Supporting information

Orthogonal light-triggered multiple effects based on photochromic nanoparticles for DNA cleavage and beyond

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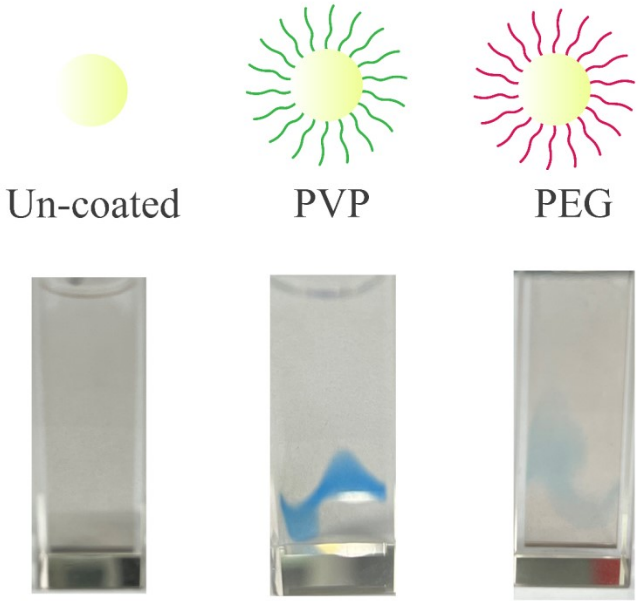

Figure S1. Photographs show the photochromic behaviors of WO_3 with different protective agents. Irradiation with 0.15 W 405 nm light for 1 min.

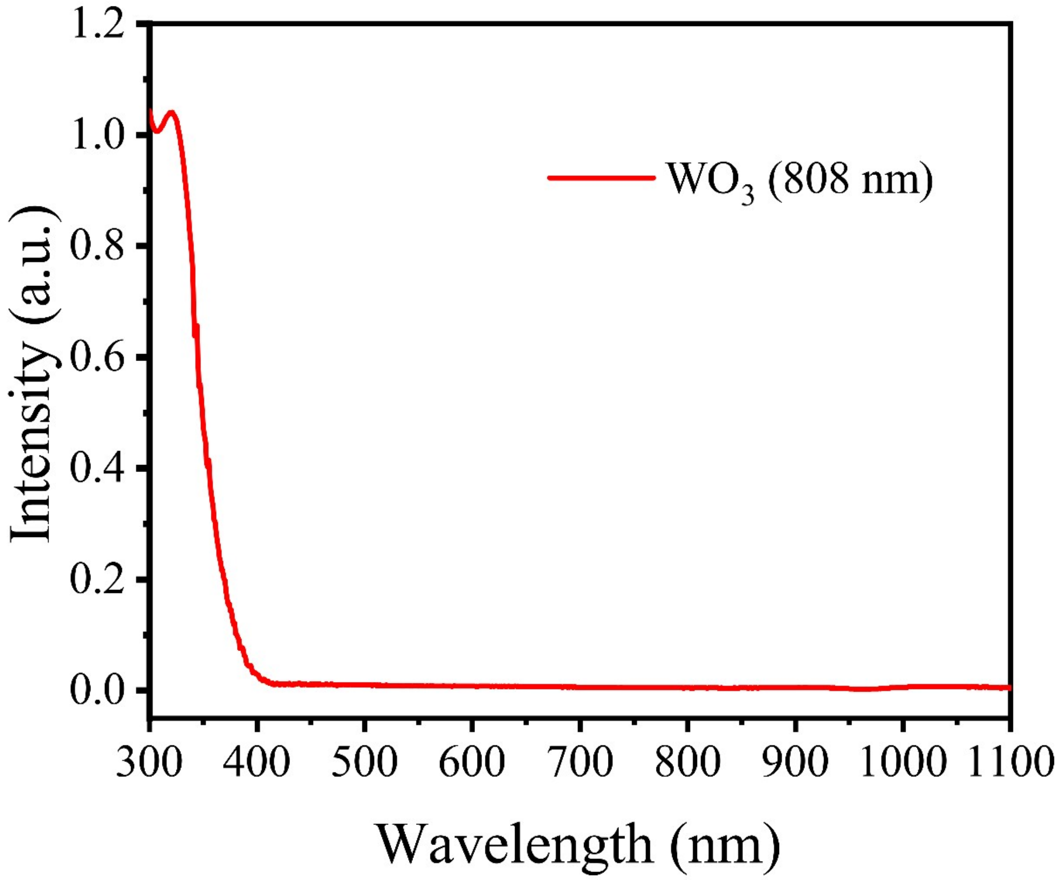

Figure S2. UV-vis spectra of WO_3 after it irradiated by 808 nm laser.

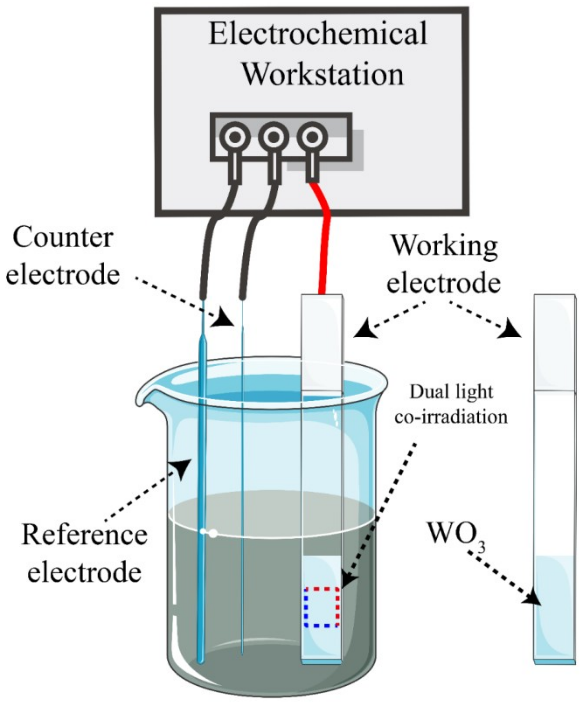

Figure S3. The diagram of the homemade photoelectrochemical device.

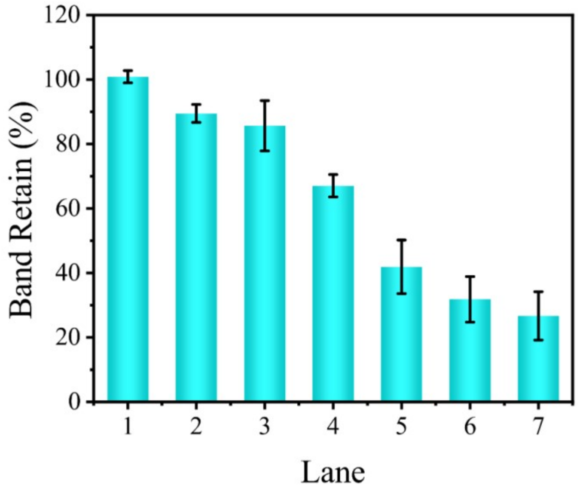

Figure S4. The corresponding statistical results of Figure 3c.

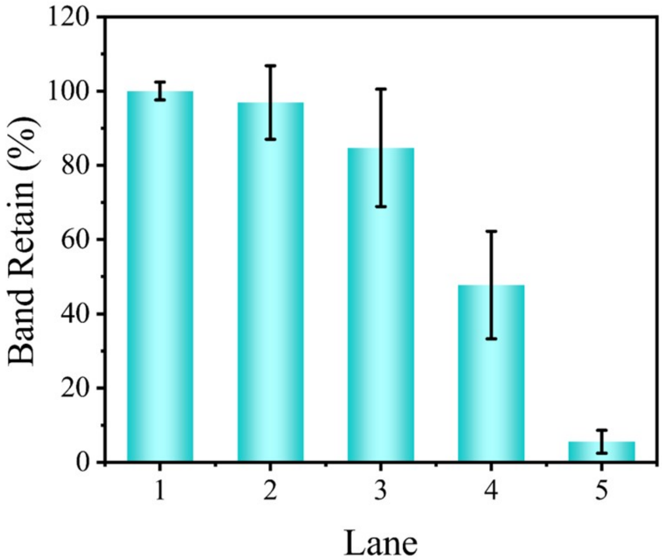

Figure S5. The corresponding statistical results of Figure 3d.

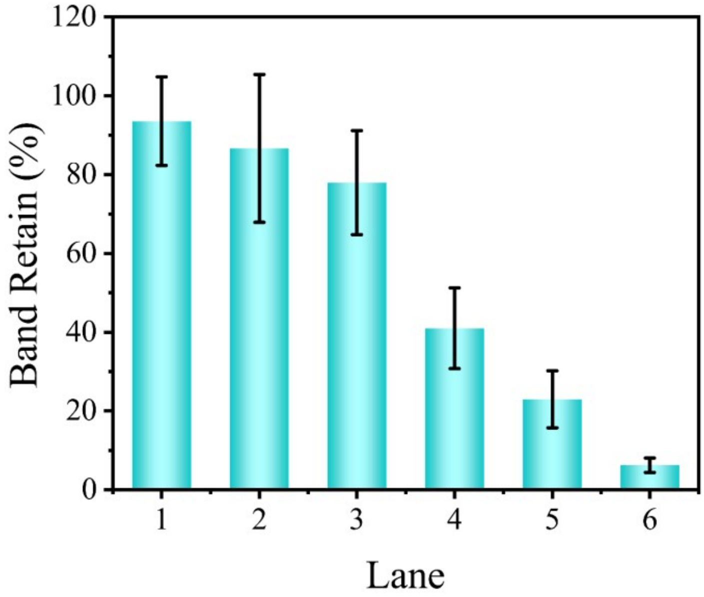

Figure S6. The corresponding statistical results of Figure 3e.

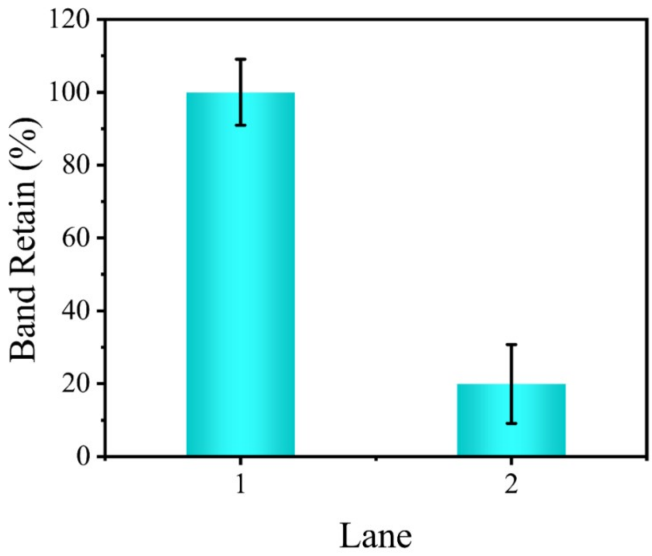

Figure S7. The corresponding statistical results of Figure 3f.

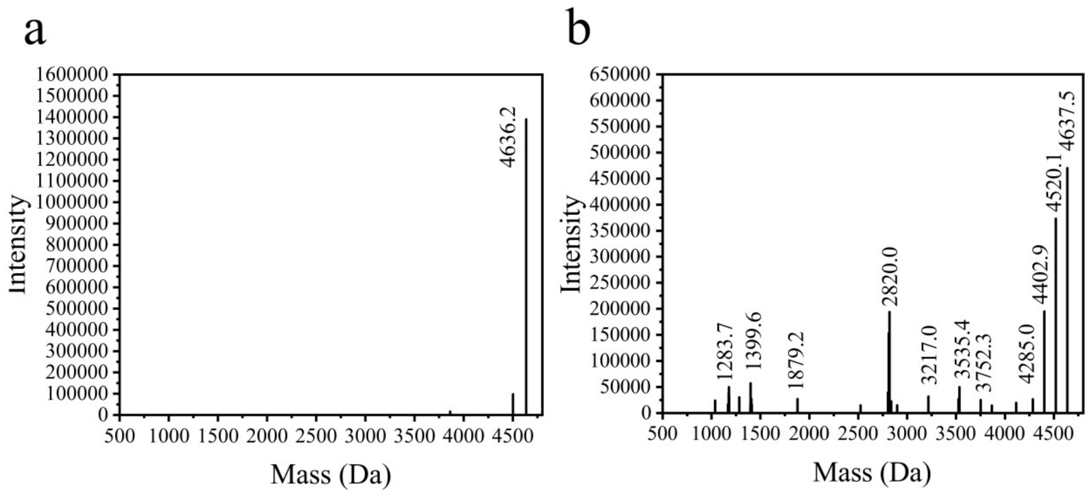

Figure S8. Mass spectrometry analysis of the ssDNA before (a) and after (b) cleavage.

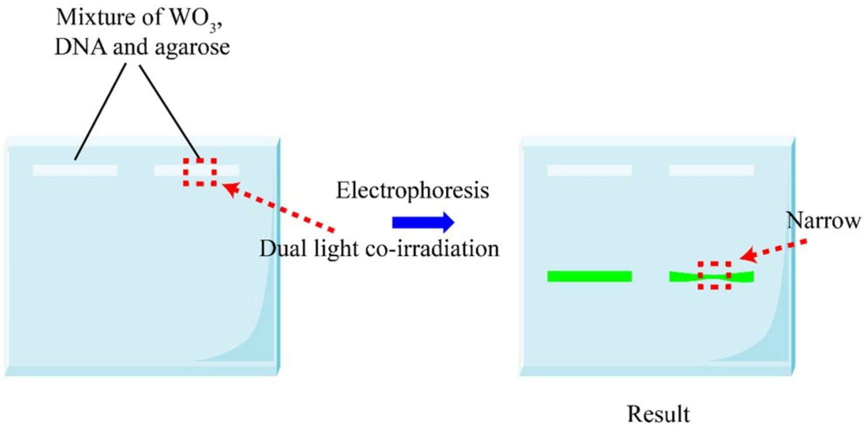

Figure S9. The diagram of spatiotemporal controllability experiment.

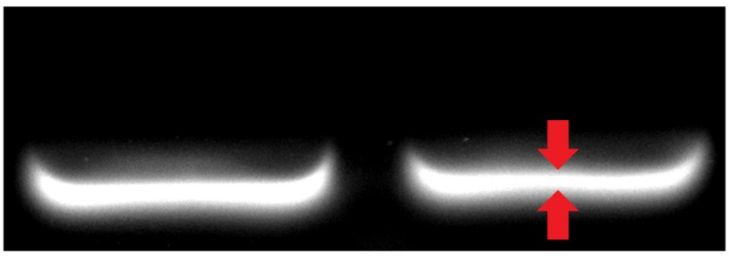

Figure S10. Agarose gel micrographs of spatiotemporal controllability experiment, the red arrows indicate the dual light co-irradiation region.

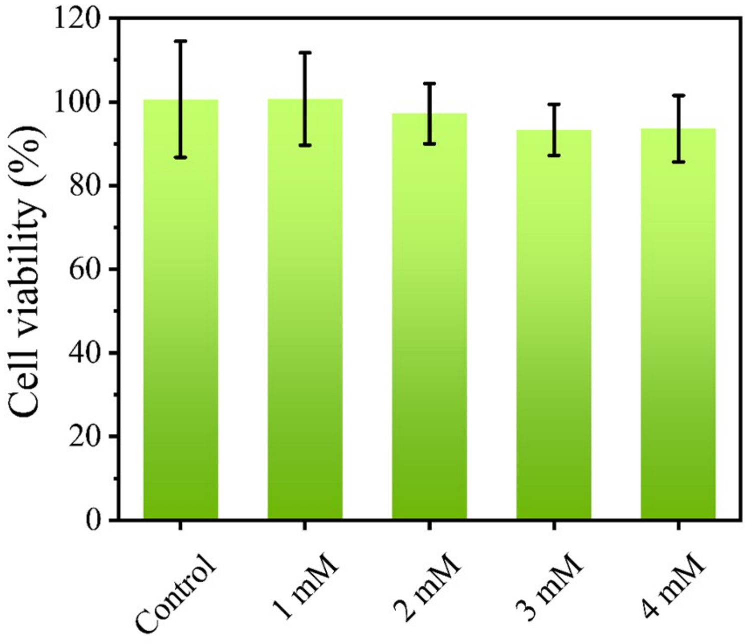

Figure S11. MTT experiment to detect the cytotoxicity of WO_3 with different concentrations.

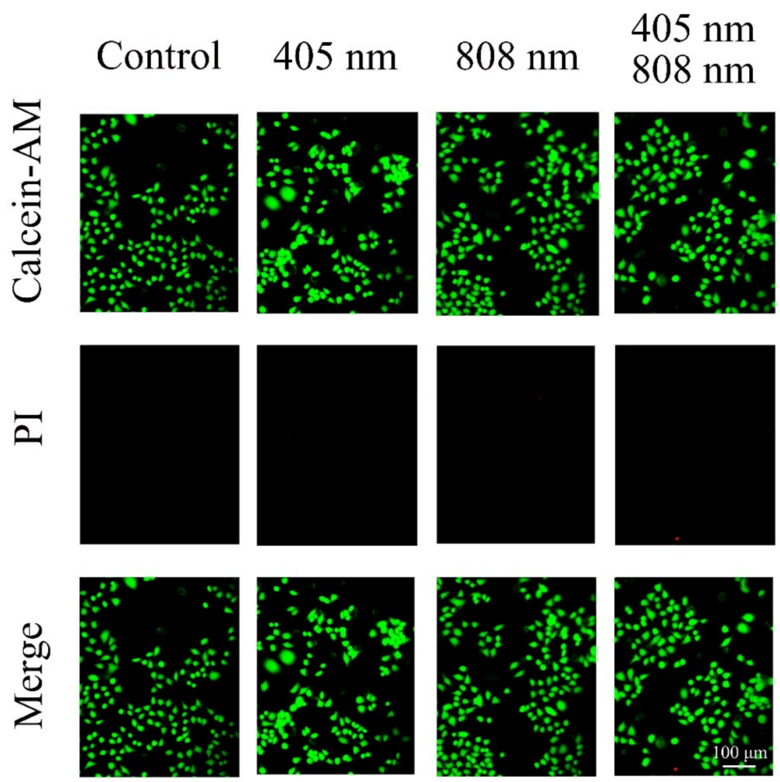

Figure S12. Fluorescence images of HeLa cells incubated with various groups containing calcein-AM (green) and propidium iodide (red). All groups were un-incubated with WO_3. 1 W 808 nm laser and 0.15 W 405 nm laser, irradiation time 20 min.

Equations indicate the mechanism of photochromic effect:

$$WO_3 + h\nu \rightarrow WO_3{}^* + e^- + h^+ \qquad (1)$$

$$h^+ + \frac{1}{2}H_2O \rightarrow H^+ + \frac{1}{4}O_2 \qquad (2)$$

$$WO_3 + xe^- + xH^+ \rightarrow H_xW^{6+}_{1-x}W^{5+}_xO_3 \qquad (3)$$

WO_3* means excited state.

Equations of photothermal conversion efficiency (η) calculation:

$$\eta = \frac{hS\left(T_{max} - T_{surr}\right) - Q_0}{I\left(1 - 10^{-A_{808nm}}\right)} \qquad (4)$$

$$\tau_s = \frac{m_d C_d}{hS} \qquad (5)$$

$$Q_0 = hS\left(T_{max,water} - T_{surr}\right) \qquad (6)$$

$$\theta = \frac{T_t - T_{surr}}{T_{max} - T_{surr}} \qquad (7)$$

The value of τ_s was slope, which obtained by linearly fitting the plot of the cooling time t versus the term -lnϑ. m_d is the mass of the nanoparticle solution and $C_d \approx 4.2$ J·g^{-1}·K^{-1}(heat capacity of water). T_{max} is the equilibrium temperature (the highest temperature of solution under irradiation), $T_{max,water}$ is the maximum temperature of water under irradiation. T_{surr} is the surrounding ambient temperature. T_t is the temperature of solution in time t.