Electronic Supplementary Information (ESI) for Analyst

A Facile Graphene Oxide-Based Fluorescent Nanosensor for in Situ "Turn-on" Detection of Telomerase Activity

Li Zhang,[†] Jie Peng,[†] Ming-Fang Hong,[†] Jia-Qing Chen,[†] Ru-Ping Liang,[†] and Jian-Ding Qiu[*,†,‡]

[†]*College of Chemistry, Nanchang University, Nanchang 330031, China*

[‡]*Department of Materials and Chemical Engineering, Pingxiang University, Pingxiang 337055, China*

*Corresponding author. (J.-D.Qiu) Tel/Fax: +86-791-83969518. E-mail: jdqiu@ncu.edu.cn.

Characterization of GO

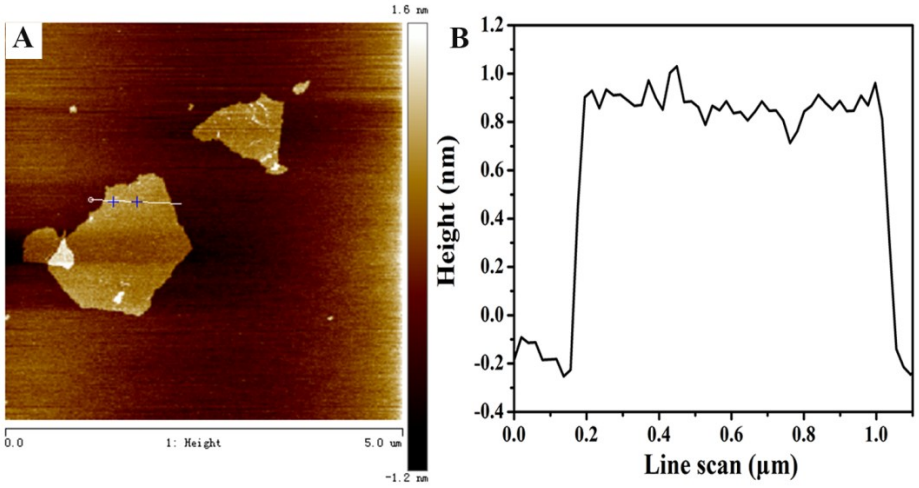

Fig. S1. AFM image (A) and height profile (B) of GO nanosheet.

Optimization of experimental conditions

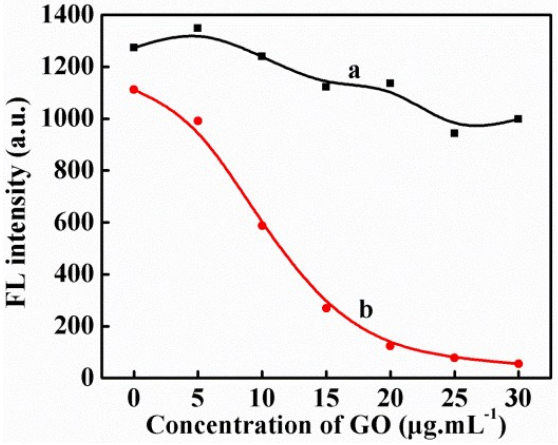

Fig. S2. Quenching effect of various concentration of GO on the fluorescence of P1 in the presence (a) and absence (b) of telomerase. (P1, 1 μM; primer-DNA, 1 μM; dNTP, 1 mM).

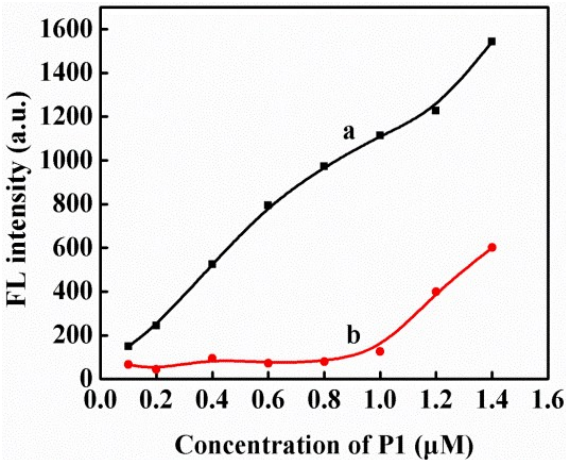

Fig. S3. Fluorescence signal of the telomerase extension product after incubation with different concentration of P1 probe in the presence (a) and absence of telomerase (b). (GO, 20 μg·mL^{-1}; primer-DNA, 1 μM; dNTP, 1 mM).

Investigation of telomerase inhibition

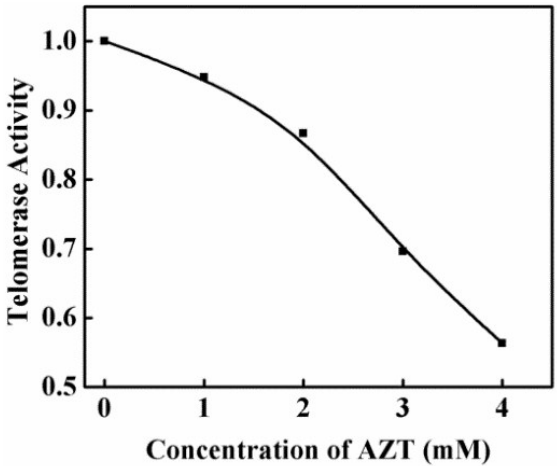

Fig. S4. Inhibition of telomerase activity by AZT. Telomerase extracted from 500 Hela cells was incubated with serial concentrations of the inhibitor for 1.5 h before performing the telomerase extension reaction.

Investigation of stability of the nanoprobe

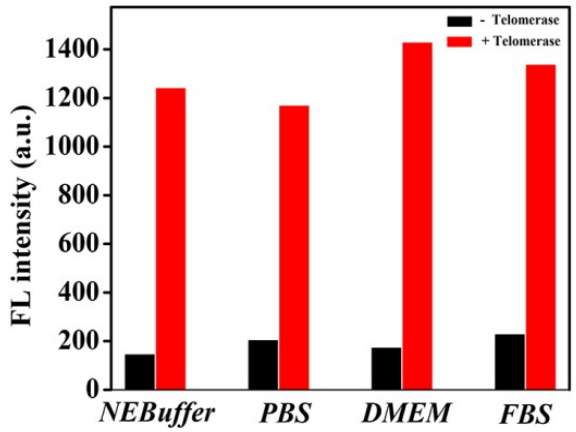

Fig. S5. Fluorescence response of the nanosensor to telomerase in different media.

Confocal images of A549 cells

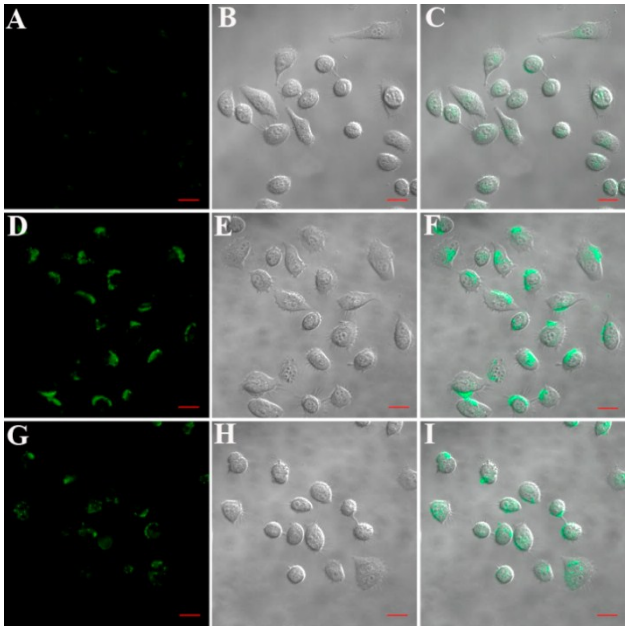

Fig. S6. Confocal microscopy images of A549 cells after incubation in different conditions: (A-C) P1/GO nanoprobe and dNTP, (D-F) primer-DNA, dNTP and P1/GO nanoprobe, and (G-I) pretreated with EGCG (100 μg·mL^{-1}) for 48 h, then incubated with primer-DNA, dNTP and P1/GO at 37 °C for 2 h. Fluorescence field (A, D, G), bright-field images (B, E, H), and overlapped fluorescence (C, F, I). Scale bar: 20 μm.

Table S1. Comparison of the sensing performance between the present method and other methods for telomerase detection

Method	System	Detection limit	Linear range	Time	Ref.
PCR-based assay	Telomeric repeat amplification protocol (TRAP)	10−100 cells	—	1 day	1
Colorimetry assay	TS-primer modified AuNPs	1 cell/μL	—	1.5 h	2
	Catalytic beacons/hemin	500 cells	—	1.5 h	3
	Colorimetry and SERS dual-mode	10 cells/mL	10–1000 cells/mL	5 h	4
	Enzymatic etching of GNRS	90 cells/mL	200–15000 cells/mL	—	5
	Hemin-graphene conjugates	60 cells/mL	100–2300 cells/mL	—	6
Electrochemical assay	Nanoscaled porphyrinic metal−organic frameworks	30 cells/mL	10^2–10^7 cells/mL	2.5 h	7
	$Ru(NH3)_6^{3+}$/DNA-Au NP conjugate	10 cells	10–100 cells	5.5 h	8
	Structure-switching DNA probe/ferrocene (Fc)	100 cells/mL	10^2–6×10^4 cells/mL	1 day	9
	T7 Exonuclease/taqman probe	5 cells	5–1000 cells	3 h	10
Fluorescence assay	ZnPPIX/G-quadruplexes	380 cells/μL	—	3.5 h	11
	AIE-based turn on technique	10 cells	—	1 h	12
	Isothermal circular strand-displacement polymerization reaction	4 cells	40–1000 cells	3 h	13
	Exonuclease III/graphene oxide/linear DNA probe	250 cells	—	2 h	14
	Hemin/telomere-G-quadruplex/L-cysteine/aggregation AuNPs	27 cells/μL	—	3 h	15
	Graphene oxide-based fluorescent nanosensor	10 cells	0–1000 cells	1.5 h	Our work

References

1. N. W. Kim, M. A. Piatyszek, K. R. Prowse, C. B. Harley, M. D. West, P. L. C. Ho, G. M. Coviello, W. E. Wright, S. L. Weinrich and J. W. Shay, *Science*, 1994, **266**, 2011-2015.

2. J. S. Wang, L. Wu, J. S. Ren and X. G. Qu, *Small*, 2012, **8**, 259-264.

3. Y. Xiao, V. Pavlov, T. Niazov, A. Dishon, M. Kotler and I. Willner, *J. Am. Chem. Soc.*, 2004, **126**, 7430-7431.

4. S. Zong, Z. Wang, H. Chen, G. Hu, M. Liu, P. Chen and Y. Cui, *Nanoscale*, 2014, **6**, 1808-1816.

5. H. T. Yang, A. R. Liu, M. Wei, Y. J. Liu, B. J. Lv, W. Wei, Y. J. Zhang and S. Q. Liu, *Anal. Chem.*, 2017, **89**, 12094-12100.

6. X. L. Xu, M. Wei, Y. J. Liu, X. Liu, W. Wei, Y. J. Zhang and S. Q. Liu, *Biosens. Bioelectron.*, 2017, **87**, 600-606.

7. P. H. Ling, J. P. Lei and H. X. Ju, *Anal. Chem.*, 2016, **88**, 10680-10686.

8. Y. Li, B. W. Liu, X. Li and Q. L. Wei, *Biosens. Bioelectron.*, 2010, **25**, 2543-2547.

9. Z. Yi, H. B. Wang, K. Chen, Q. Gao, H. Tang, R. Q. Yu and X. Chu, *Biosens. Bioelectron.*, 2014, **53**, 310-315.

10. H. B. Wang, S. Wu, X. Chu and R. Q. Yu, *Chem. Commun.*, 2012, **48**, 5916-5918.

11. Z. Zhang, E. Sharon, R. Freeman, X. Liu and I. Willner, *Anal. Chem.*, 2012, **84**, 4789-4797.

12. X. D. Lou, Y. Zhuang, X. L. Zuo, Y. M. Jia, Y. N. Hong, X. H. Min, Z. Y. Zhang, X. M. Xu, N. N. Liu, F. Xia and B. Z. Tang, *Anal. Chem.*, 2015, **87**, 6822-6827.

13. C. F. Ding, X. L. Li, Y. Ge and S. S. Zhang, *Anal. Chem.*, 2010, **82**, 2850-2855.

14. L. Peng, Z. Zhu, Y. Chen, D. Han and W. Tan, *Biosens. Bioelectron.*, 2012, **35**, 475-478.

15. E. Sharon, E. Golub, A. Niazov-Elkan, D. Balogh and I. Willner, *Anal. Chem.*, 2014, **86**, 3153-3158.