Electronic Supplementary Information

A chemical/molecular 4-input/2-output keypad lock with easy resettability based on red-emission carbon dots-Prussian blue composite film electrodes

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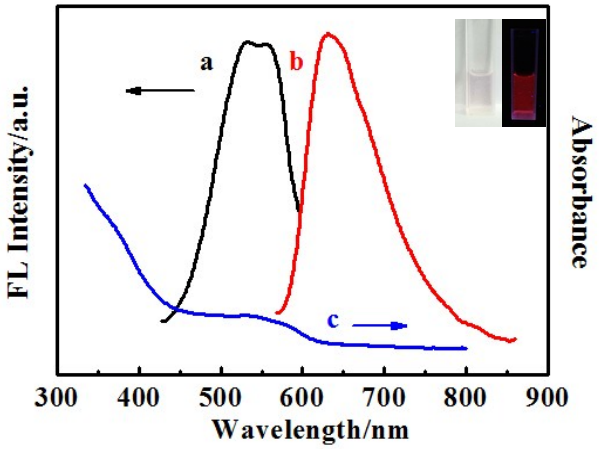

Fig. S1 (a) Excitation and (b) emission spectra of fluorescence (FL), and (c) UV-vis absorption spectrum of rCDs dispersions in pH 5.0 buffers. Inset: The photographs of rCDs aqueous dispersions under the natural light (left) and the UV excitation at 365 nm (right).

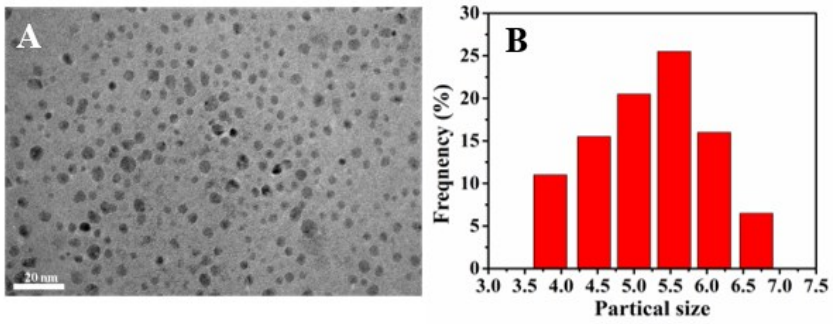

Fig. S2 (A) TEM image of rCDs. (B) Particle size distribution of rCDs.

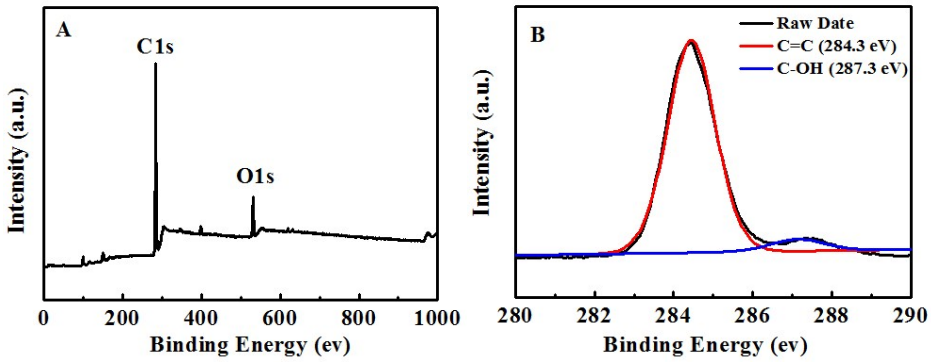

Fig. S3 (A) XPS spectrum of rCDs. (B) Deconvoluted high-resolution C1s XPS spectra.

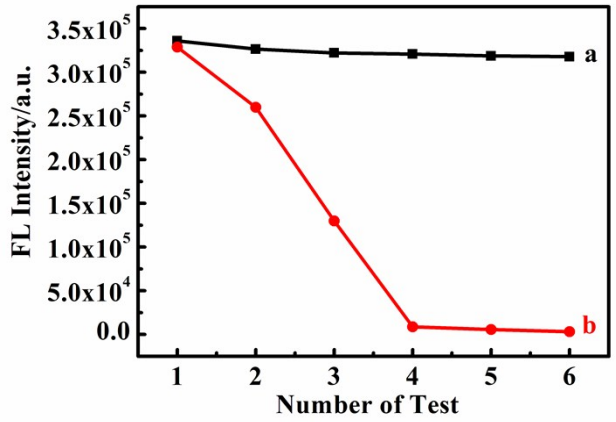

Fig. S4 Variation of fluorescence emission (FL) intensity at 630 nm under excitation at 530 nm on the number of repeated tests for (a) rCDs-Chi/PW and (b) rCDs/PW films in pH 5.0 buffers.

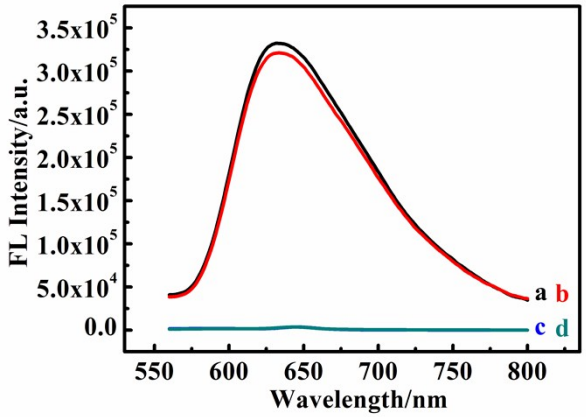

Fig. S5 Fluorescence emission (FL) spectra of rCDs-Chi film electrodes after the application of (a) −0.2 V and (b) 0.4 V in pH 5.0 buffers under the excitation at 530 nm. FL spectra of (c) Chi/PB and (d) Chi/PW film electrodes under the excitation at 530 nm in pH 5.0 buffers.

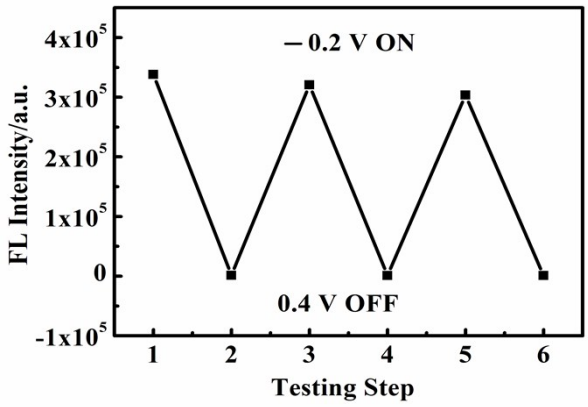

Fig. S6 Variation of fluorescence emission (FL) intensity at 630 nm with the application of potentials switched between –0.2 and 0.4 V for rCDs-Chi/PB film modified electrodes in pH 5.0 buffers.

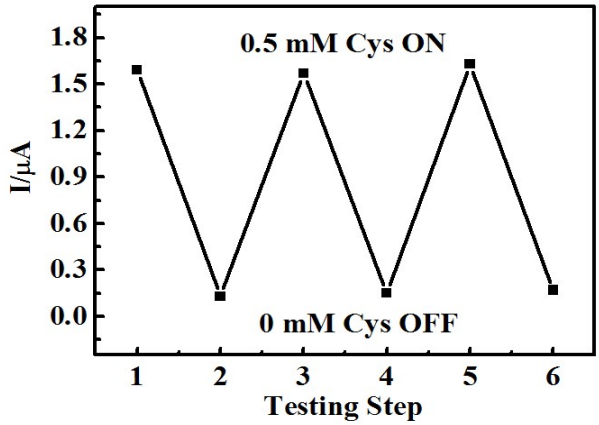

Fig. S7 Variation of amperometric currents (*I*) at rCDs-Chi/PB film electrodes in pH 5.0 buffers under the potential of 0.4 V with switching the film electrodes in the solution between in the presence of 0.5 mM Cys and in the absence of Cys.

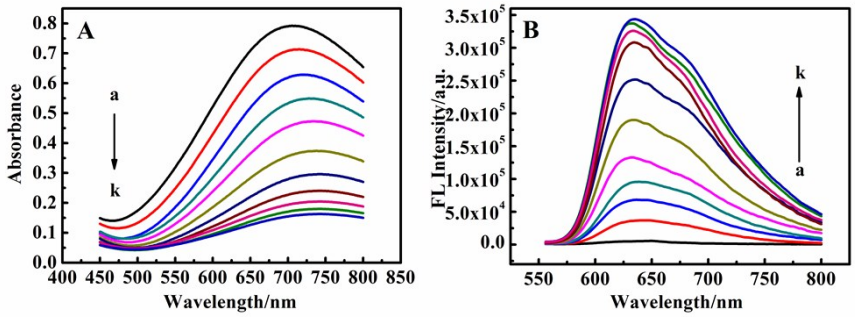

Fig. S8 (A) UV-vis absorption and (B) fluorescence emission (FL) spectra under the excitation at 530 nm for rCDs-Chi/PB films upon addition of Cys in pH 5.0 buffers with different concentrations: (a) 0, (b) 0.05, (c) 0.10, (d) 0.15, (e) 0.20, (f) 0.25, (g) 0.30, (h) 0.35, (i) 0.40, (j) 0.45 and (k) 0.50 mM.

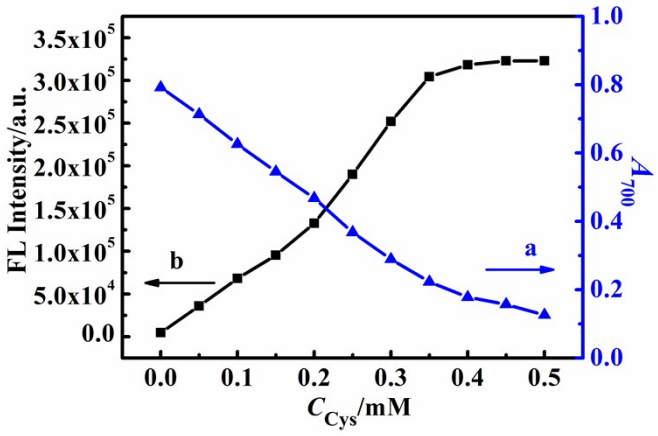

Fig. S9 Dependence of (a) A_{700} and (b) fluorescence emission (FL) intensity at 630 nm for rCDs-Chi/PB films upon C_{Cys} in pH 5.0 buffers.

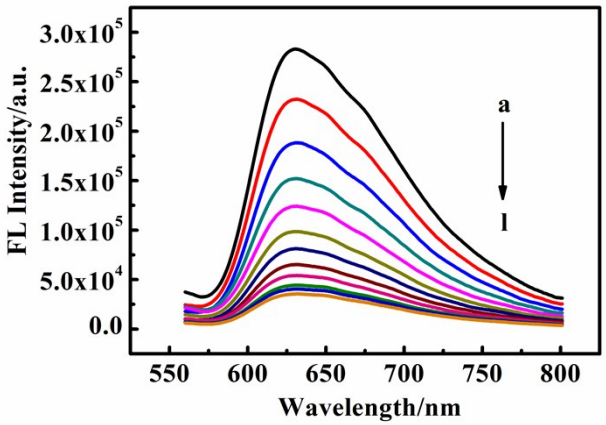

Fig. S10 Fluorescence emission (FL) spectra under the excitation at 530 nm for rCDs-Chi/PW films upon addition of Fe^{3+} in pH 5.0 buffers at different concentrations: (a) 0, (b) 0.1, (c) 0.2, (d) 0.3, (e) 0.4, (f) 0.5, (g) 0.6, (h) 0.7, (i) 0.8 ,(j) 0.9, (k) 1.0 and (l) 1.1 mM.

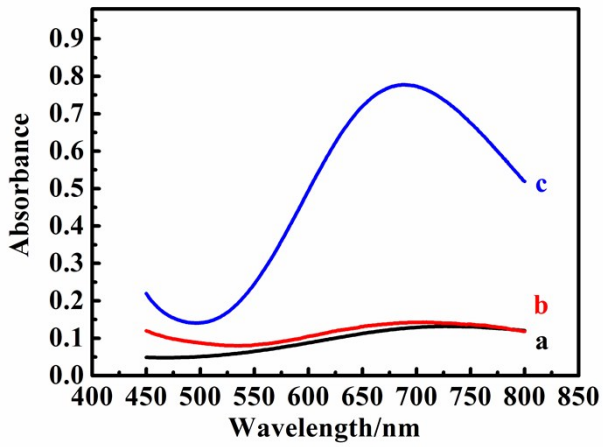

Fig. S11 UV-vis spectra of (a) rCDs-Chi/PW films, (b) rCDs-Chi/PW films with 1.0 mM Fe^{3+}, and (c) rCDs-Chi/PB films in pH 5.0 buffers.

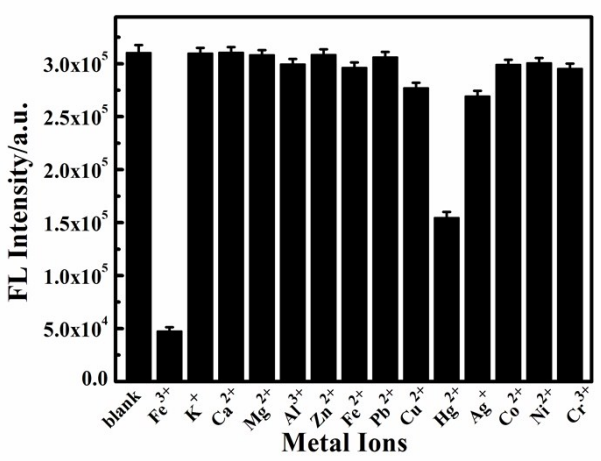

Fig. S12 Fluorescence emission (FL) intensity at 630 nm under the excitation at 530 nm for rCDs-Chi/PW films upon addition of various metal ions at 0.9 mM in pH 5.0 buffers.

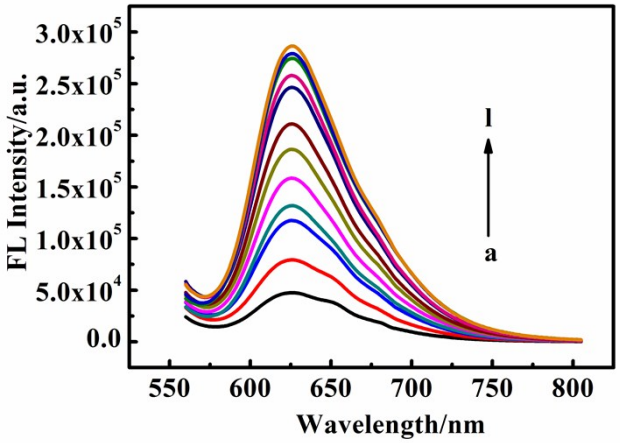

Fig. S13 Fluorescence emission (FL) spectra under the excitation at 530 nm for rCDs-Chi/PW films with 1.0 mM Fe^{3+} in pH 5.0 buffers upon addition of Cys at various concentrations: (a) 0, (b) 0.1, (c) 0.2, (d) 0.3, (e) 0.4, (f) 0.5, (g) 0.6, (h) 0.7, (i) 0.8, (j) 0.9, (k) 1.0, (l) 1.1 mM.

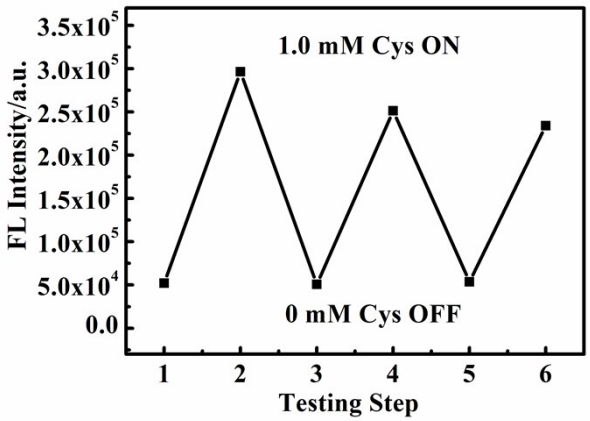

Fig. S14 Dependence of fluorescence (FL) intensity at 630 nm for rCDs-Chi/PW films in pH 5.0 buffers with 1.0 mM Fe^{3+} upon switching the composite films in the buffers between in the presence of 1.0 mM Cys and in the absence of Cys.

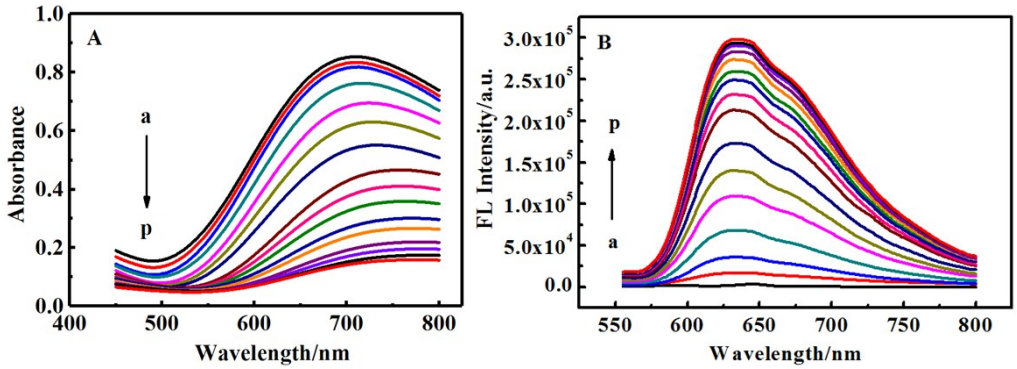

Fig. S15 (A) UV-vis absorption spectra and (B) fluorescence emission (FL) spectra under the excitation at 530 nm for rCDs-Chi/PB films in pH 5.0 buffers with 1.0 mM Fe^{3+} upon addition of Cys at different concentrations: (a) 0, (b) 0.1, (c) 0.2, (d) 0.3, (e) 0.4, (f) 0.5, (g) 0.6, (h) 0.7, (i) 0.8, (j) 0.9, (k) 1.0, (l) 1.1, (m) 1.2, (n) 1.3, (o) 1.4 and (p) 1.5 mM.

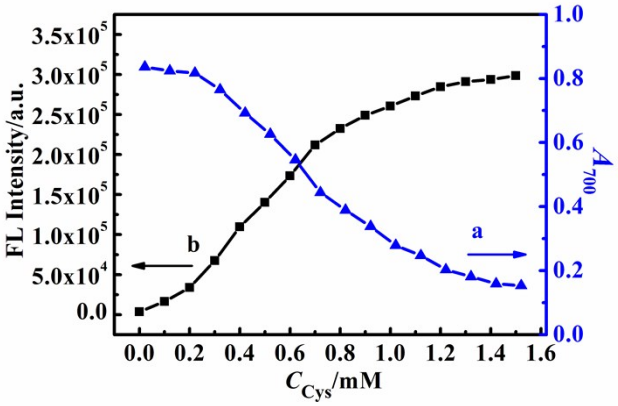

Fig. S16 Dependence of (a) A_{700} and (b) fluorescence emission (FL) intensity at 630 nm for rCDs-Chi/PB films in pH 5.0 buffers with 1.0 mM Fe^{3+} upon C_{Cys}.

Table S1. Truth table of the 3-input/3-output logic gate circuit

Input 1 **Potential**	**Input 2** **Fe^{3+}**	**Input 3** **Cys**	**Output A** ***I***	**Output B** **A_{700}**	**Output C** **FL (630 nm)**
0	**0**	**0**	**0**	**0**	**1**
0	**0**	**1**	**0**	**0**	**1**
0	**1**	**0**	**0**	**0**	**0**
0	**1**	**1**	**0**	**0**	**1**
1	**0**	**0**	**0**	**1**	**0**
1	**0**	**1**	**1**	**0**	**1**
1	**1**	**0**	**0**	**1**	**0**
1	**1**	**1**	**1**	**0**	**1**

Table S2. Definition of 4 inputs and 2 outputs for the keypad lock

Inputs			
C	**U**	**E**	**F**
1.5 mM Cys	**Excitation light at 530 nm**	**0.4 V 100 s**	**1.0 mM Fe^{3+}**
Outputs			
	AM	**FL**	
	***I*/μA**	**FL at 630 nm**	
1	**> 1.0**	**> 2.0×10^5**	
0	**≤ 1.0**	**≤ 2.0×10^5**	

Table S3. Truth table of the 4-input/2-output keypad lock

Input Order				Output AM	Output FL
C	**U**	**E**	**F**	**1**	**1**
C	**U**	**F**	**E**	**0**	**1**
C	**E**	**U**	**F**	**1**	**0**
C	**E**	**F**	**U**	**1**	**0**
C	**F**	**U**	**E**	**0**	**1**
C	**F**	**E**	**U**	**0**	**0**
U	**C**	**E**	**F**	**1**	**0**
U	**C**	**F**	**E**	**0**	**0**
U	**E**	**C**	**F**	**0**	**0**
U	**E**	**F**	**C**	**0**	**0**
U	**F**	**C**	**E**	**0**	**0**
U	**F**	**E**	**C**	**0**	**0**
E	**C**	**U**	**F**	**0**	**1**
E	**C**	**F**	**U**	**0**	**1**
E	**U**	**C**	**F**	**0**	**0**
E	**U**	**F**	**C**	**0**	**0**
E	**F**	**C**	**U**	**0**	**1**
E	**F**	**U**	**C**	**0**	**0**
F	**C**	**U**	**E**	**0**	**0**
F	**C**	**E**	**U**	**0**	**1**
F	**U**	**C**	**E**	**0**	**0**
F	**U**	**E**	**C**	**0**	**0**
F	**E**	**C**	**U**	**0**	**1**
F	**E**	**U**	**C**	**0**	**0**