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Supporting Information

Versatile graphene-based photothermal nanocomposites for effectively capturing, killing bacteria, and destructing bacteria biofilms

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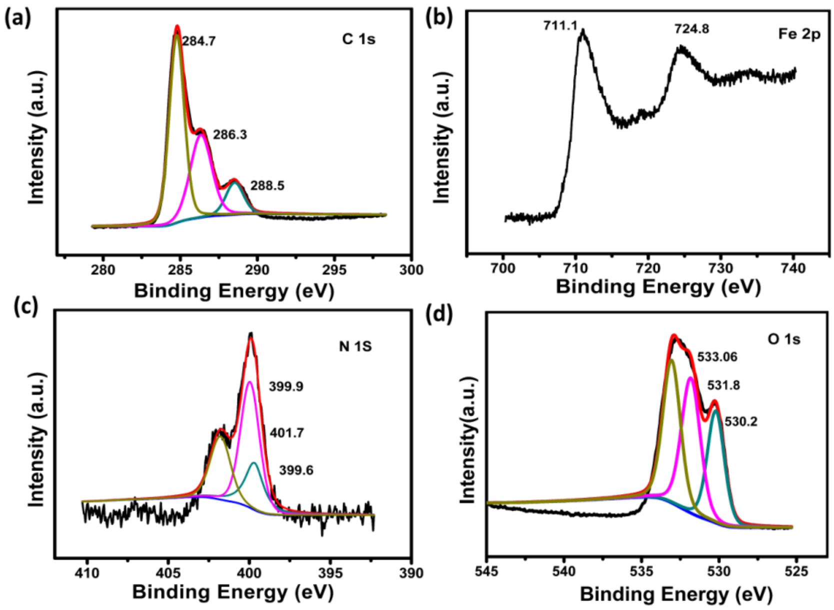

Fig. S1.XPS spectra of C (a), Fe (b), N (c), and O (d) elements in the GO-IO-CS.

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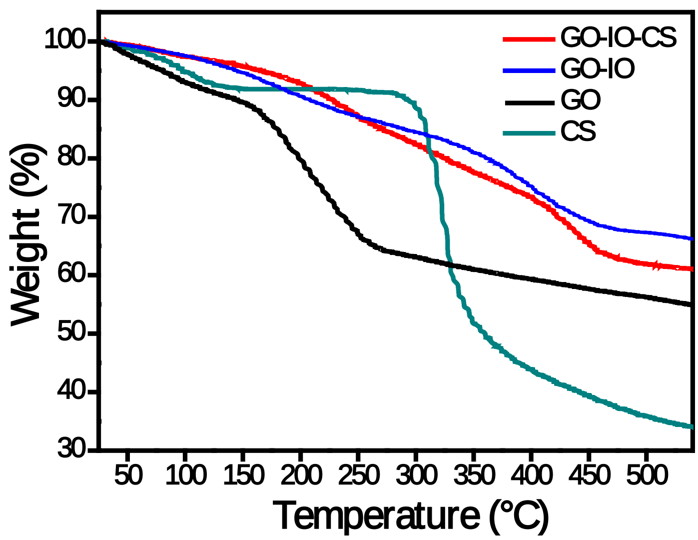

Fig. S2. The TGA - mass loss curves of CS, GO, GO-IO and GO-IO-CS.

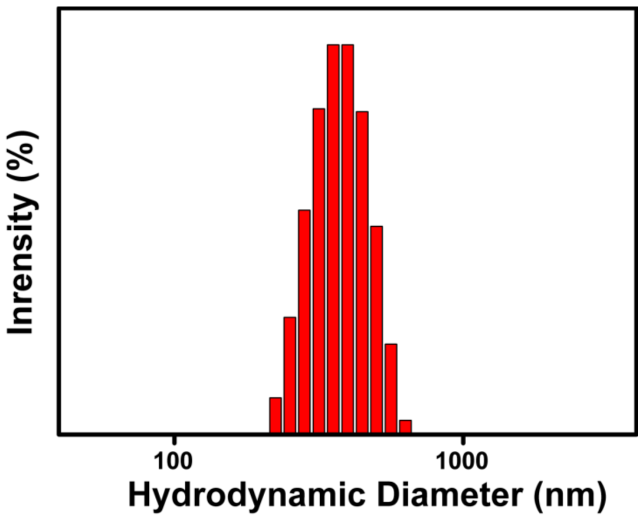

Fig. S3. Size distrbu of GO-IO-CS in PBS.

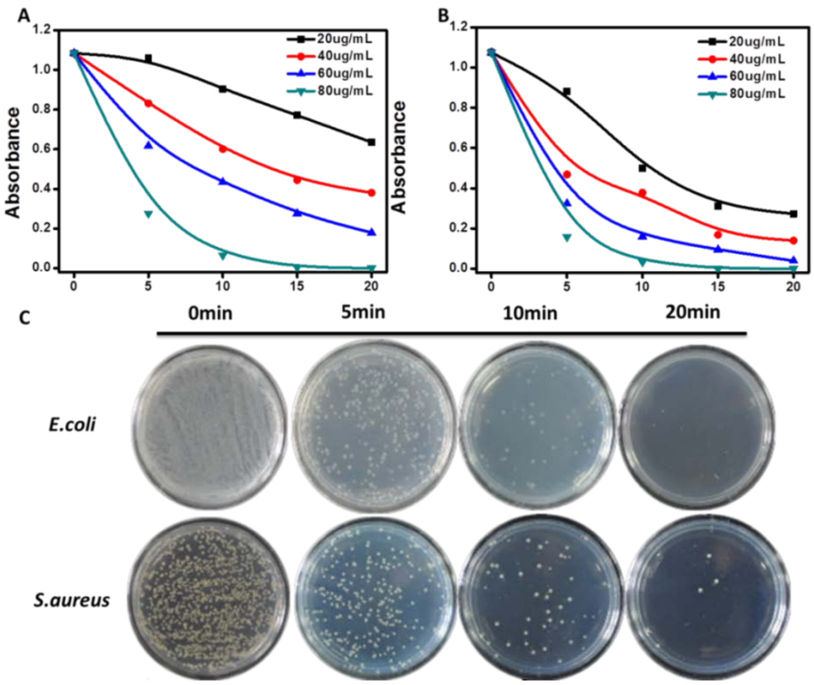

Fig.S4. (A,B)Bacteria capturing and separating capability of GO-IO-CS with various concentrationstowards *E.coli* and*S.aureus*, respectively.(C) The related bacterial coloniestreated with 80 μg/mL GO-IO-CS during different magnetic separation time.

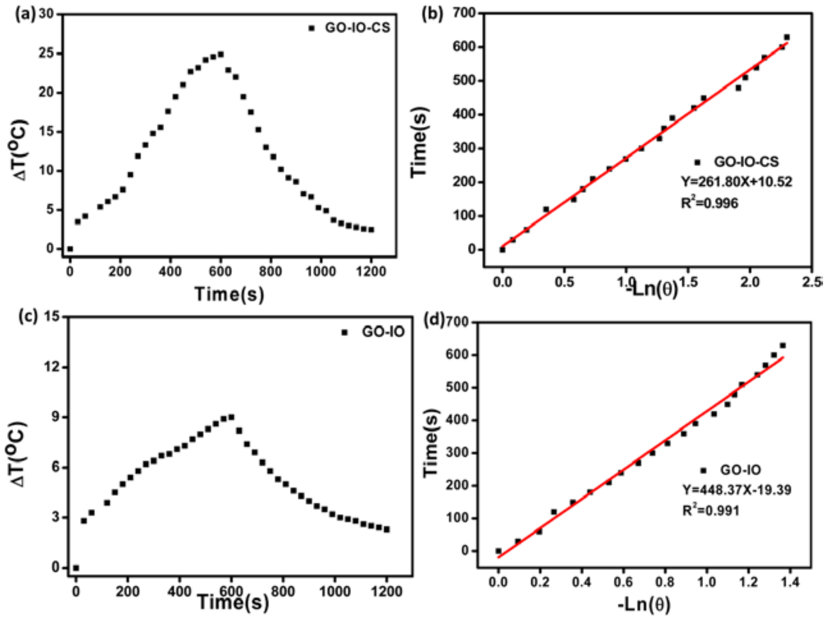

Fig.S5. (a,c): Photothermal effect of the GO-IO-CS and the GO-IO dispersion with NIR laser irradiation (The laser light was shut off after irradiation for10min). (b,d): Plot of cooling period after 600s versus negative natural logarithm of driving force temperature.

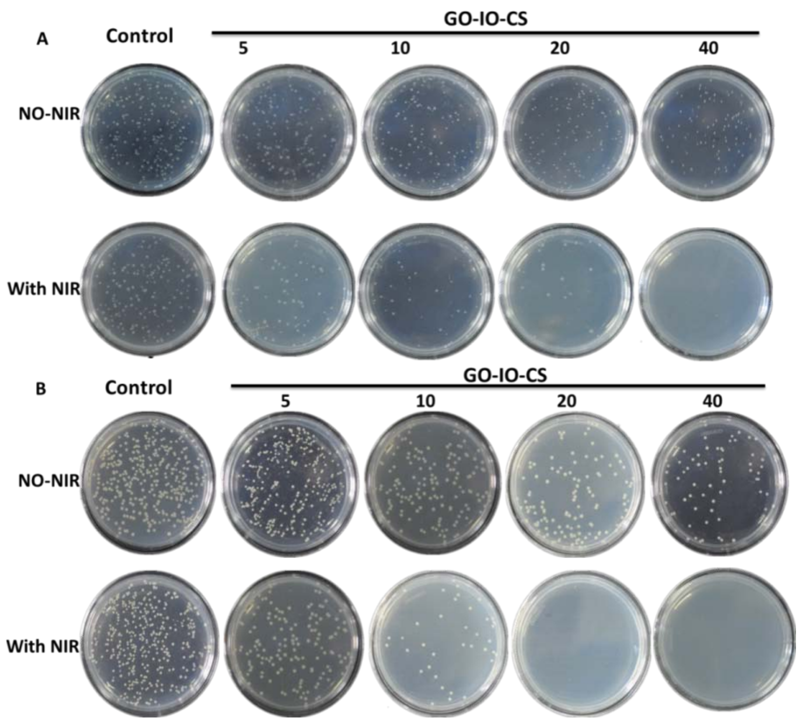

Fig.S6. The *E.coli* (A) and *S. aureus* (B) bacterial colonies treated with different concentrations of GO-IO-CS with or without NIR irradiation.

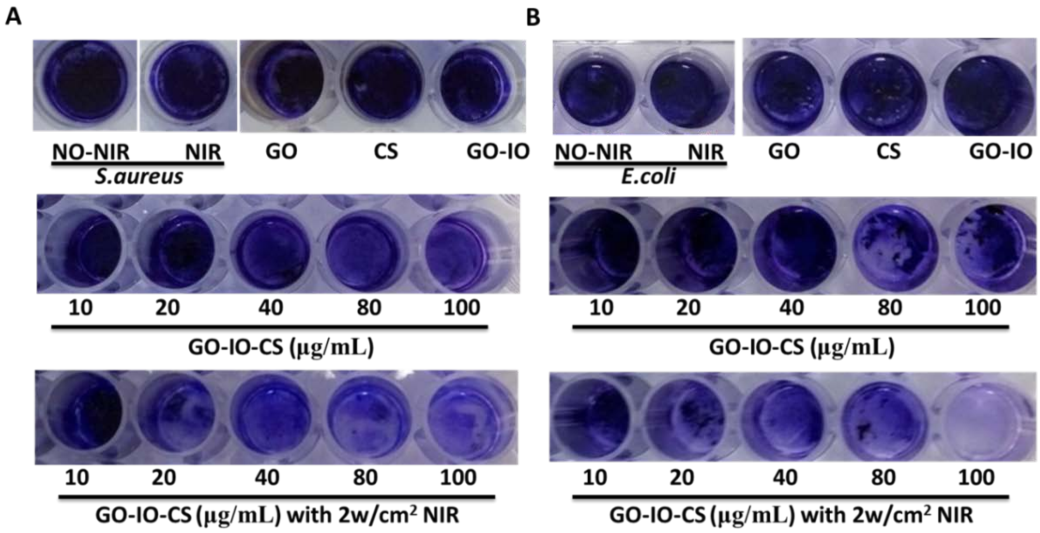

Fig. S7. The photographs of thestaining bacteria biofilm after treated with various materials atdifferent concentrations with or without NIR irradiation for 10 min. (A) for *S.aureus* biofilms, (B) for *E.coli*biofilms.

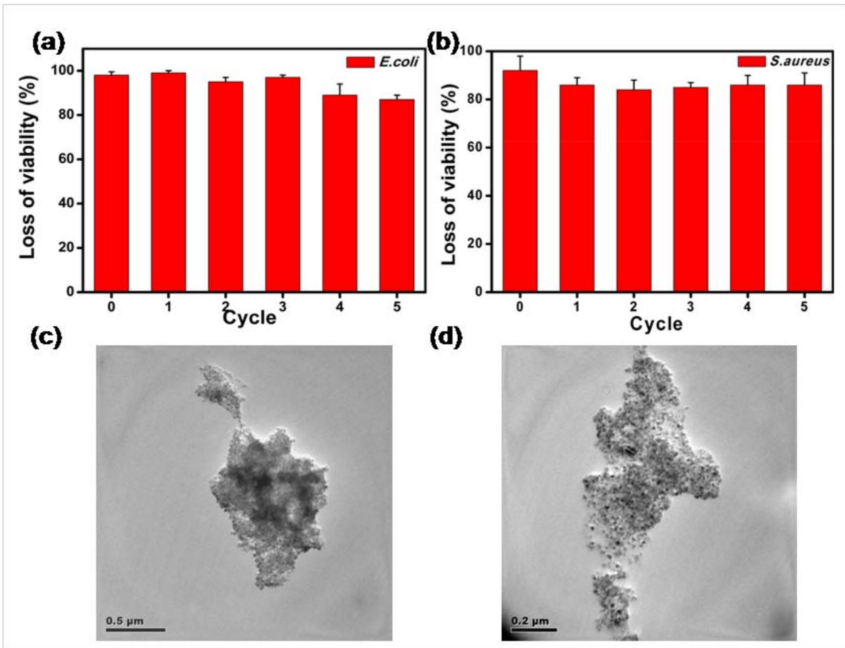

Fig.S8. The antibacterial ability of GO-IO-CS for 5 cycle photothermal antibacterial utilization (a) for *E. coli,* (b) for *S. aureus.* The TEM images after 5 recycle antibacterial utilization (c) for *E. coli*, (d) for *S. aureus*.

Table S1. Atom ratios of the GO-IO-CS based on the XPS survey measurements.

Elements	Atom ratio. %
C 1s	72.712
N 1s	3.643
O 1s	22.120
Fe 2p	1.526

Table S2. The Zeta potential of GO-IO-CS

	CS	GO	GO-IO	GO-IO-CS
Zeta potential (mV)	23.4±3.0	-40.3±0.7	-39.6±2.0	15.1±1.9

Results are given as the mean standard deviation of 3 times.

Photothermal conversion efficiency:

The photothermal conversion efficiency (η) of GO-IO and GO-IO-CS were determined according to the previous reports.[1-3]The GO-IO and GO-IO-CS were firstly exposed to 808nm NIR light for 10min.Then, the laser light was shut off and cooled to room temperature. The real-time temperature of GO-IO and GO-IO-CS were record by a temperature contact. Thus, the photothermal conversion was calculated according to the following equation (1):

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

$$Q_0 = hS(T_{max} - T_{surr}) \qquad (2)$$

where h is the heat transfer coefficient, S is the surface area of sample container, T_{max} is the steady-state maximum temperature, T_{surr} is room temperature, Q_0 is the baseline energy input by the solvent and the sample container without any materials, I is the laser power, andA_{808} is the absorbance of GO-IO or GO-IO-CS at 808 nm. The value of hS is calculated by the equation (3):

$$hS = \frac{m_d C_d}{\tau_s} \qquad (3)$$

where m_d(g) is the mass of the GO-IO or GO-IO-CS solution, C_d(4.2 J g^{-1}℃$^{-1}$) is the heat capacity of water, andτ_s is the sample thermal time constant which was measured by the following equations(4) and (5):

$$t = -\tau_s \ln(\theta) \qquad (4)$$

$$\theta = \frac{T - T_{surr}}{T_{max} - T_{surr}} \qquad (5)$$

Therefore, the photothermal conversion efficiency of GO-IO and GO-IO-CS was shown in the following Table S3:

Table S3. The photothermal conversion efficiency of GO-IO and GO-IO-CS

	(g)	C_d (J $^{-1o}$C^{-1})	τ_S (s)	hS (mW^{o}C^{-1})	Q_0 (mW)	A_{808}	I (Wcm^{-2})	η (%)
GO-IO	1	4.2	448.37	9.37	4.69	0.16	2	12.92
GO-IO-CS	1	4.2	261.80	16.04	8.02	0.41	2	32.86

Reference:

1. J. Yu, W. Y. Yin, X. P. Zheng, G. Tian, X. Zhang, T. Bao, X. H. Dong, Z. L. Wang, Z. J. Gu, X. Y. Ma and Y. L. Zhao, *Theranostics*, 2015, **5**, 931.
2. W. Y. Yin, L. Yan, J. Yu, G. Tian, L. J. Zhou, X. P. Zheng, X. Zhang, Y. Yong, J. Li, Z. J. Guand Y. L. Zhao, *ACS Nano*, 2014, **8**, 6922.
3. X. J. Liu, B. Li, F. F. Fu, K. B. Xu, R. J. Zou, Q. Wang, B. J. Zhang, Z. G. Chen and J. Q. Hu, *Dalton Trans.*, 2014,**43**, 11709.