Nitrogen-doped Graphene Oxide dots-based "turn-off" H_2O_2, Au (III) and "turn off–on" Hg (II) sensors as Logic gates and Molecular Keypad Lock

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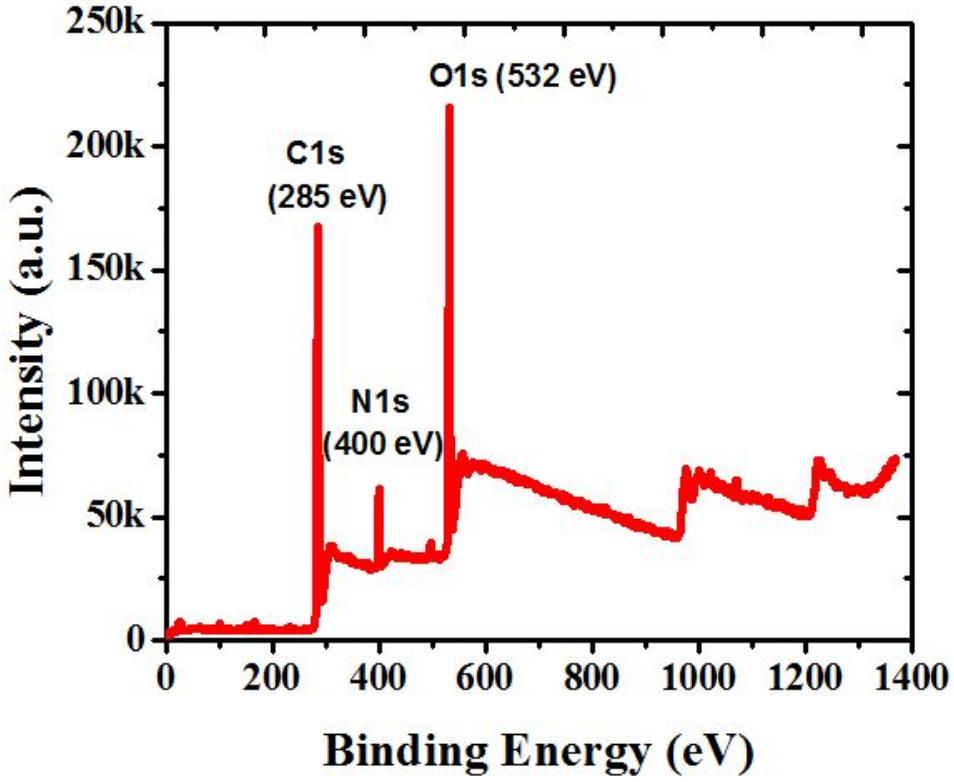

Figure S1. The XPS full survey scan of as-prepared NGODs

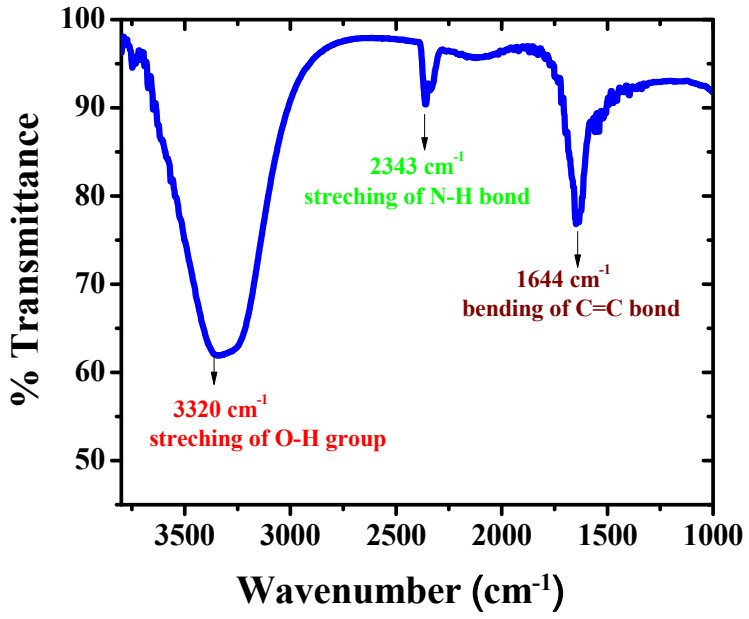

Figure S2. FTIR spectrum of as-prepared NGODs.

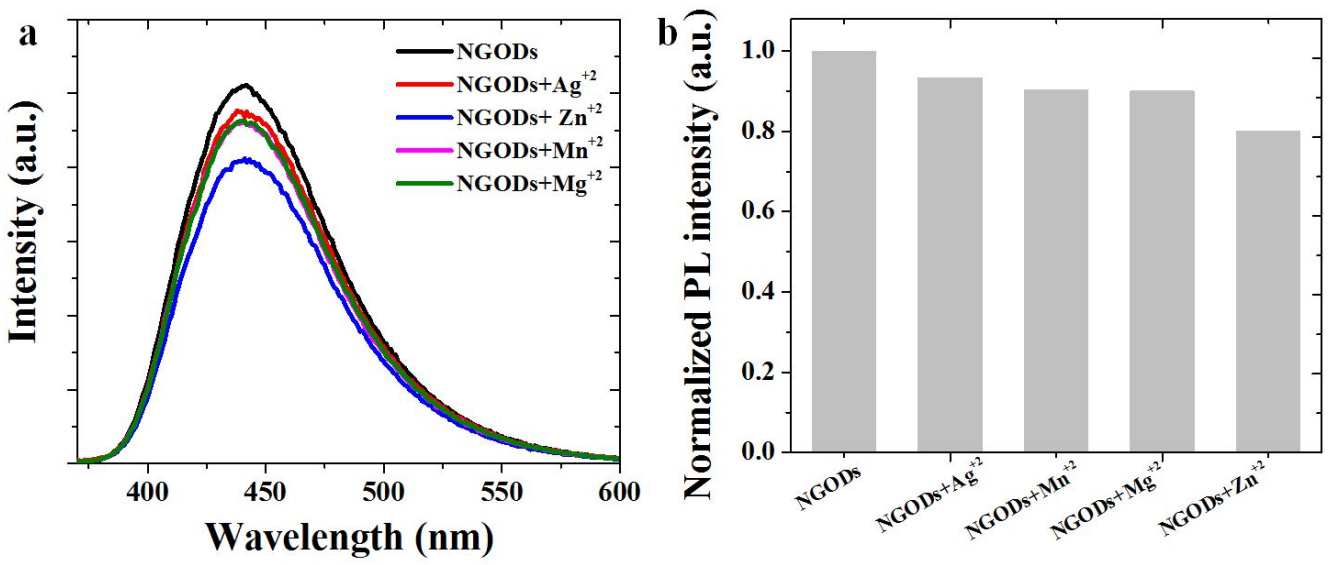

Figure S3. PL spectroscopy analysis of Ag^{+1}, Mn^{+2}, Mg^{+2}, and Zn^{+2} using NGODs as probe (a) PL Intensity vs wavelength at λ_{ex} = 344 nm for different metal ions at 250 μM concentration and (b) Corresponding normalized graph at λ_{em} = 441 nm.

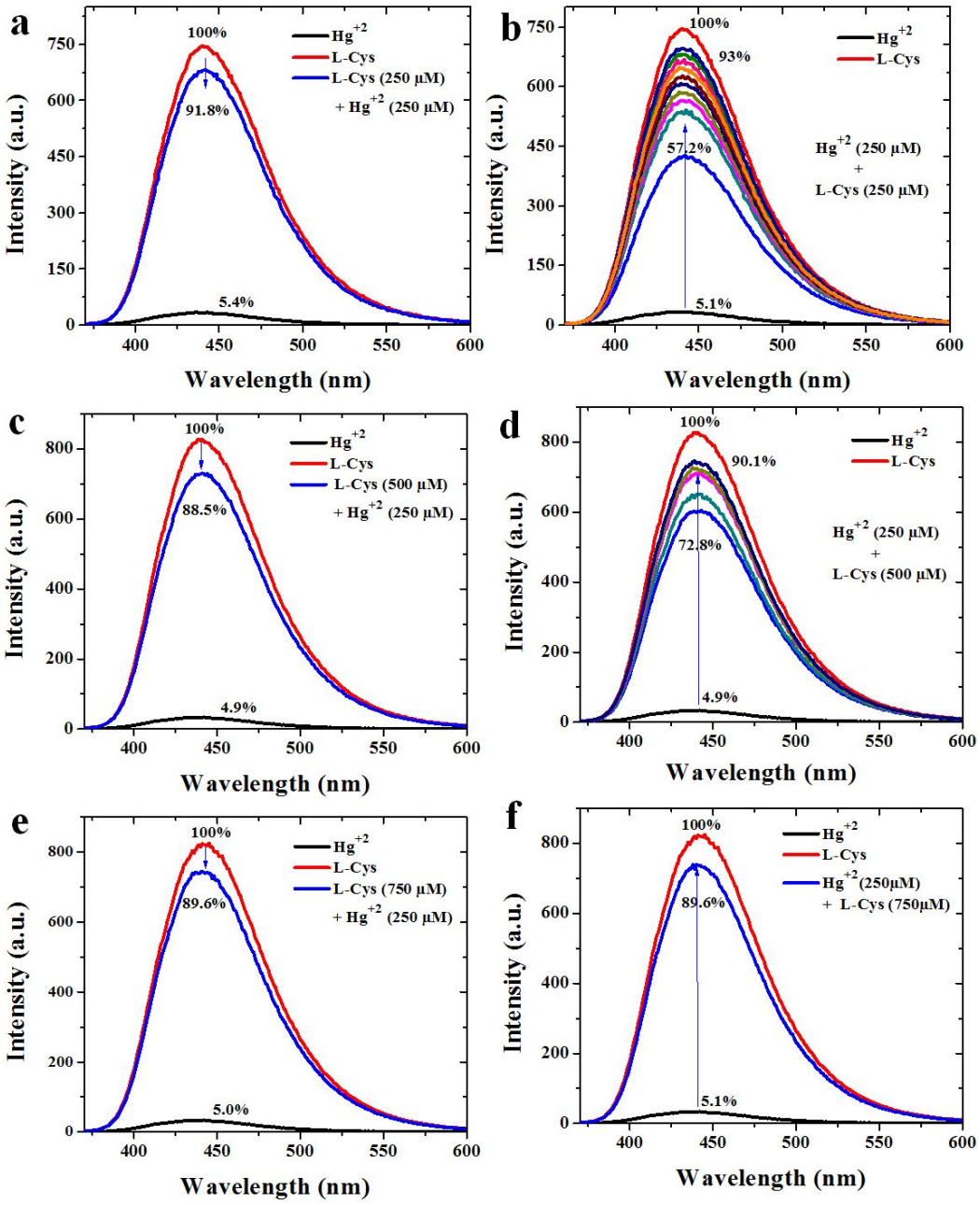

Figure S4. Effect of variation in the order of addition of L-Cys and Hg^{+2}: Time dependent PL (excitation wavelength = 344nm) response, taken after every 40 ± 10 seconds, at 3 different concentrations of L-Cys in (First Column) NGODs + L-Cys + Hg^{+2} (a) 250 µM, (c) 500 µM and (e) 750 µM; (Second Column) NGODs + Hg^{+2} +L-Cys (b) 250 µM, (d) 500 µM and (f) 750 µM complexes. The control sample (i.e. as prepared NGODs with L-Cysteine (L-Cys)) is shown for reference as 100% in each set of experiment and the concentration of Hg^{+2} is kept fixed/constant at 250 µM.

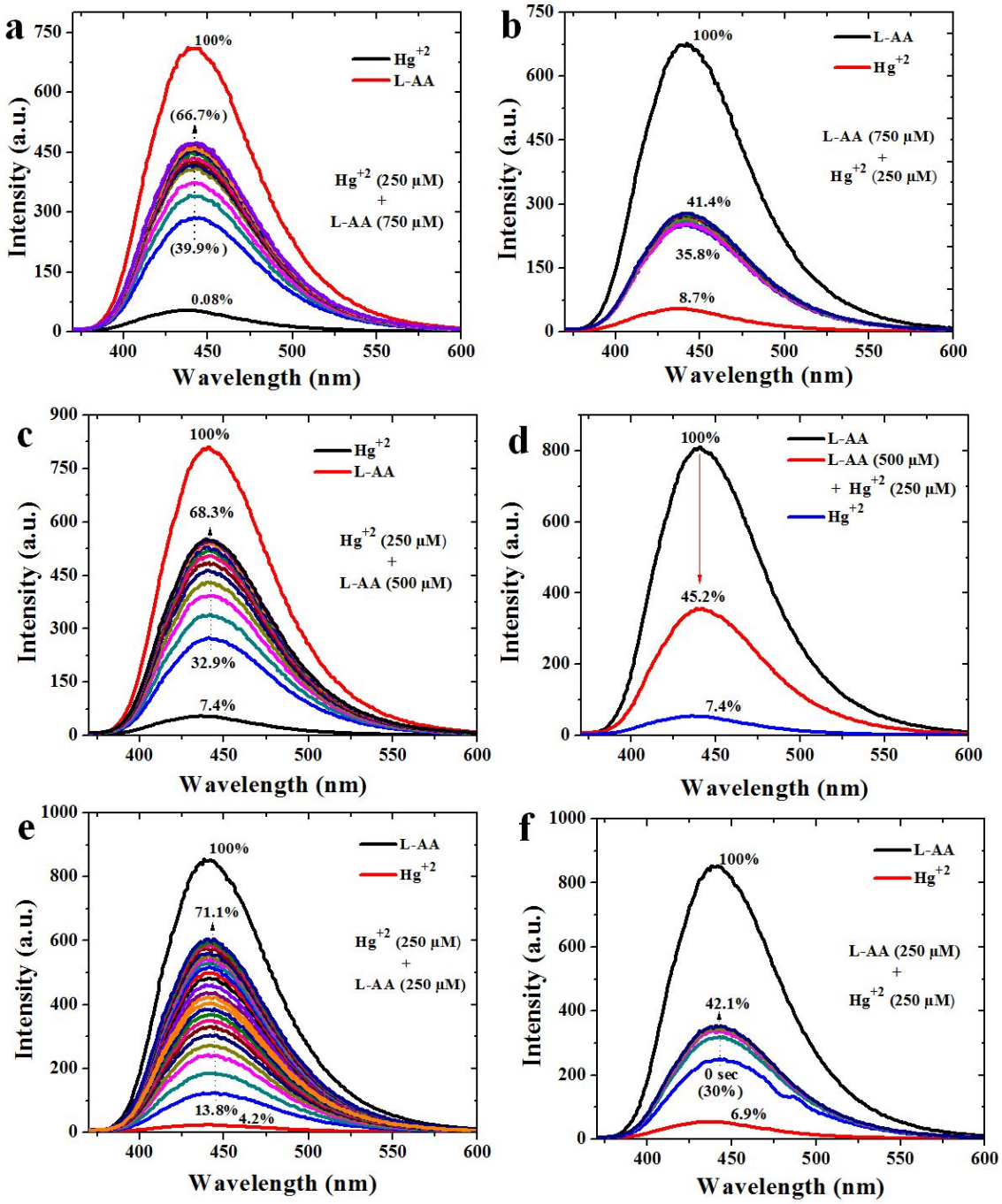

Figure S5. Effect of variation in the order of addition of L-AA and Hg^{+2}: Time dependent PL (excitation wavelength = 344nm) response, taken after every 40 ± 10 seconds, at 3

different concentrations of L-AA in (First Column) NGODs + Hg^{+2} + L-AA (a) 750 µM, (c) 500 µM and (e) 250 µM; (Second Column) NGODs +L-AA+Hg^{+2} (b) 750 µM, (d) 500 µM and (f) 250 µM complexes. The control sample (i.e. as prepared NGODs with L-Ascorbic acid (L-AA)) is shown for reference as 100% in each set of experiment and the concentration of Hg^{+2} is kept fixed/constant at 250 µM.

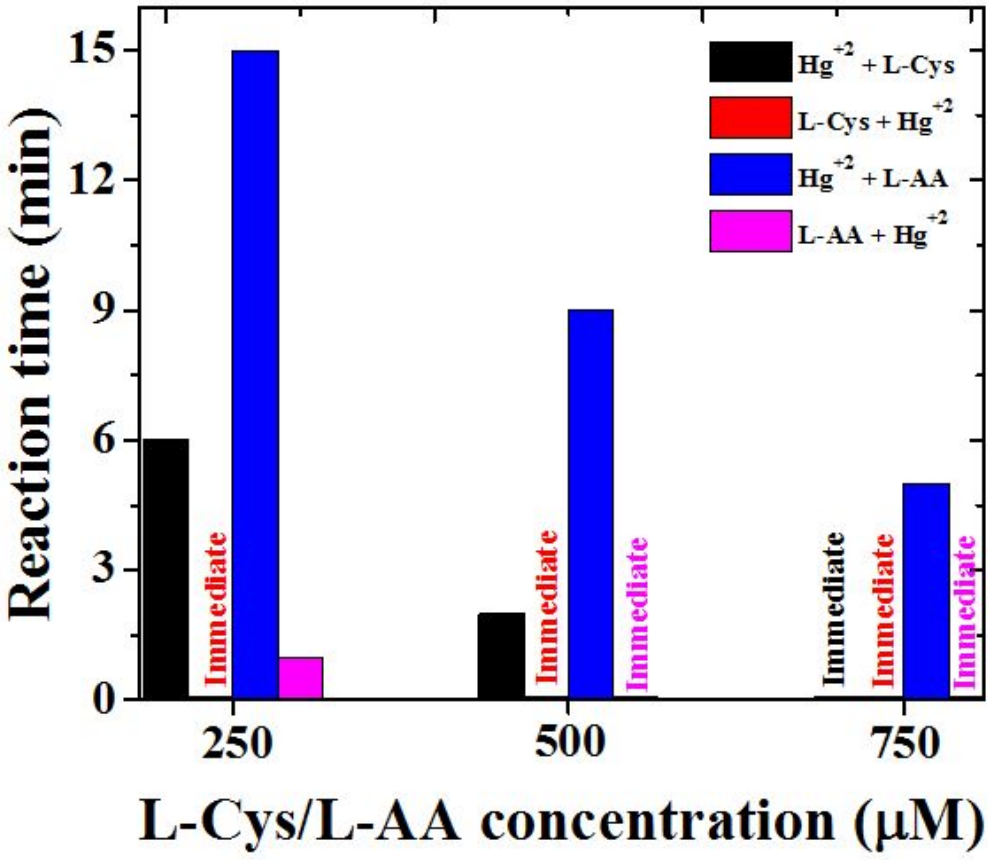

Figure S6. Data analysis of Figure S3 and Figure S4 representing time taken in PL signal recovery and quenching during Hg^{+2} detection: Reaction time vs concentration of L-Cys and L-AA (color of the word "immediate" represents the solution complex mentioned in the bar graph labels)

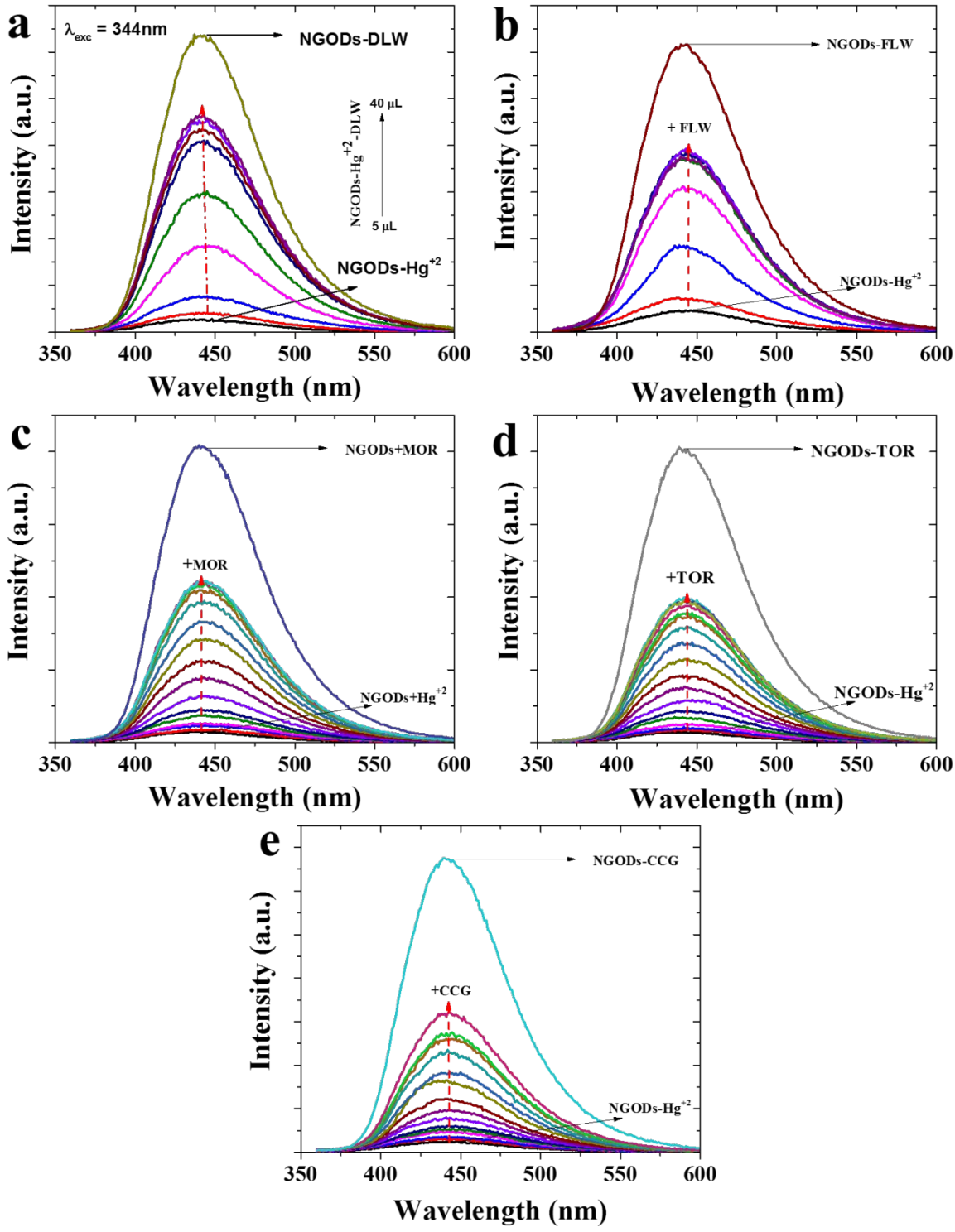

Figure S7. PL response of NGODs+Hg^{+2} in different dilutions of citrus fruit juice (a) NGODs+ Hg^{+2} + diluted lemon water (DLW) from Green lemon, (b) NGODs+ Hg^{+2}+ Fanta lemon water (FLW), (c) NGODs+ Hg^{+2}+ Mandarina orange (MOR), (d) NGODs+ Hg^{+2}+Tangerine orange (TOR) and (e) NGODs+ Hg^{+2}+ Cotton candy grape (CCG).

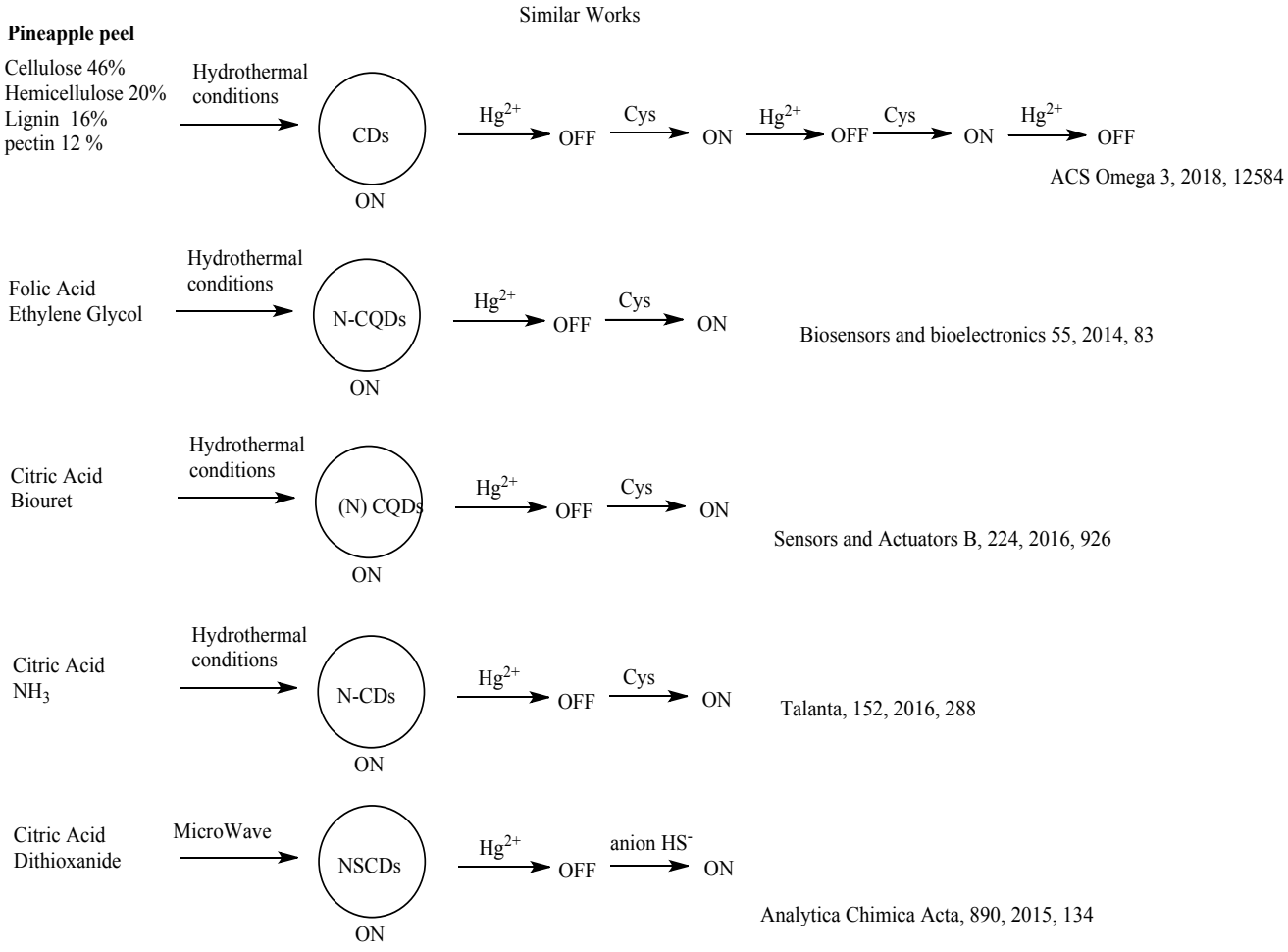

Figure S8. Schematically represented outcome of similar works related to PL signal recovery using L-Cystine (Cys) and anion HS^-

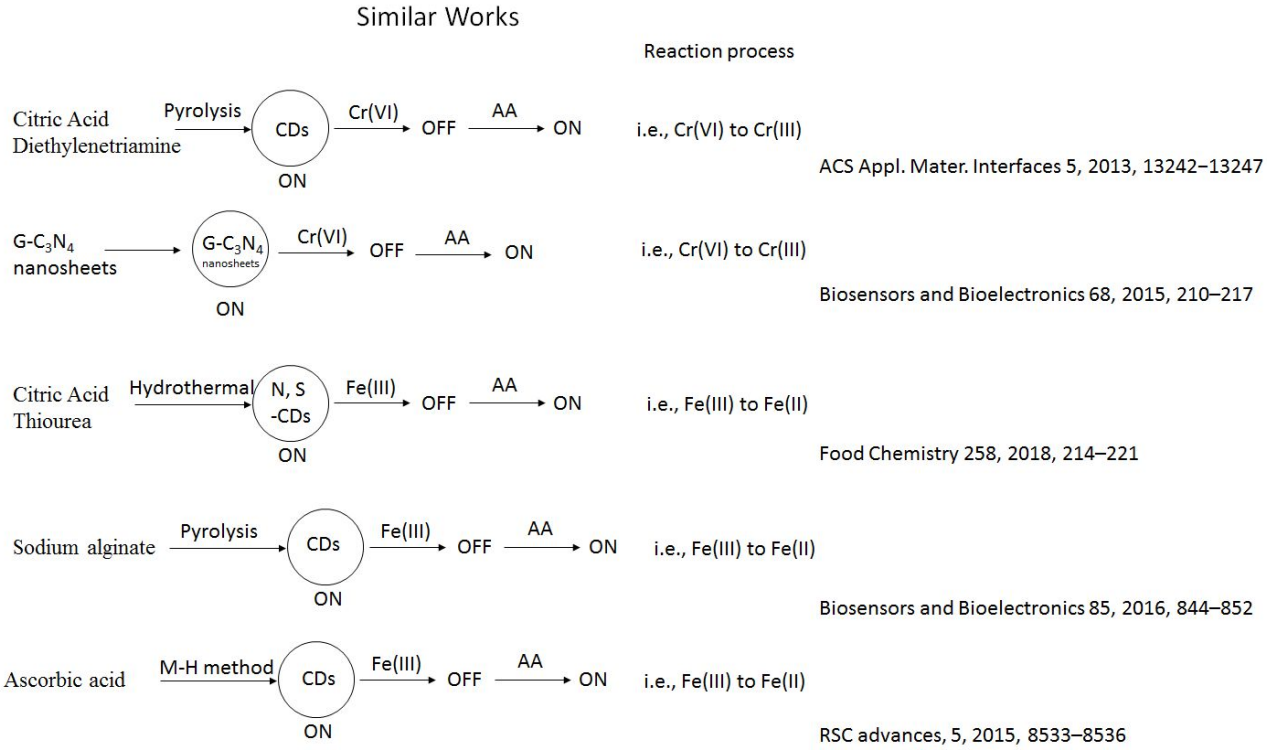

Figure S9. Schematically represented outcome of similar works related to PL signal recovery (quenching from Cr^{+6} and Fe^{+3}) using L-Ascorbic acid

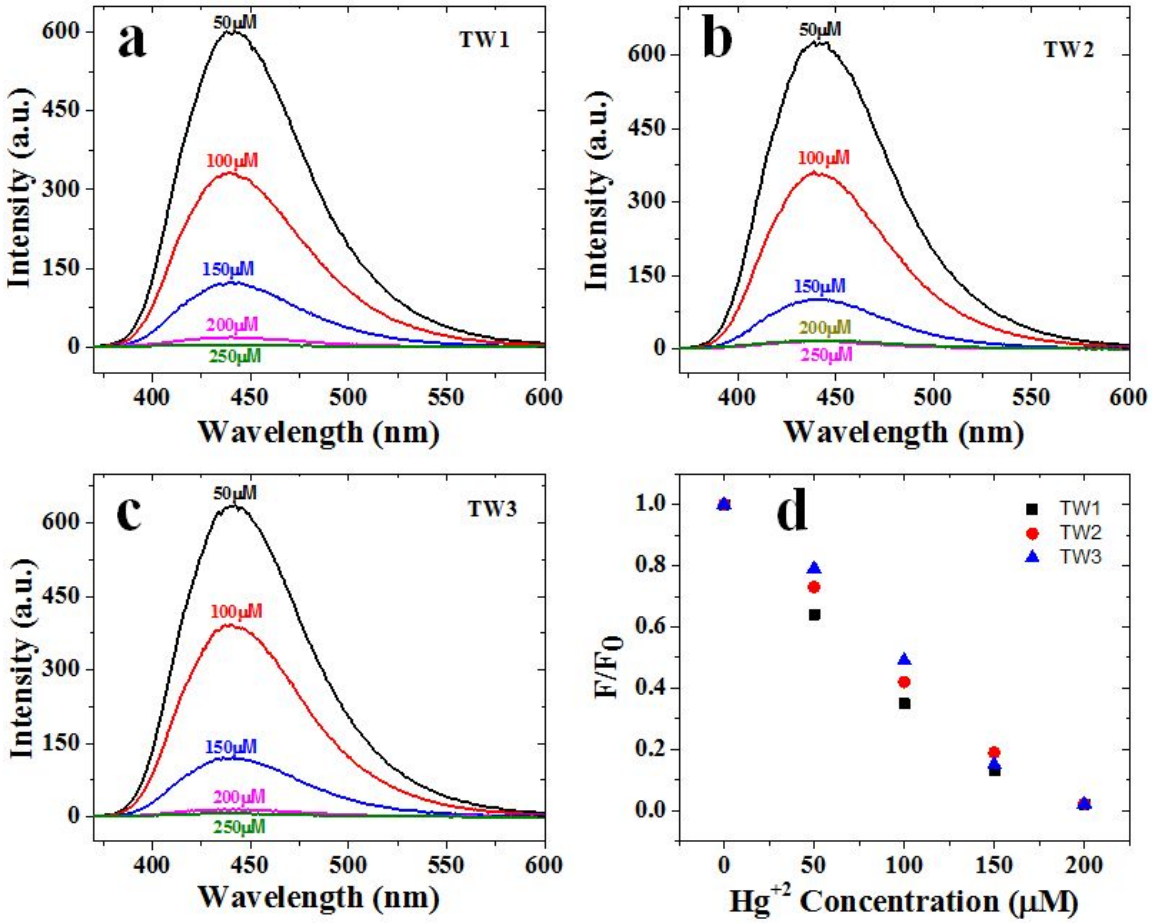

Figure S10. Optical response of NGODs from Hg^{+2} spiked real tap water collected from three different places (a) TW1 (google map view: 18.94926,-99.2709454), (b) TW2 (18.977705, -99.247733) and (c) TW3 (18.9808869,-99.2401062) and (d) F/F_0 vs Hg^{+2} concentration, (F is PL intensity of NGODs-Hg^{+2} complex at different concentrations of Hg^{+2} and F_0 is NGODs PL intensity (fixed)).

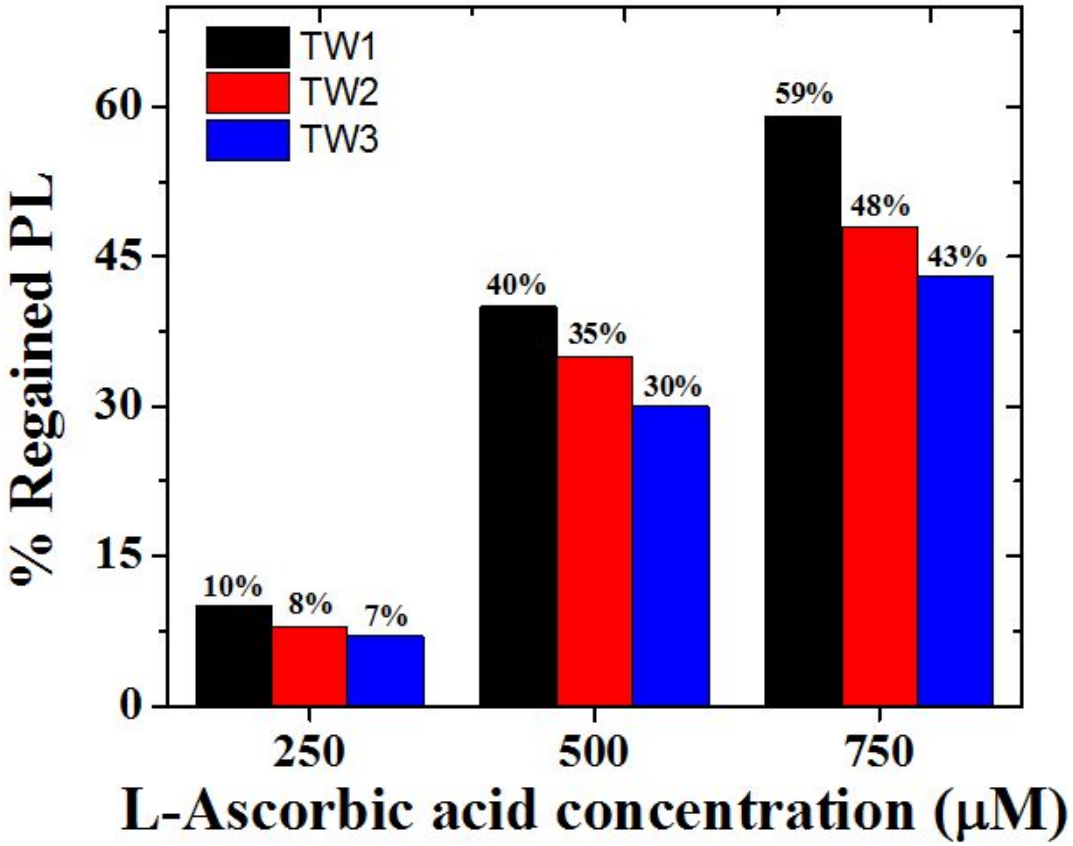

Figure S11. Regained PL signal (%) from Hg (II) spiked tap water sample from 3 different locations (TW1, TW2 and TW3) at 3 different concentrations of L-Ascorbic acid.

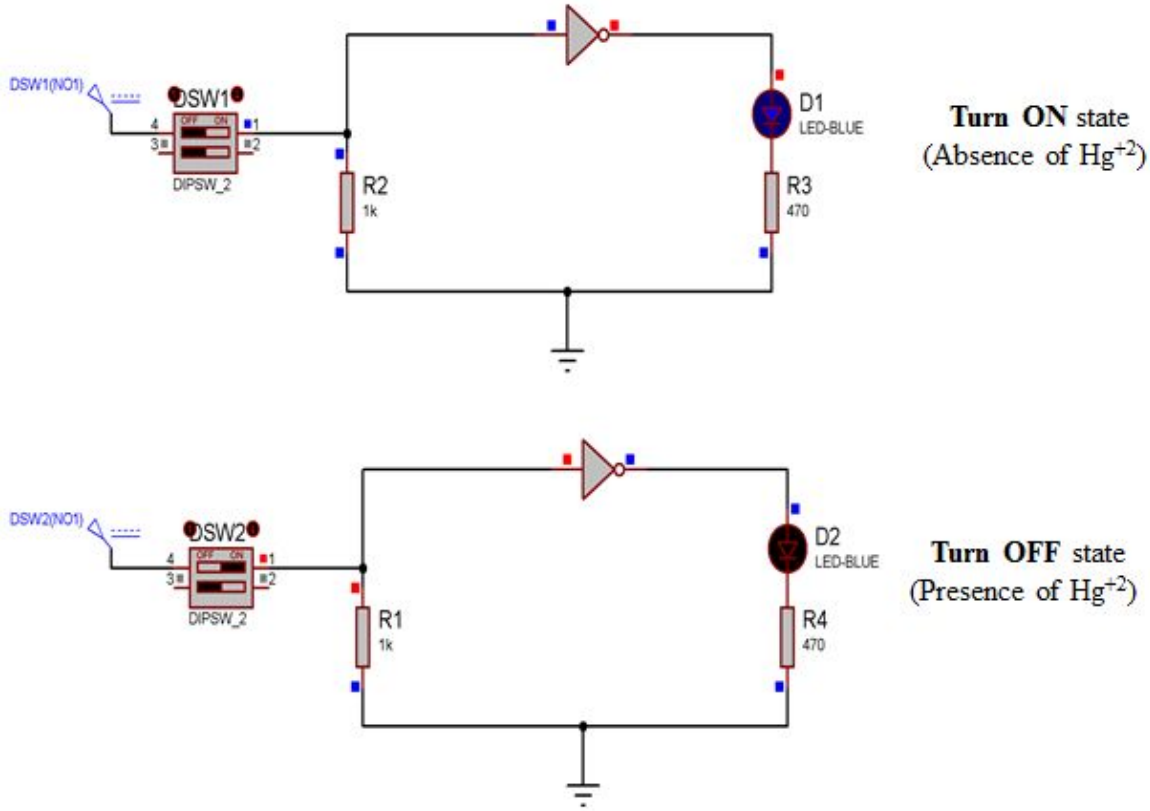

Figure S12. NGODs-Hg^{+2} complex is representing NOT gate (upper image) operations (where the presence (upper) and absence (lower) of Hg^{+2} in NGODs' solution represents OFF (upper) and ON (lower) respectively in the executed circuit; the outputs were found to match with the experimental results). Red dots indicate TURN ON state and blue dots indicate TURN OFF state.

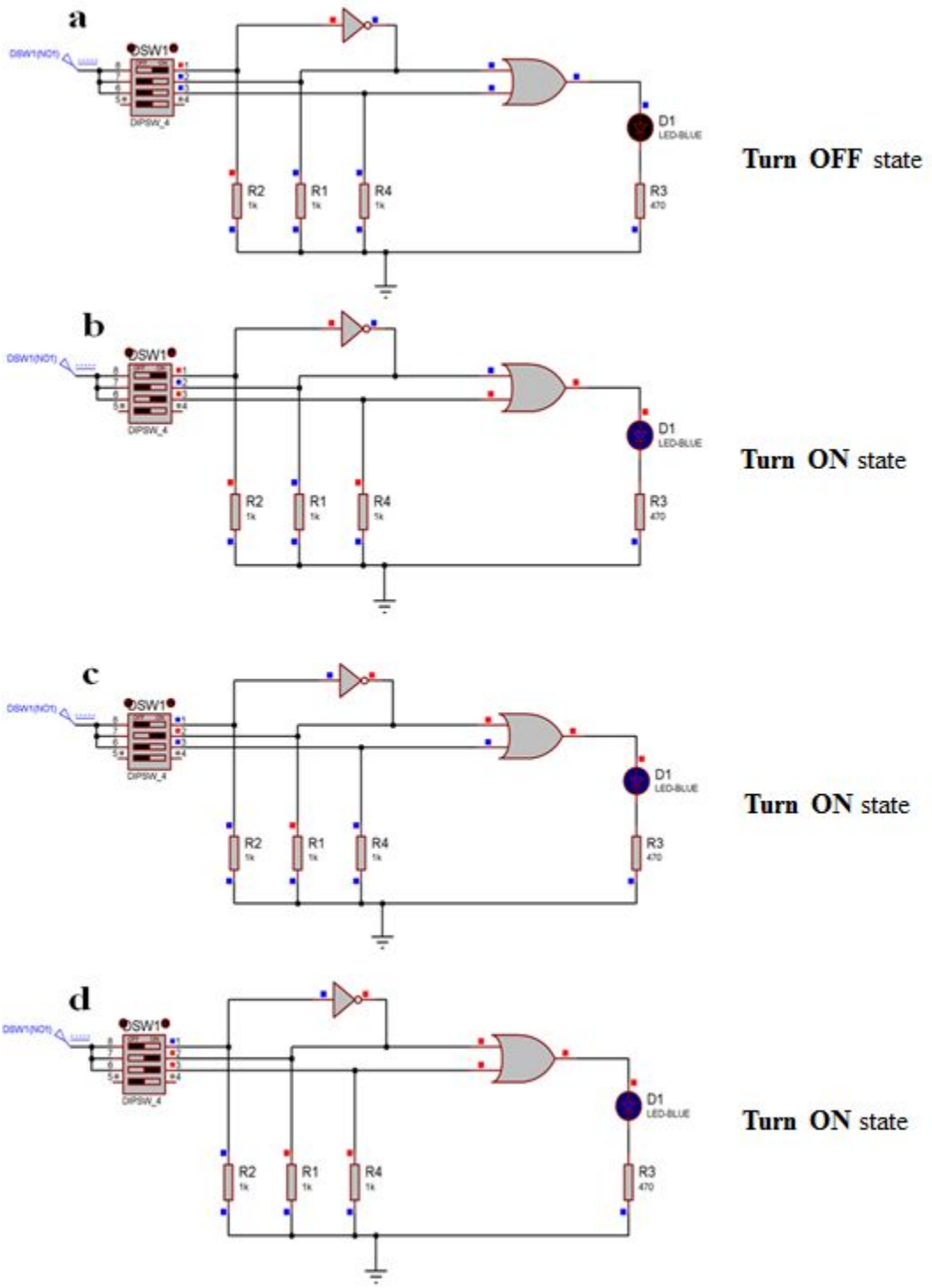

Figure S13. Simulations corresponding to figure 8a; (a) Input 1 is 1, input 2 is 0 and input 3 is 0 gives output 0 (turn off state), (b) Input 1 is 0, input 2 is 1 and input 3 is 0 gives output 1 (turn on state) (c) Input 1 is 1, input 2 is 0 and input 3 is 1 gives output 1 (turn on state), and (d) Input 1 is 0, input 2 is 1 and input 3 is 1 gives output 1 (turn on state). Red dots

indicate Turn ON state and blue dots indicates Turn OFF state. (Input 1= Hg^{+2}; Input 2 = Output of Input 1; Input 3= L-Cys/L-AA) ; Red dots indicate TURN ON state and blue dots indicate TURN OFF state.

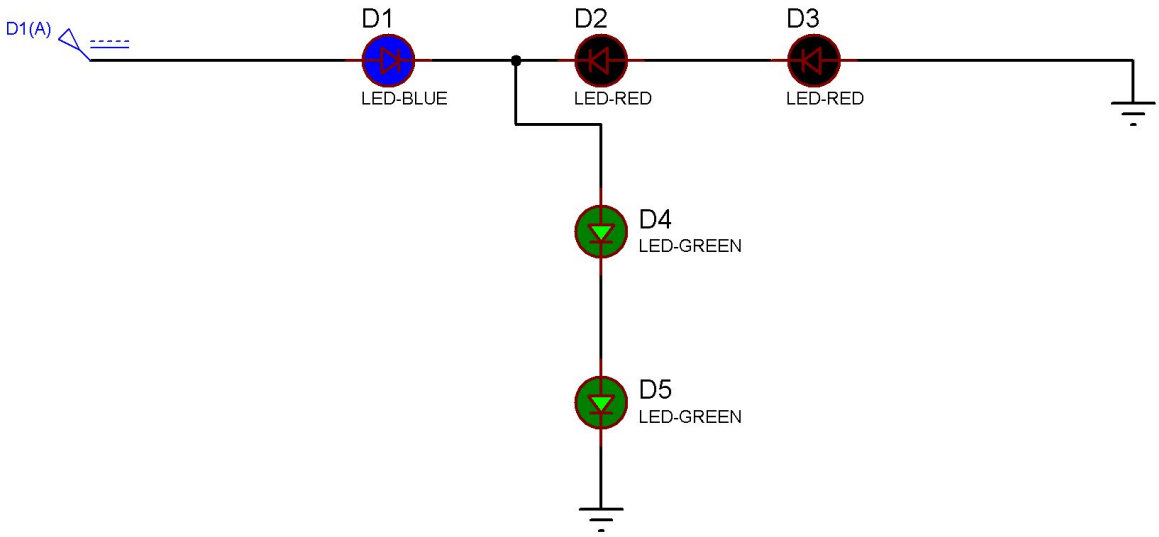

Figure S14. Simulations corresponding to figure 8e (D1=L-AA, D2=Hg^{+2}, D3=OFF, D4=L-AA and D5=ON)

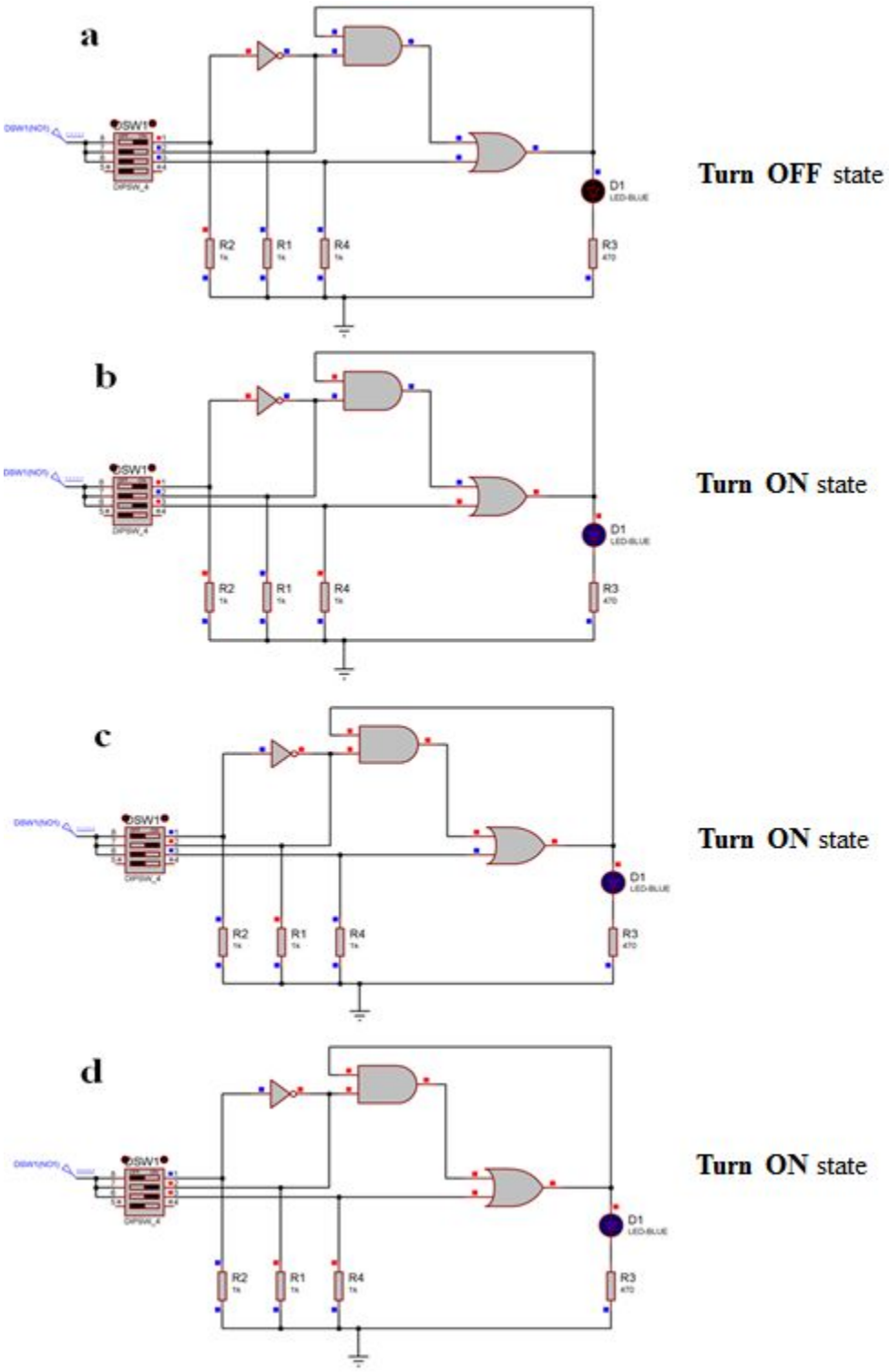

Figure S15. Simulations corresponding to figure 9e: (a) Input 1 is 1, input 2 is 0 and input 3 is 0 then the output is 0 (turn off state), (b) Input 1 is 1, input 2 is 0 and input 3 is 1 then the output is 1 (turn on state) (c) Input 1 is 0, input 2 is 1 and input 3 is 0 then the output is 0 (turn on state), and (d) Input 1 is 0, input 2 is 1 and input 3 is 1 then the output is 1 (turn on

state).Red dots indicates Turn ON state and blue dots indicates Turn OFF state. (Input 1= Hg^{+2}; Input 2 = Output of Input 1; Memory element initial = O(OFF); Input 3= L-Cys/L-AA)

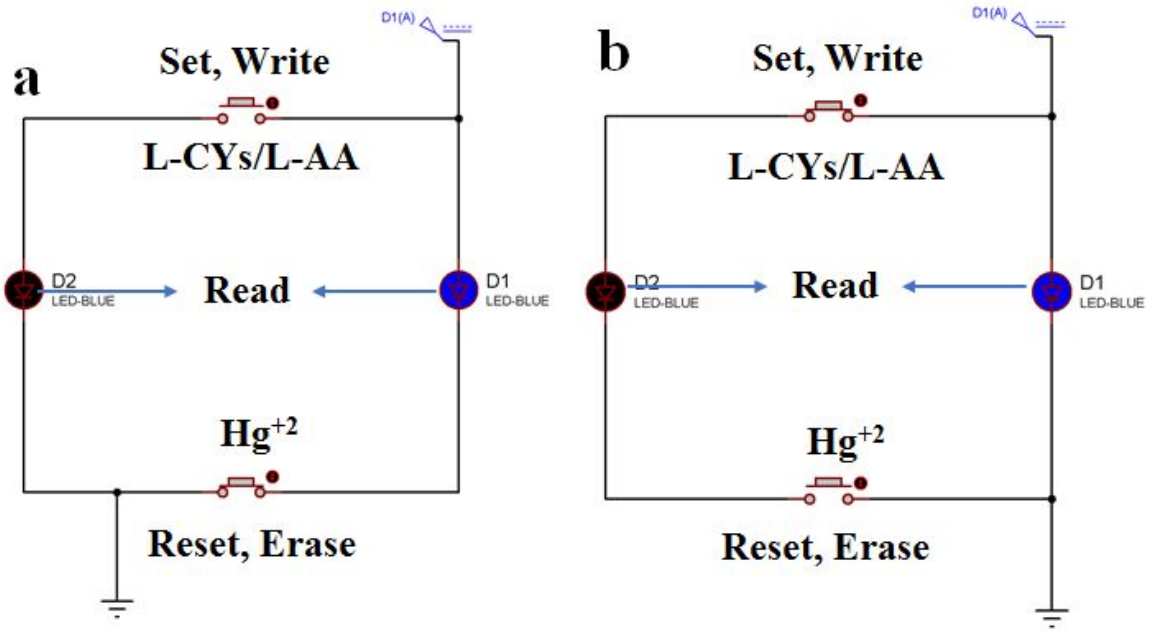

Figure S16. Simulations corresponding to figure 9f; (a) Reset and (b) Set.