

# Supporting Information

## Red Emitting Copper Nanoclusters: From Bulk Scale Synthesis to Catalytic Reduction

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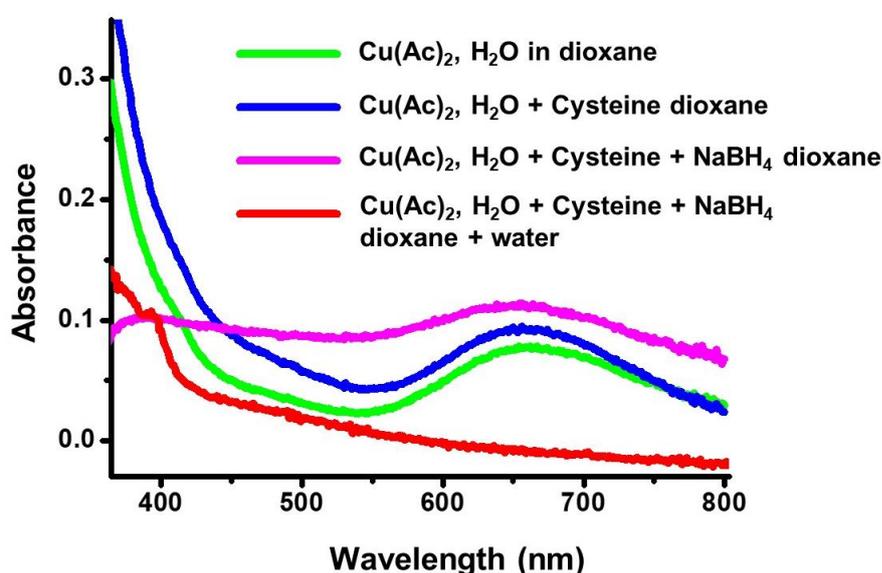
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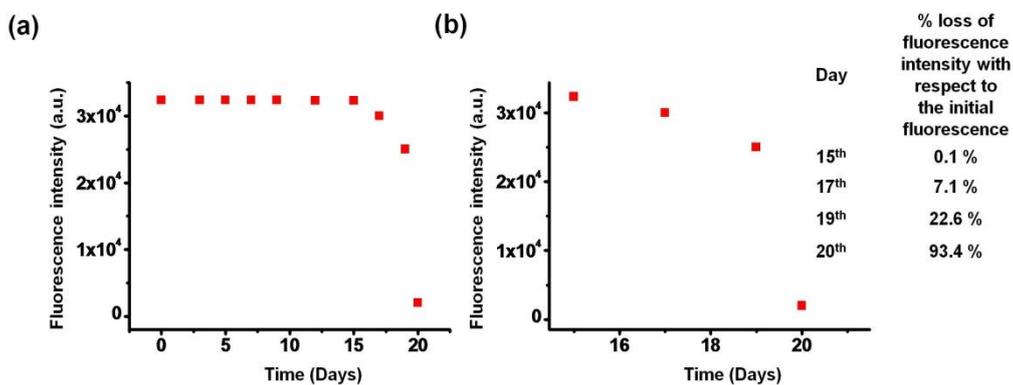
## Materials:

Copper acetate, monohydrate and Dioxane were purchased from Merck, Germany. Cysteine was purchased from SRL, India. 4-nitrophenol and 4-nitroaniline were purchased from AVRA, India. Matrix for MALDI-TOF analysis was purchased from Sigma-Aldrich, Germany. Water used for this study was ultra pure Milli-Q grade. Water used for the real sample was collected from local river.

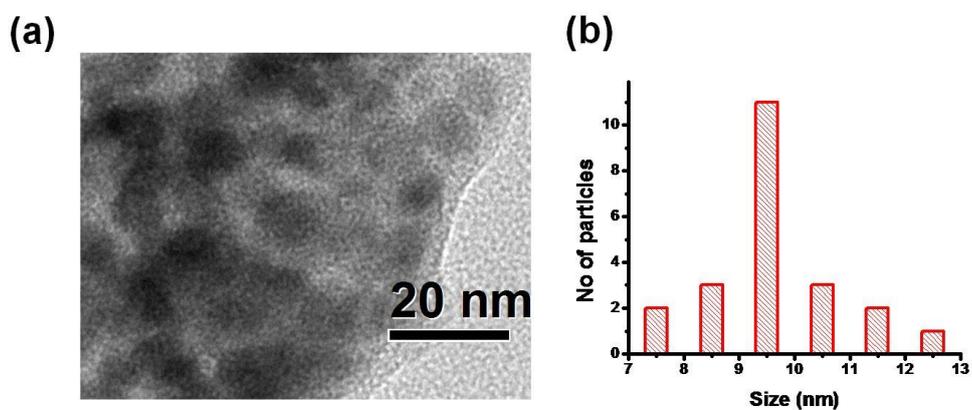
## Supporting figures:



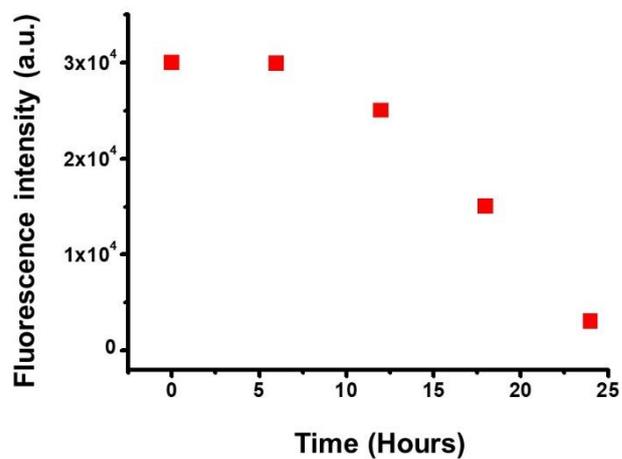
**Figure S1:** UV-vis absorption spectroscopy of the reaction mixture at different stages of the reaction. Green: solution of copper acetate monohydrate [Cu(Ac)<sub>2</sub>, H<sub>2</sub>O] in dioxane; blue: solution of Cu(Ac)<sub>2</sub>, H<sub>2</sub>O and cysteine in dioxane; purple: solution of Cu(Ac)<sub>2</sub>, H<sub>2</sub>O, cysteine and sodium borohydride in dioxane; red: after the addition of water into the previous (corresponding to purple curve) mixture.



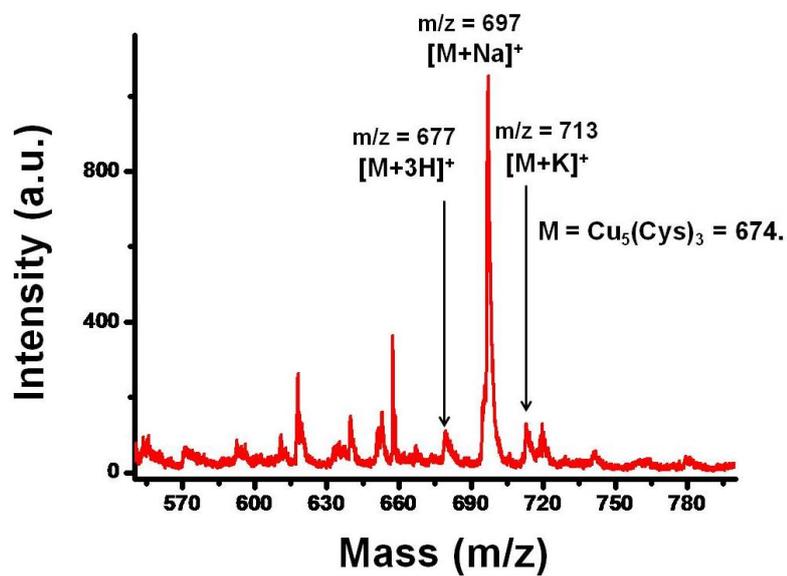
**Figure S2:** (a) Time dependent change in fluorescent intensity of CuNCs synthesized in dioxane/water mixture (b) expanded view of the degradation period (15<sup>th</sup> to 20<sup>th</sup> day) with % loss of fluorescence shown in table.



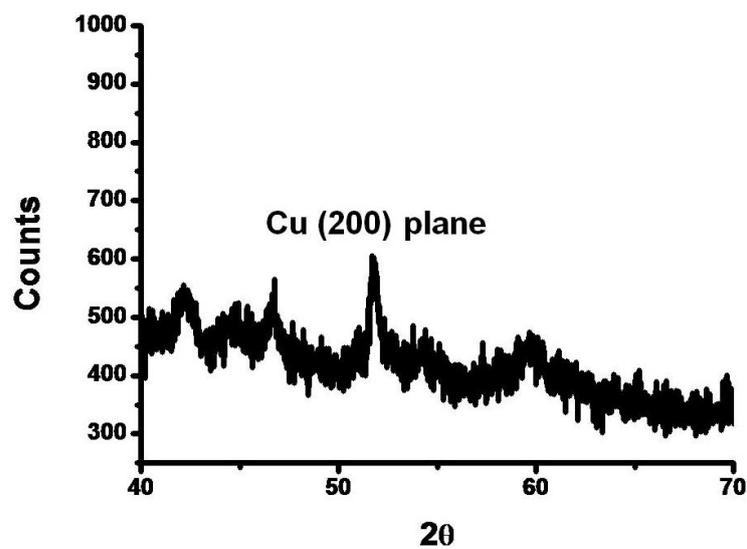
**Figure S3:** (a) FEG-TEM study of the degraded CuNCs after 20 days of synthesis; (b) particle size distribution obtained from the UHR-FEG-TEM with most populated size of particles 9.5 nm.



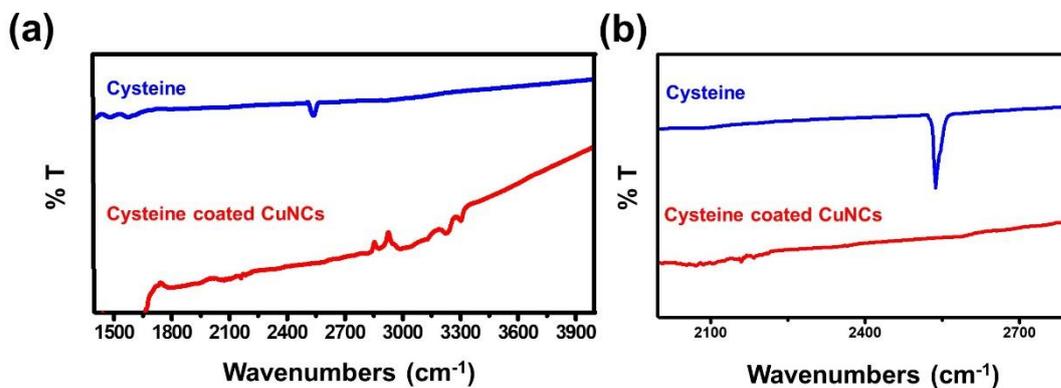
**Figure S4:** Time dependent change in fluorescent intensity of CuNCs synthesized in acetone/water mixture.



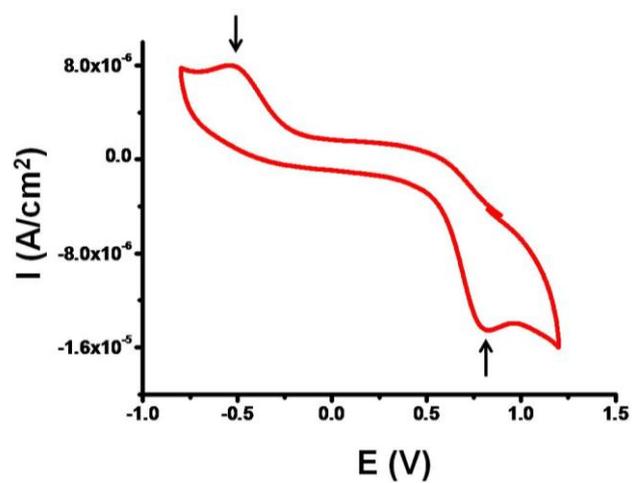
**Figure S5:** MALDI-TOF mass analysis of CuNCs synthesized in acetone/water mixture.



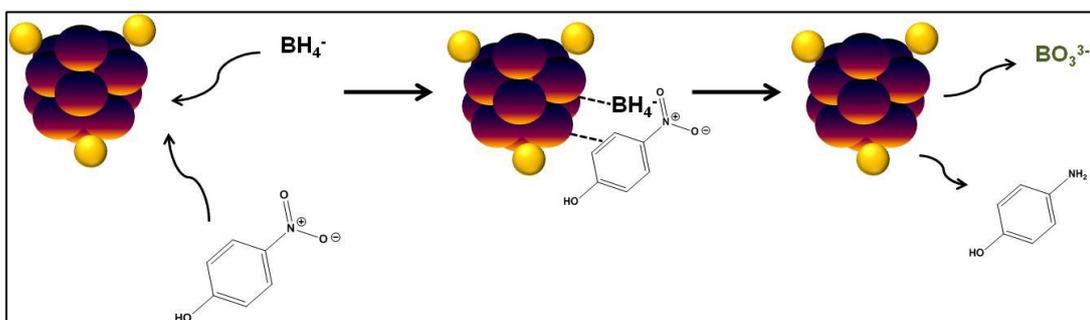
**Figure S6:** X-ray diffraction pattern obtained from the powdered CuNC, showing a small peak for Cu (200) plane.



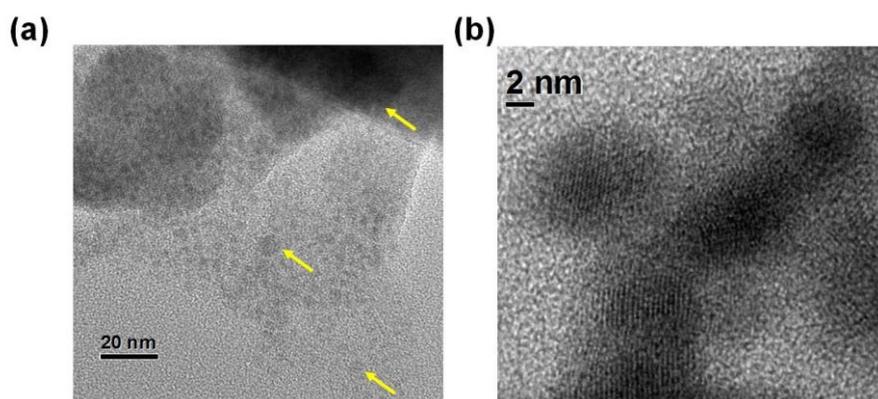
**Figure S7:** (a) FT-IR of cysteine (blue) and CuNCs (red) showing the presence and absence of S-H bond at  $2530\text{ cm}^{-1}$  respectively, (b) the enlarged spectra at  $2100$  to  $2700\text{ cm}^{-1}$  range.



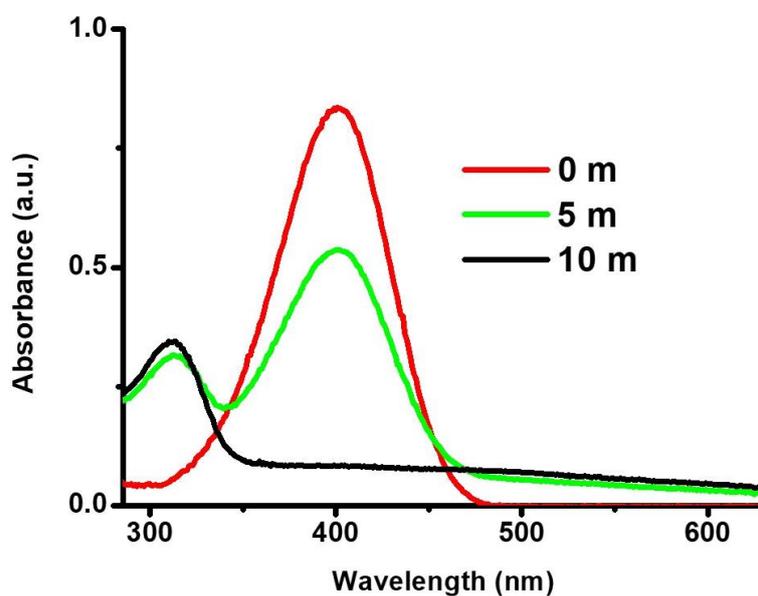
**Figure S8.** Cyclic voltammogram of CuNCs (using standard Ag/Ag<sup>+</sup> electrode).



**Figure S9:** Probable pathway of catalysis.



**Figure S10:** UHR-FEG-TEM images of (a) CuNCs after the 1st round of catalysis (yellow arrows showing presence of agglomerated particles) (b) CuNCs after the 2nd round of catalysis showing only presence of agglomerated particles.



**Figure S11:** Degradation of 4-NP in real waste water sample.