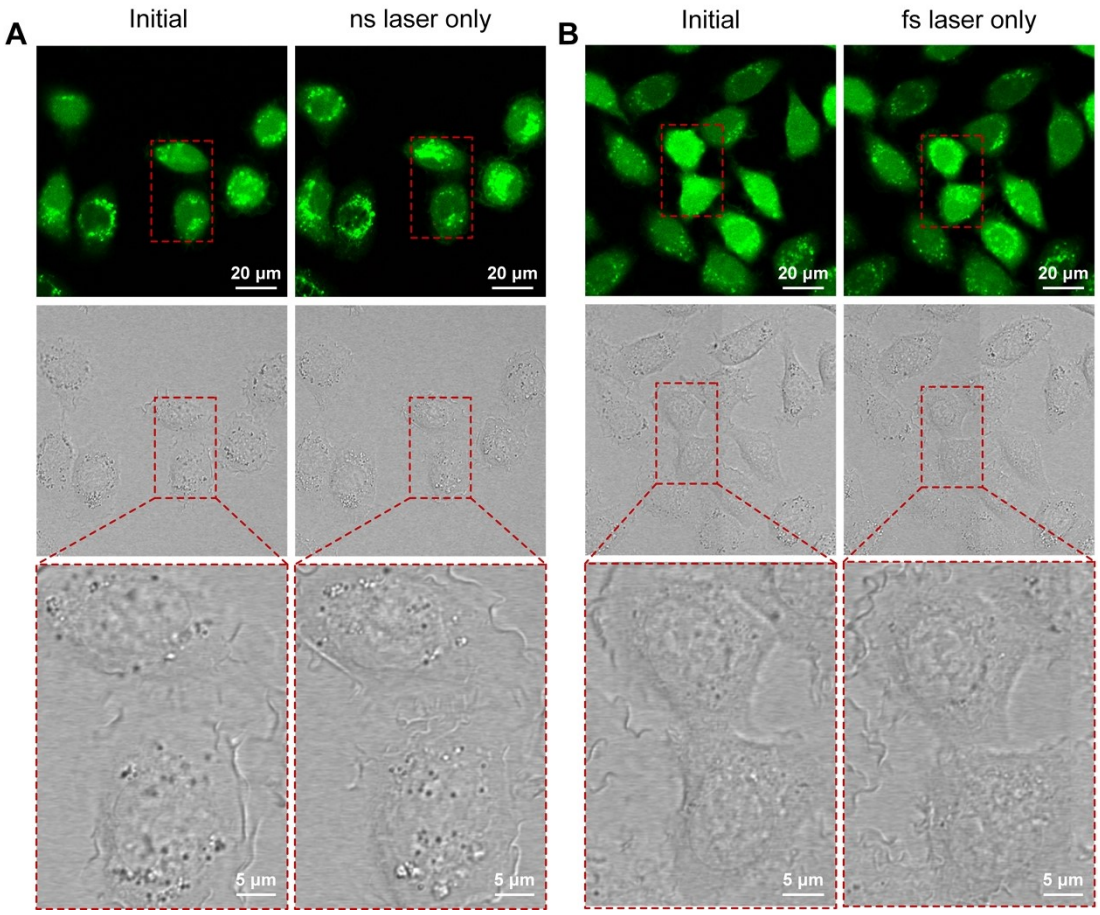

Figure S5. Morphological changes of EMT6 cells co-incubated without Nb_2C-PVP NSs before and after **A)** ns laser or **B)** fs laser irradiation under the same energy density, respectively.

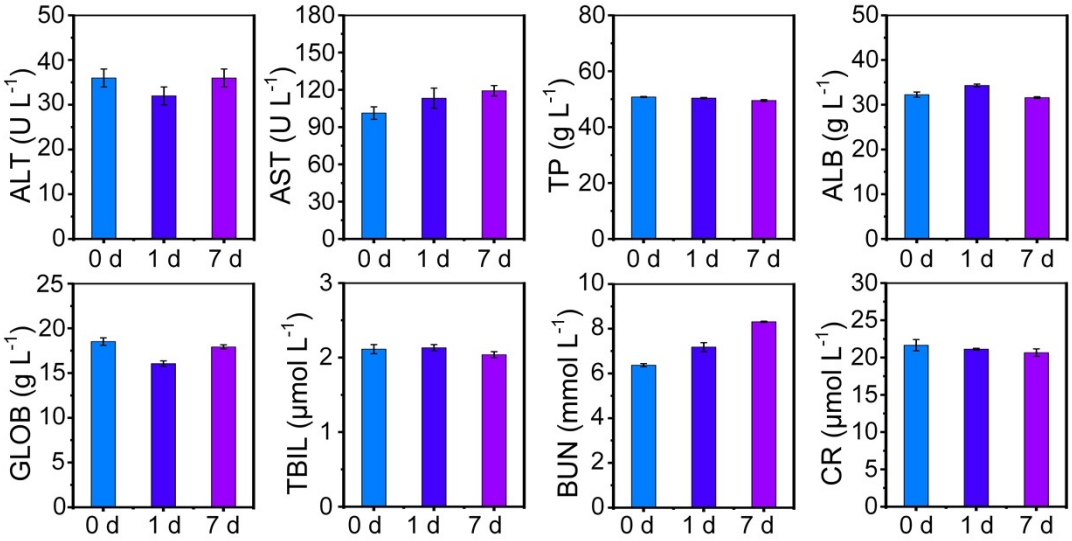

Figure S6. Blood biochemical analyses of healthy nude mice after intravenous injection with PBS and Nb_2C-PVP NSs for 1 and 7days, respectively. The terms are following: alanine transaminase (ALT), aspartate transaminase (AST), total protein (TP), albumin (ALB), globulin (GLOB), total bilirubin (TBIL), blood urea nitrogen (BUN), creatinine (CR).

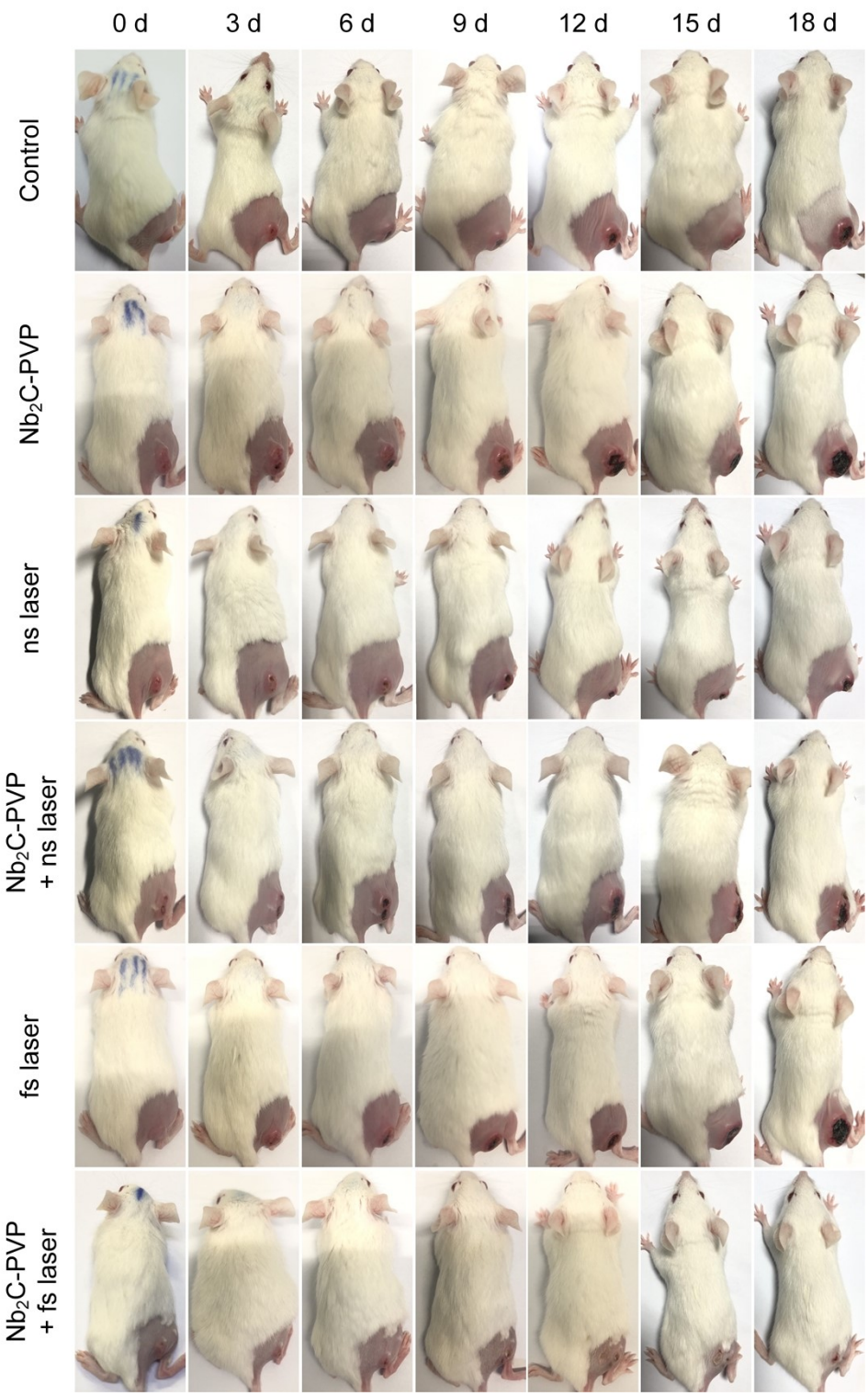

Figure S7. Photographs of EMT6 tumor-bearing mice after the control and different treatments in 18 days' period.

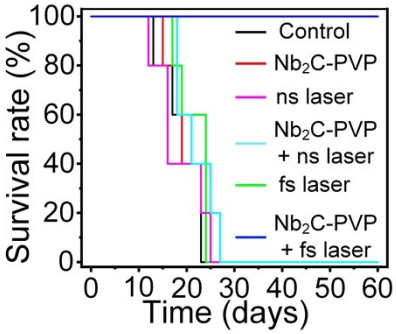

Figure S8. Survival rates of the EMT6 tumor-bearing mice within the feeding period.

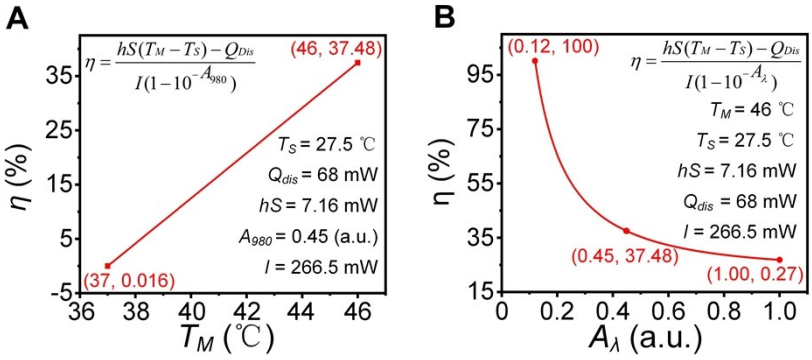

Figure S9. The curve of photothermal conversion efficiency (η) change with **A)** T_M or **B)** A_λ.

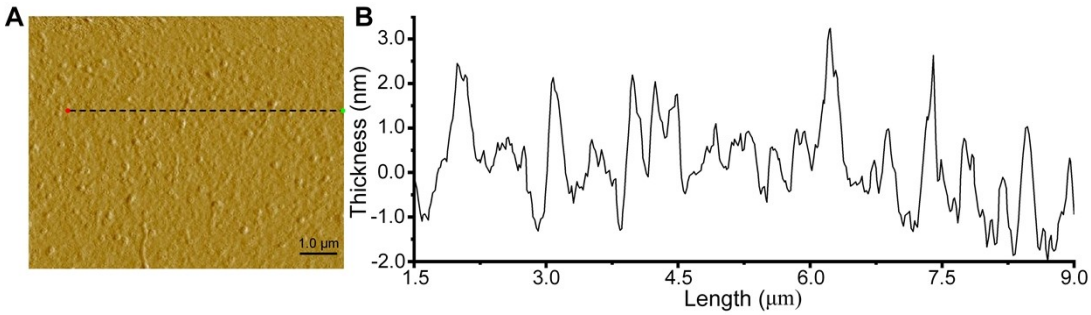

Figure S10. **A)** AFM image of Nb_2C NSs. **B)** Thickness distribution analysis of Nb_2C NSs.

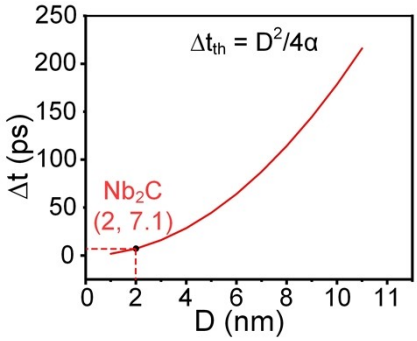

Figure S11. The simulated line of thermal confinement time changing with laser pulse width.

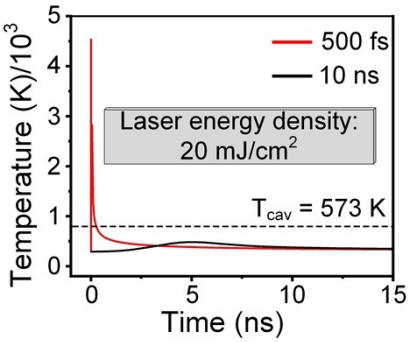

Figure S12. FEA Simulation line of lattice temperature rise of Nb_2C under the irradiation of femtosecond laser and nanosecond laser with the same single pulse energy density.

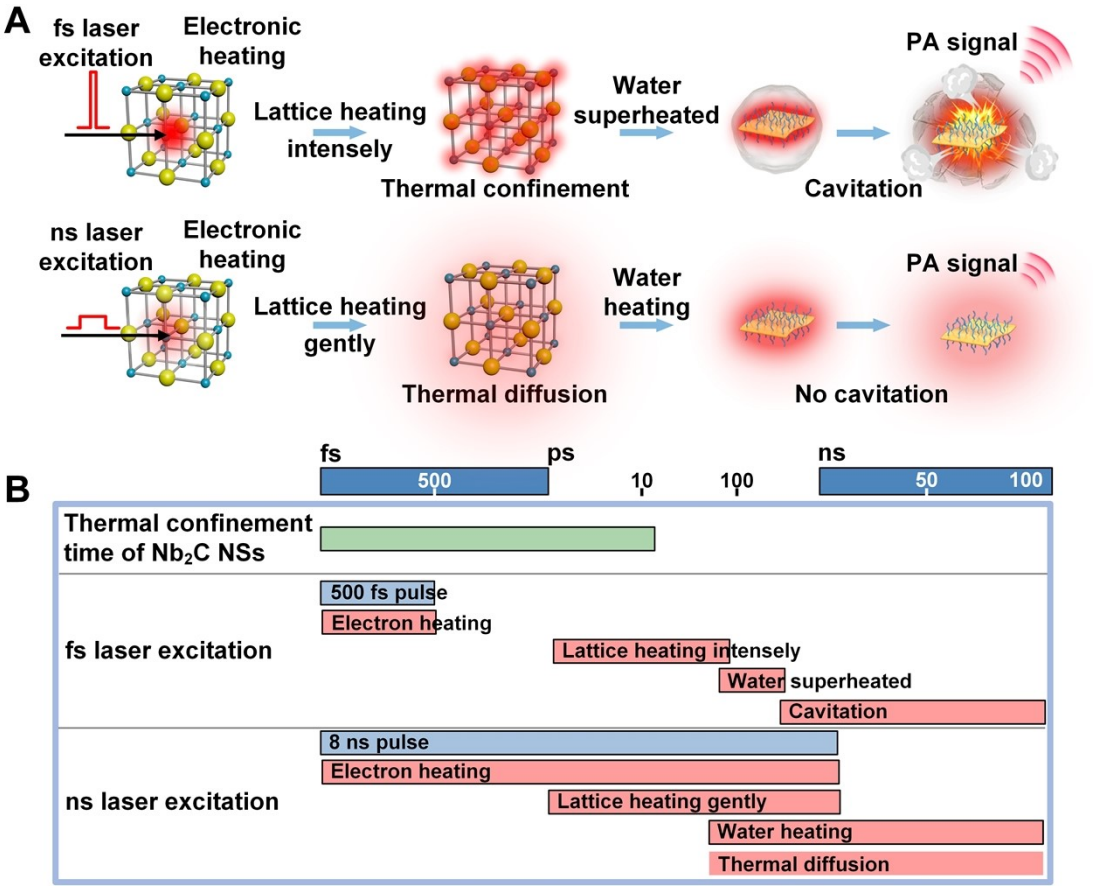

Figure S13. A) Schematic illustration of different physical mechanisms generated by fs and ns lasers irradiation with the same single pulse energy density. **B)** The related physical process and their timescales of fs and ns lasers.

Table S1 Parameters used for air water and Nb_2C.

Symbol	Parameter	Values	Symbol	Parameter	Values
μ_0 (Air)	relative permeability	1	ρ (H_2O)	density	1×10^3 kg/m^3
ε_0 (Air)	the permittivity	1	σ (H_2O)	conductivity	5.5 μS/m
α (H_2O)	thermal diffusivity	1.4×10^{-3} cm^2/s	k (Nb_2C)	thermal conductivity	14 W/(m•k)
Δt_{th}	thermal confinement time	0.40 ns	α (Nb_2C)	thermal expansivity	6.65×10^{-6} 1/k
k (H_2O)	thermal conductivity	0.58 W/(m•k)	C_p (Nb_2C)	heat capacity	185.8 J/(kg•k)
α (H_2O)	thermal expansivity	70×10^{-6} 1/k	ρ (Nb_2C)	density	7.85×10^3 kg/m^3
C_p (H_2O)	heat capacity	4.2×10^3 J/(kg•k)			