Supplementary Information

Fluorescent Ti_3C_2 MXene Quantum Dots for Alkaline Phosphatase Assay and Embryonic Stem Cell Identification Based on Inner Filter Effect

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CONTENT

Synthesis of Ti_3C_2 MXenes.

Two-gram of Ti_3AlC_2 crystals were pretreated by immersing in diluted HF (10%-20%) for 1 h at a concentration of 0.1 g/ml. After collecting by centrifugation, the crystals were dispersed in 25% TMAOH for 20 h at room temperature. Then, the powder was retrieved by centrifugation at 4000 rpm for 5 min. Finally, the wet sediment was re-dispersed in 50 mL H_2O, and shaken repeatedly by hand for ~10 min to achieve complete delamination. Centrifugation at 3500 rpm was performed to remove the un-delaminated powder. The product was determined by filtration and weighing.

Calculation of Quantum Yield

The quantum yield (QY) of the Ti_3C_2 QDs was calculated using quinine sulfate (QY = 0.53) in sulfuric acid (0.1 mol L^{-1}, η = 1.33) as the standard, and 365 nm was used as the excitation wavelength. For calculation of quantum yield, five concentrations of each compound were made, all of which had absorbance less than 0.1 at 365 nm. The Ti_3C_2 QDs was dissolved in water. Their fluorescence spectra were recorded at same excitation of 365 nm. Then the quantum yield was estimated with equation 1:

$$\emptyset_x = \emptyset_{std}\left[\frac{m_x}{m_{std}}\right]\left[\frac{n_x^2}{n_{std}^2}\right]_1$$

where, $\emptyset$ is the quantum yield, and m is the slope of the line obtained from the plot of the integrated fluorescence intensity vs. absorbance and n is the refractive index of solvent (water η=1.33 in both cases).

Inhibition efficiency calculation.

To investigate our fluorescent probe could assess ALP inhibitor, the ALP reaction system (containing Ti_3C_2 QDs, 10 U L^{-1} ALP, and 0.1 μM $MgSO_4$) pre-incubated with different concentrations of Na_3VO_4 (from 0 to 200 μM) was stewing at 37 °C for 30 min, Then, 200 μM PNPP was added into the reaction system. After reaction at 37 °C for 30 min, the fluorescence spectra were recorded at the excitation wavelength of 365 nm.

The inhibition efficiency *I* (%) was calculated with equation 2:

$$I(\%) = \frac{F_I - F_0}{F_B - F_0} \times 100$$

where the F_B represents the initial fluorescence intensity of Ti_3C_2 QDs solution, and F_0 and F_I stand for the fluorescence intensity of the reaction system contain ALP with and without Na_3VO_4, respectively.

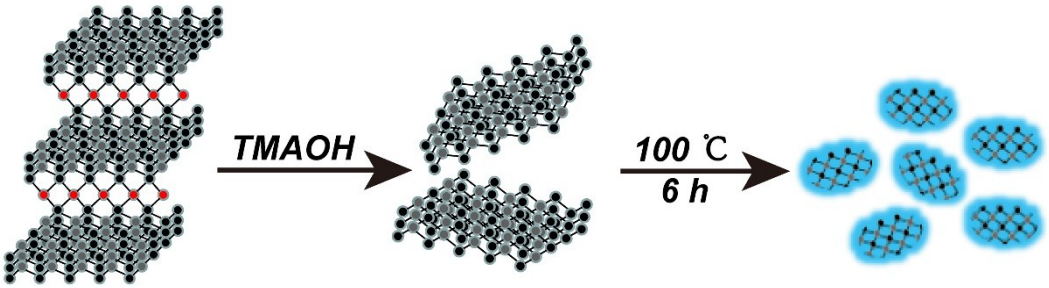

Figure S1. Hydrothermal synthesis of Ti_3C_2 QDs using Ti_3C_2 MXenes as precursor. Ti_3C_2 MXenes come from selectively etching of Ti_3AlC_2 by TMAOH.

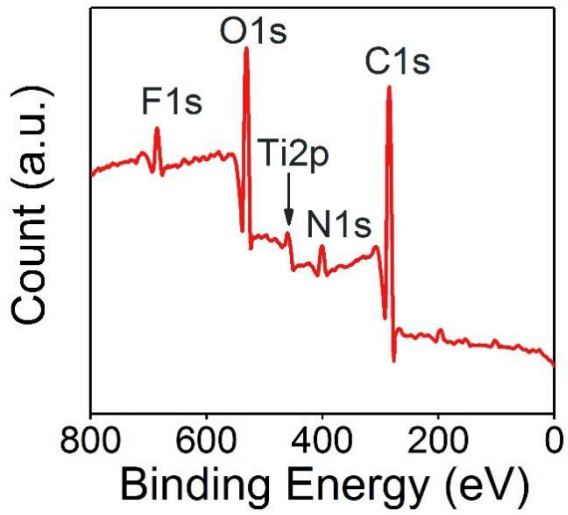

Figure S2. XPS survey spectrum of Ti_3C_2 QDs.

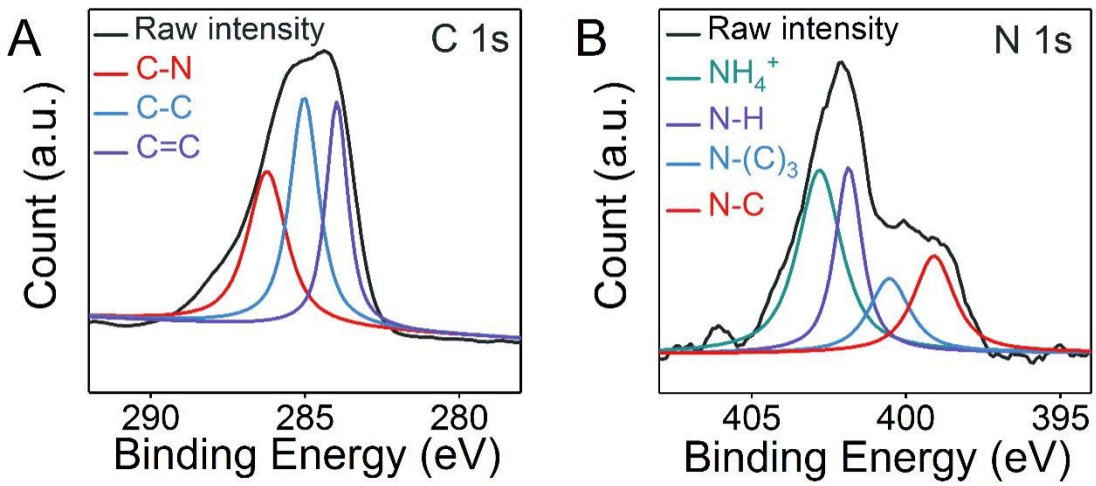

Figure S3. High-resolution spectra for the C 1s **(A)** and N 1s **(B)**.

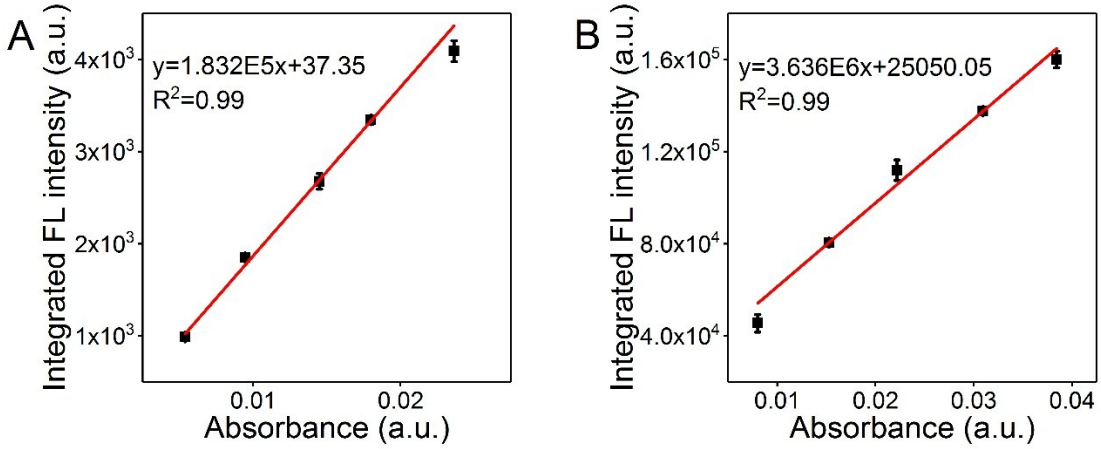

Figure S4. Plot of the integrated fluorescence intensity versus absorbance of (A) Ti_3C_2 QDs and (B) quinine sulfate.

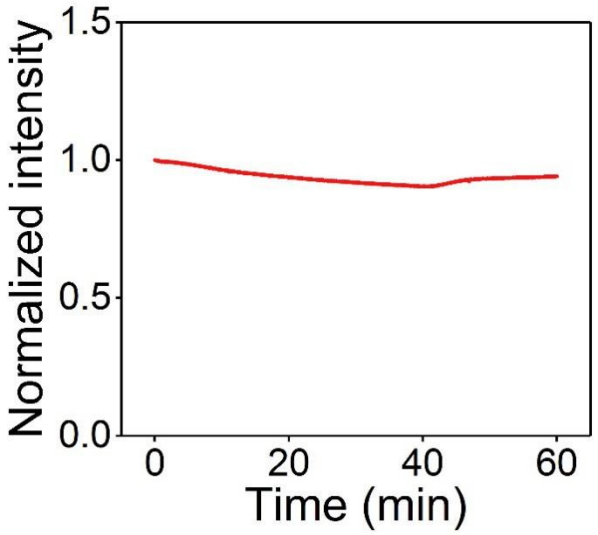

Figure S5. Fluorescence intensity variation of the Ti_3C_2 QDs as a function of time under 365 nm light illumination.

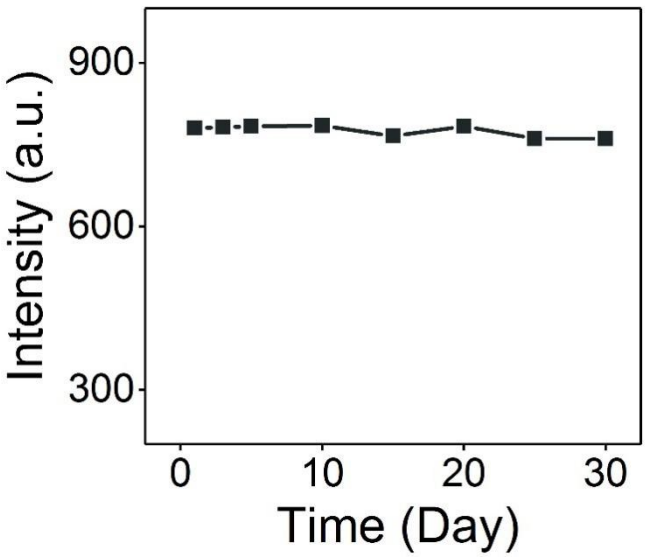

Figure S6. Fluoresce of the Ti_3C_2 QDs after storage at 4 °C for different times.

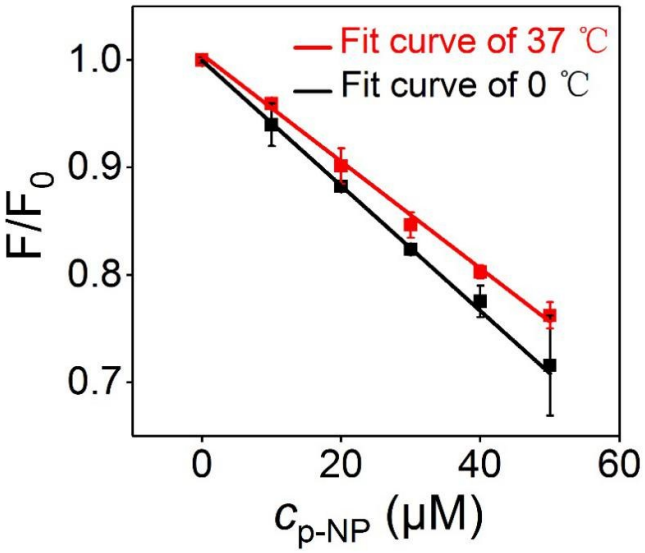

Figure S7. Fluorescence responses of Ti_3C_2 QDs in the presence of different concentration *p*-NP at 0 °C and 37 °C. F_0 and F are the fluorescence intensity of Ti_3C_2 QDs in the absence and presence of *p*-NP, respectively.

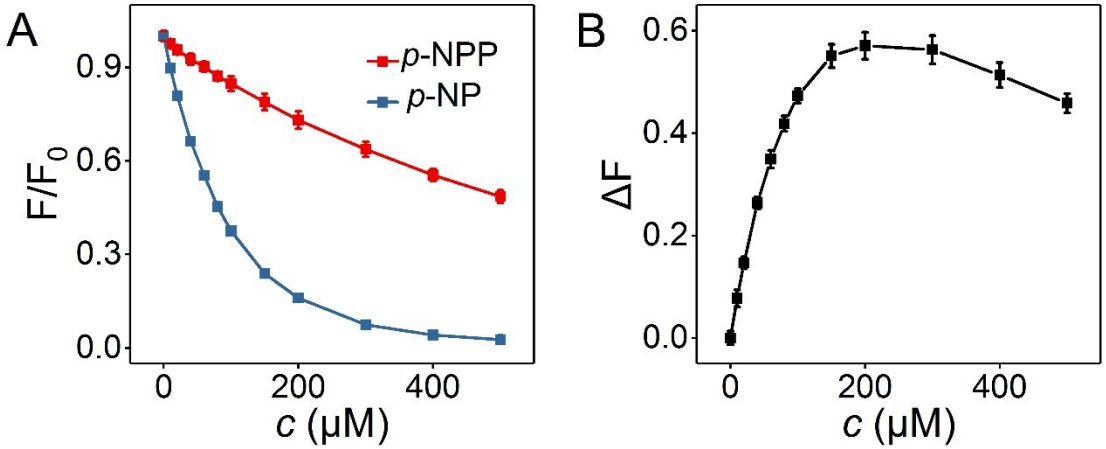

Figure S8. (A) Fluorescence responses of Ti_3C_2 QDs in the presence of different concentration of *p*-NPP and *p*-NP, F_0 and F are the fluorescence intensity of Ti_3C_2 QDs in the absence and presence of *p*-NPP or *p*-NP, respectively. (B) The difference ΔF in presence of different concentration of *p*-NPP and *p*-NP, where $\Delta F = (F/F_0)_{p\text{-NPP}} - (F/F_0)_{p\text{-NP}}$.

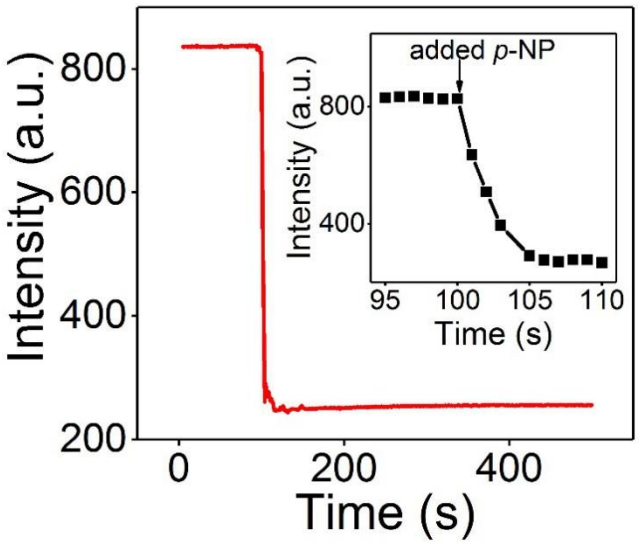

Figure S9. Time-dependent fluorescence changes of Ti_3C_2 QDs after the addition of *p*-NP (100 μM) at room temperature.

References

1. A. Gupta, A. Chaudhary, P. Mehta, C. Dwivedi, S. Khan, N. C. Verma and C. K. Nandi. *Chem. Commun.,* 2015, **51**, 10750-10753.