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# DNA nanolantern as biocompatible drug carrier for simple preparation of porphyrin/G-quadruplex nanocomposite photosensitizer with high photodynamic efficacy

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## Materials and Reagents

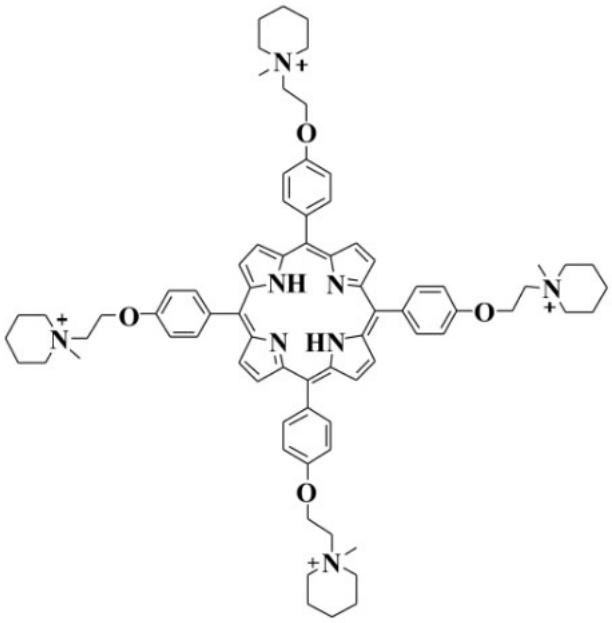
DNA oligonucleotides (Table S1) were purchased from Sangon Biotech. Co., Ltd. (Shanghai, China). The concentrations of the oligonucleotides were represented as single-stranded concentration, which was determined by measuring the absorbance at 260 nm. Molar extinction coefficient was determined using a nearest neighbour approximation (http: //www.idtdna.com/analyzer/Applications/OligoAnalyzer), and the calculated molar extinction coefficients were listed in Table S1. 5,10,15,20-tetra-{4-[2-(1-methyl-1-piperidinyl)ethoxy] phenyl} porphyrin (TMPipEOPP) was synthesized according to the strategy reported by our group. Hydrochloric acid (HCl), magnesium chloride ($MgCl_2$), potassium chloride (KCl), ammonium persulfate ($(NH_4)_2S_2O_8$), acrylamide ($C_3H_5NO$), tetramethylethylenediamine (TEMED) and Gel Red were obtained from Sigma-Aldrich (Shanghai, China). 1,3-diphenylisobenzofuran (DPBF) was obtained from Damas Reagent Co., Ltd (Shanghai, China). 3-(4,5-dimethylthiazol-2-yl)- 2,5-diphenyltetrazolium bromide (MTT), Tween-20 and 2′,7′-dichlorodihydrofluorescein diacetate (DCFH-DA) were obtained from Beyotime Reagent Co., Ltd. (Shanghai, China). Dulbecco's Eagle's Medium (DMEM) and Dulbecco's phosphate buffered saline (PBS), RMPI 1640, fetal bovine serum (FBS) and 4% paraformaldehyde were obtained from Invitrogen Corp. Deoxyribonuclease I (DNase I) was bought from New England Biolabs Beijing Ltd.

## Instruments

Hydrodynamic size and zeta potential were measured by using a Zetasizer Nano ZS (Malvern Instruments, UK). Scanning electron microscope (SEM) characterization was performed by spraying a metal film after depositing a dried sample on a metal sample stage. The SEM images were recorded by a Hitachi S-4800 scanning electron microscope. UV-Vis absorption spectral characterization was conducted on a Cary-60 UV-Vis spectrophotometer (Agilent Technologies). Atomic force microcopy (AFM) characterization was carried out using Bruker Dimension Icon (USA).

**Table S1**. All the oligonucleotides used in this work.

| No. | DNA | Sequence （from 5′ to 3′） | Extinction coefficient [$L \cdot mol^{-1} \cdot cm^{-1}$] |
|---|---|---|---|
| 1 | A1 | ATTGTGACCCACCAGCAGTGTATGACCCGTTCGGA | 336300 |
| 2 | A2 | GGATGTCAAGAGTGAGTGGTCACGACGTCATTA | 335000 |
| 3 | P1 | AAAAAAAAAAAAACAAAAACAAAAATAATGACGTCGTGACGTGCTGGTGGGTCACAAT | 612900 |
| 4 | P2 | AAAAAAAAAAAAACAAAAACAAAAATCCGAACGGGTCATAGTGTCACTCTTGACATCC | 602400 |
| 5 | t-KRAS | TTTTTGTTTTTGTTTTTTTTTTTTTAGGGCGGTGTGGGAAGAGGGAAGAGGGGGAGG | 548300 |
| 6 | KRAS | AGGGCGGTGTGGGAAGAGGGAAGAGGGGGAGG | 341000 |



**Scheme S1.** Chemical structure of TMPipEOPP

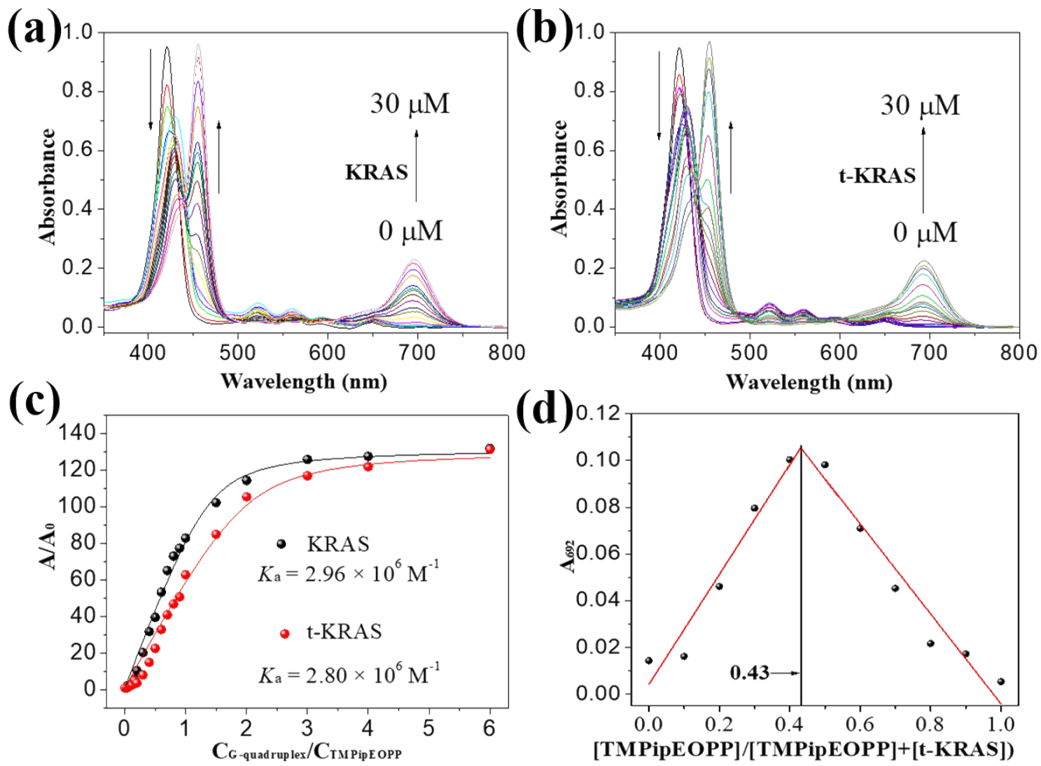



Figure S1. Interactions of TMPipEOPP with KRAS or t-KRAS. (a,b) UV-Vis absorption spectra of TMPipEOPP in the presence of different concentrations of (a) KRAS or (b) t-KRAS. [TMPipEOPP] = 5 μM. (c) Binding affinity between TMPipEOPP and KRAS (or t-KRAS). (d) Job Plot analysis for the binding interaction between TMPipEOPP and t-KRAS. [TMPipEOPP] + [t-KRAS] = 5 μM.

The binding affinity between TMPipEOPP and KRAS was calculated using the following equation.

$$\frac{A}{A_0} = 1 + \frac{P-1}{2}(M + 1 + x - \sqrt{(M+1+x)^2 - 4x})$$

Where $A$ and $A_0$ are the absorption signal intensities at 692 nm in the presence and absence of KRAS, respectively. $P = A_{max}/A_0$ ($A_{max}$ is maximum absorption intensity in the presence of maturated KRAS). $M = 1/(K_a \cdot C_{TMPipEOPP})$. Here, $K_a$ is the apparent binding constant between TMPipEOPP and KRAS, and $C_{TMPipEOPP}$ is the TMPipEOPP concentration. $x = nC_{KRAS}/C_{TMPipEOPP}$ ($n$ is the putative TMPipEOPP-binding site number on KRAS). By fitting the $A/A_0$~$C_{KARS}$ plot using above equation, $K_a$ between TMPipEOPP and KRAS can be obtained. The Ka between TMPipEOPP and t-KRAS is obtained by the same way.

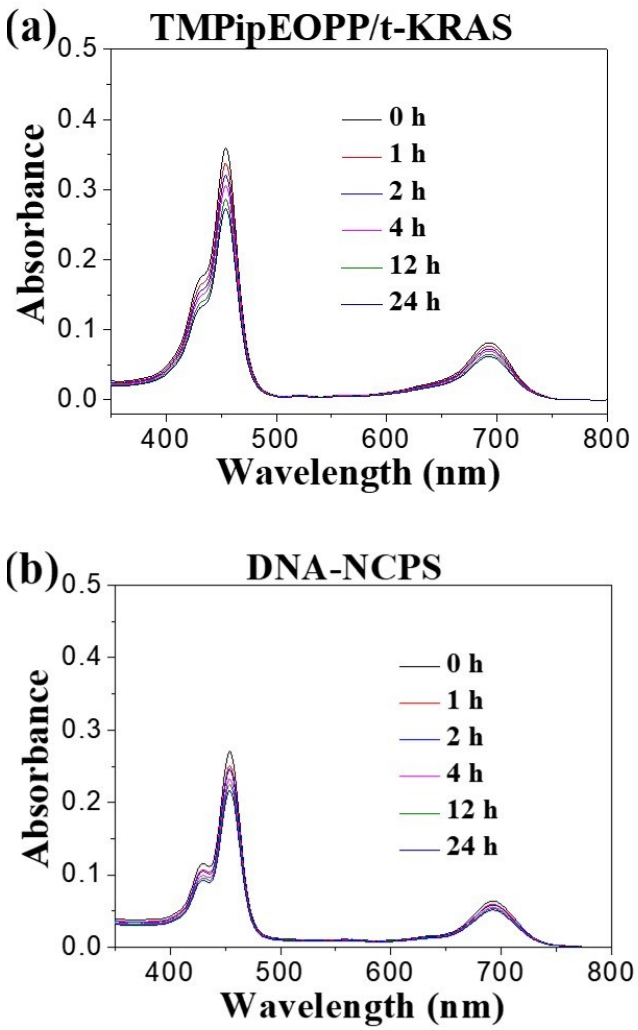



Figure S2. UV-Vis absorption spectra of (a) TMPipEOPP/t-KRAS complex and (b) DNA-NCPS after incubation with 10% FBS for different time.

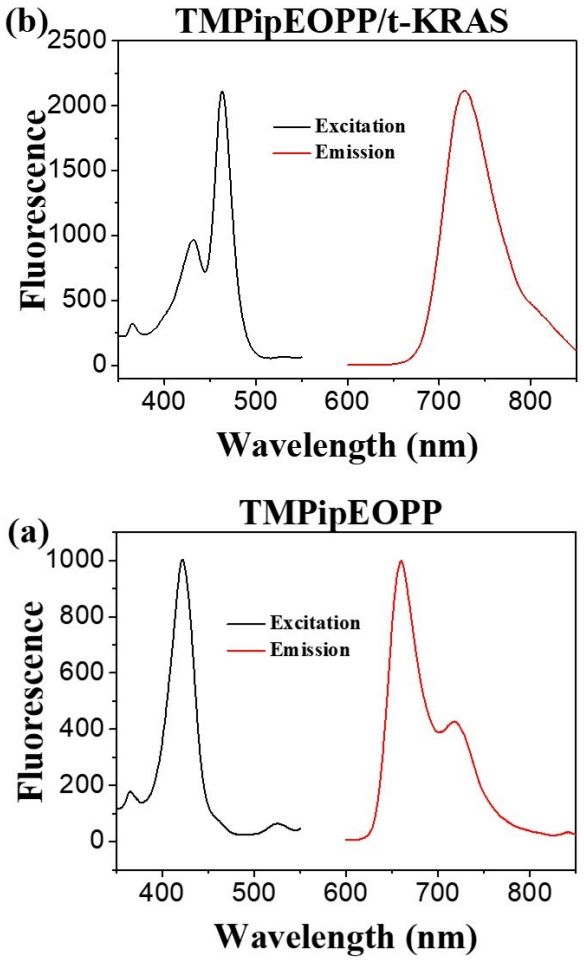



Figure S3. Excitation and emission spectra of (a) TMPipEOPP and (b) TMPipEOPP/t-KRAS complex.

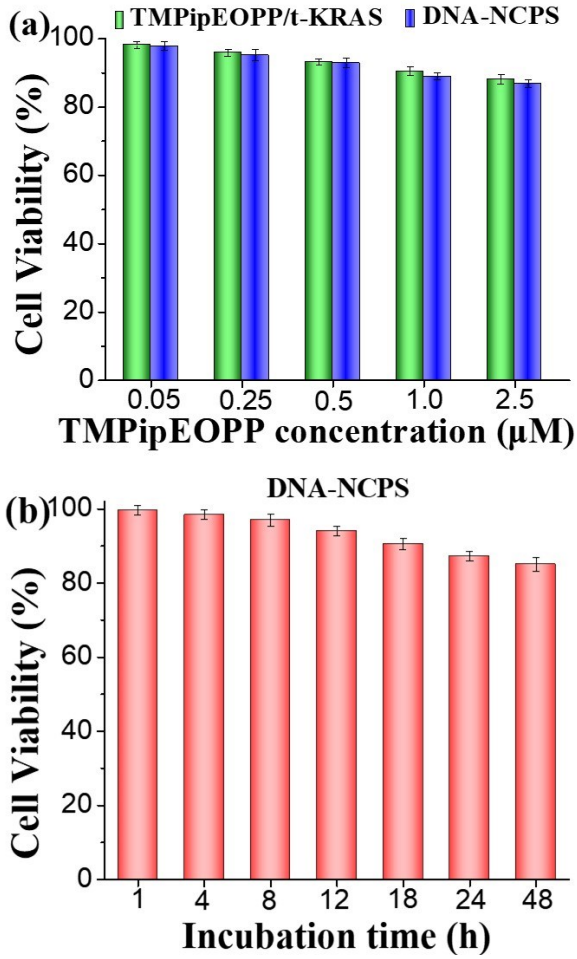



Figure S4. Cytotoxicities of TMPipEOPP/t-KRAS complex and DNA-NCPS in dark. (a) Cell viability after treatment with different concentrations (TMPipEOPP concentration) of TMPipEOPP/t-KRAS or DNA-NCPS for 12 h. (b) Cell viability after treatment with 0.5 μM DNA-NCPS for different time.