

## Electronic Supplementary Information (ESI)

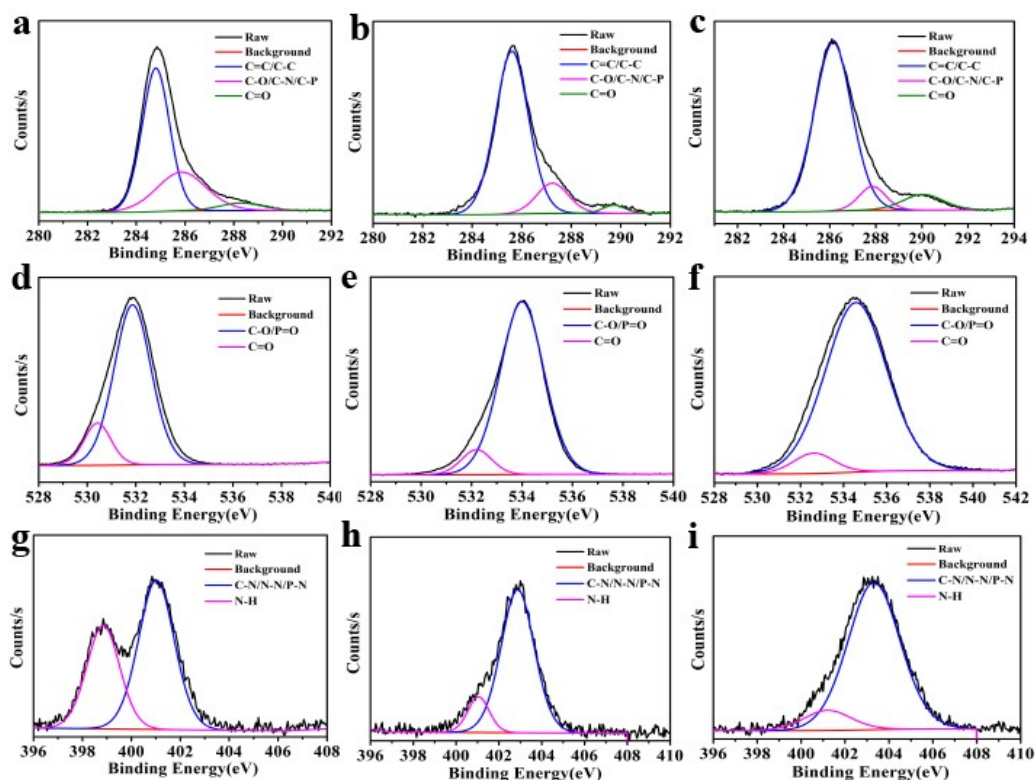
### Enhanced antibacterial activity with increasing P doping ratio in CQDs

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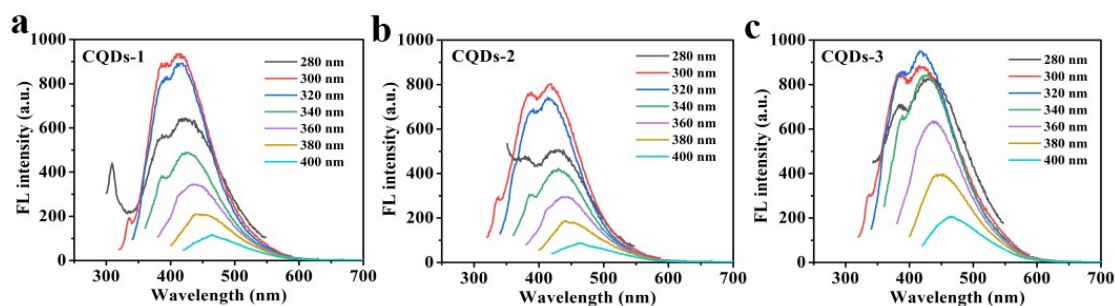
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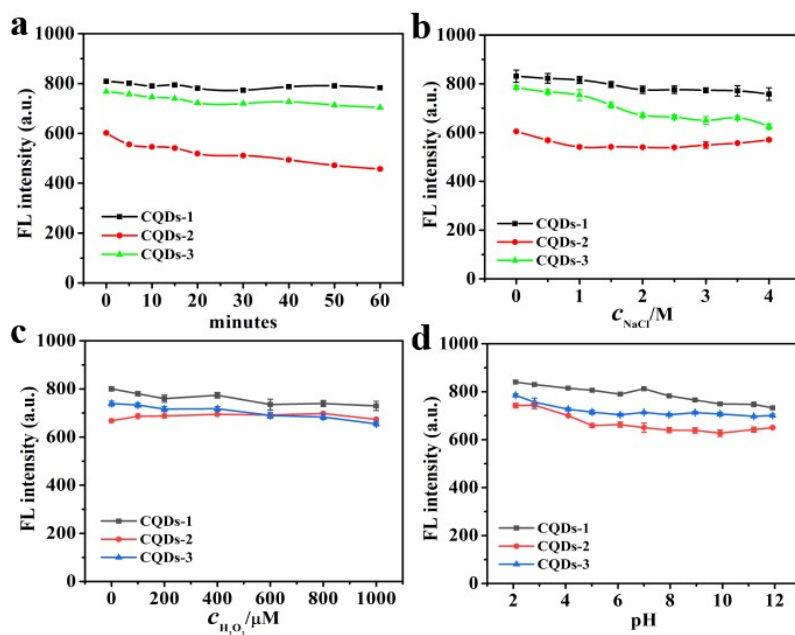
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**Fig. S1** The high-resolution C 1s (a–c), O 1s (d–f), N 1s (g–i) XPS spectra of CQDs-1 (a, d, g), CQDs-2 (b, e, h) and CQDs-3 (c, f, i).



**Fig. S2** FL emission spectra of CQDs-1 (a), CQDs-2 (b) and CQDs-3 (c) under the excitation of 280–400 nm light beam.



**Fig. S3** Fluorescent spectra of CQDs in different incubation time (a), different concentration of NaCl (b) and H<sub>2</sub>O<sub>2</sub> (c), pH solutions (d).

**Table a** OD values of *E. coli* treated with different concentrations of CQDs-1, CQDs-2, CQDs-3

$c_{\text{CQDs}}$ (mg/mL)	CQDs-1			CQDs-2			CQDs-3			Blank group	Negative group
2.86	0.042	0.046	0.047	0.048	0.046	0.050	0.053	0.050	0.052	0.053	0.545
1.43	0.043	0.047	0.048	0.052	0.047	0.050	0.050	0.051	0.049	0.045	0.580
0.71	0.036	0.038	0.036	0.040	0.040	0.044	0.044	0.046	0.046	0.038	0.468
0.51	0.511	0.556	0.571	0.045	0.043	0.047	0.049	0.050	0.051		

0.36	0.579	0.615	0.634	0.588	0.588	0.599	0.051	0.057	0.057
0.18	0.519	0.566	0.563	0.571	0.615	0.633	0.046	0.046	0.045
0.16	0.463	0.487	0.492	0.524	0.574	0.555	0.581	0.565	0.622

Table b OD values of *Sh. flexneri* treated with different concentrations of CQDs-1, CQDs-2, CQDs-3

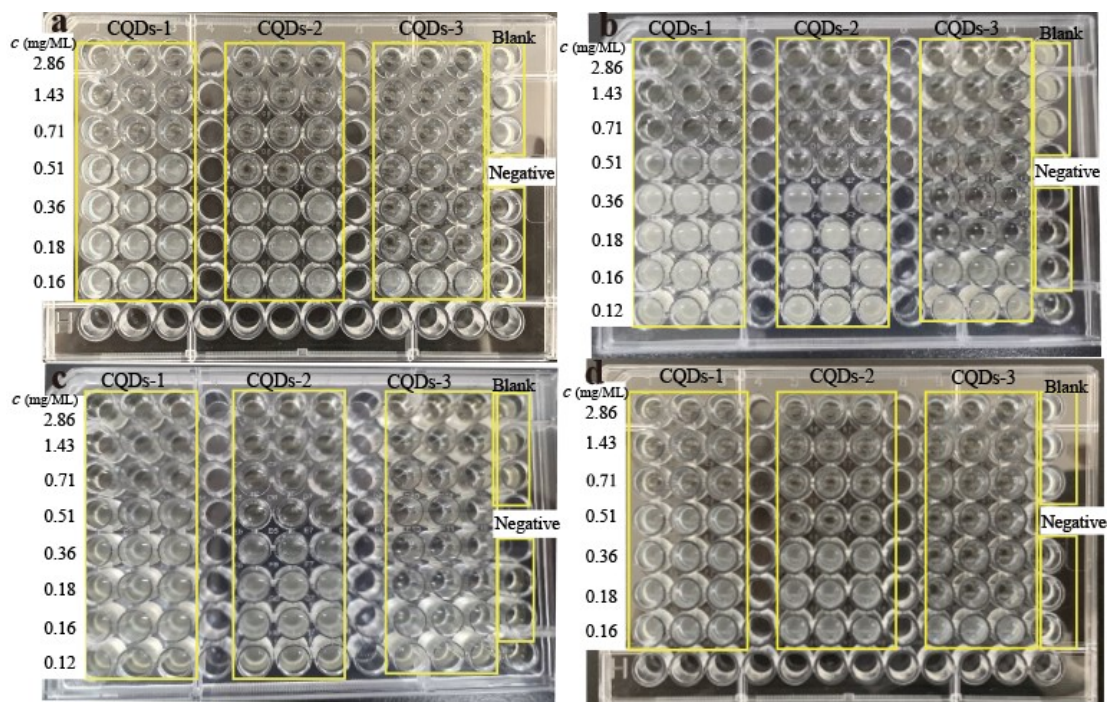
$c_{\text{CQDs}}$ (mg/mL)	CQDs-1			CQDs-2			CQDs-3			Blank group	Negative group
2.86	0.056	0.056	0.066	0.071	0.06	0.062	0.063	0.06	0.061	0.047	0.534
1.43	0.058	0.056	0.06	0.067	0.066	0.069	0.072	0.068	0.069	0.058	0.504
0.71	0.042	0.042	0.041	0.049	0.049	0.093	0.053	0.049	0.054	0.064	0.489
0.51	0.227	0.184	0.189	0.052	0.052	0.051	0.062	0.055	0.06		
0.36	0.361	0.362	0.385	0.209	0.182	0.185	0.066	0.061	0.062		
0.18	0.452	0.411	0.449	0.371	0.43	0.449	0.061	0.061	0.063		
0.16	0.477	0.451	0.51	0.475	0.464	0.453	0.255	0.248	0.247		
0.12	0.518	0.453	0.491	0.47	0.485	0.478	0.46	0.415	0.433		

Table c OD values of *P. aeruginosa* treated with different concentrations of CQDs-1, CQDs-2, CQDs-3

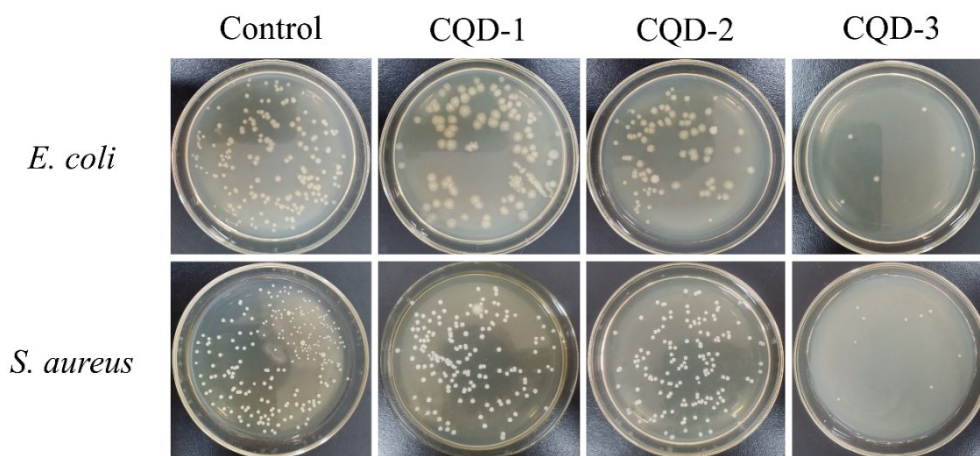
$c_{\text{CQDs}}$ (mg/mL)	CQDs-1			CQDs-2			CQDs-3			Blank group	Negative group
2.86	0.055	0.056	0.058	0.061	0.059	0.06	0.062	0.066	0.059	0.084	0.955
1.43	0.056	0.059	0.06	0.062	0.068	0.064	0.062	0.069	0.063	0.058	0.924
0.71	0.041	0.044	0.046	0.045	0.047	0.049	0.049	0.053	0.05	0.072	0.961
0.51	0.309	0.296	0.311	0.050	0.054	0.058	0.057	0.059	0.06		
0.36	0.881	0.892	0.852	0.341	0.348	0.361	0.064	0.065	0.065		
0.18	0.909	0.853	0.932	0.908	0.956	0.972	0.063	0.073	0.067		
0.16	0.989	0.962	0.981	0.955	1.015	1.023	0.433	0.434	0.454		
0.12	0.982	0.945	0.987	0.924	0.979	0.962	0.96	0.916	0.856		

Table d OD values of *S. aureus* treated with different concentrations of CQDs-1, CQDs-2, CQDs-3

$c_{\text{CQDs}}$ (mg/mL)	CQDs-1			CQDs-2			CQDs-3			Blank group	Negative group
2.86	0.048	0.045	0.048	0.047	0.053	0.050	0.053	0.050	0.057	0.048	0.325
1.43	0.047	0.047	0.048	0.051	0.049	0.051	0.052	0.063	0.071	0.044	0.371
0.71	0.039	0.039	0.039	0.044	0.043	0.047	0.079	0.044	0.053	0.042	0.328
0.51	0.227	0.267	0.253	0.042	0.044	0.052	0.053	0.048	0.060		
0.36	0.322	0.298	0.282	0.282	0.288	0.265	0.056	0.048	0.065		
0.18	0.324	0.311	0.288	0.290	0.320	0.308	0.051	0.047	0.055		
0.16	0.377	0.298	0.293	0.307	0.286	0.290	0.266	0.311	0.384		



**Fig. S4** The antibacterial ability of CQDs-1, CQDs-2 and CQDs-3 on *E. coli* (a), *Sh. Flexneri* (b), *P. aeruginosa* (c) and *S. aureus* (d).



**Fig. S5** Typical photographs of *E. coli* and *S. aureus* after treatment with CQDs-1, CQDs-2 and CQDs-3 on LB nutrient agar medium for 24 h.