# Electronic Supplementary Information (ESI)

## Fragmentation of Supported Gold Nanoparticles @ Agarose Film by Thiols and the Role of their Synergy in Efficient Catalysis

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### Determination of loading of $Au^{3+}$ into Agr film

For the study, first 2.5 % agarose hydrogel film (Agr) is prepared as mentioned in the experimental section. A 10 ml solution of 5 mM $HAuCl_4$ is prepared and its UV-visible spectrum is recorded. After this, the 10 ml solution of 5 mM $HAuCl_4$ is poured into the petri dish containing the prepared Agr film and kept as such for 1 h 15 min. After completion, the $HAuCl_4$ solution is recovered from the petri dish and its UV-visible spectrum is again recorded (Fig. S1). It is very clear from fig. S1 that there is considerable decrease in absorbance of $HAuCl_4$ solution after its loading into Agr film. The difference in the absorbance value of $HAuCl_4$ solution before and after loading into Agr film is considered for calculating the % $Au^{3+}$ loading into Agr film.

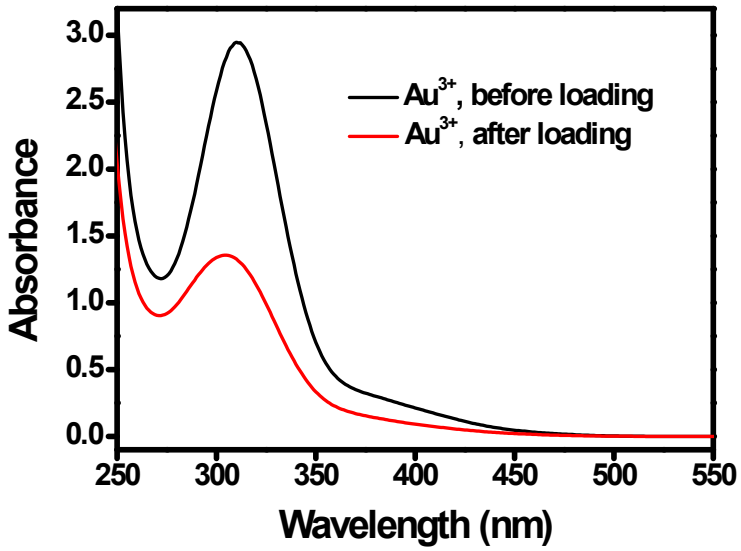



**Fig. S1** The UV-Visible analysis to determine the loading of $Au^{3+}$ into the agarose film.

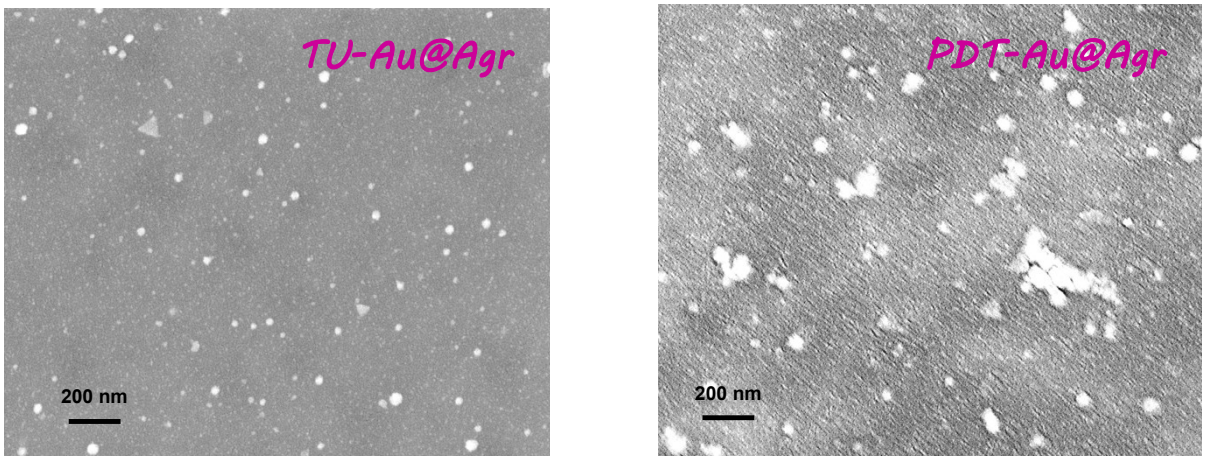



**Fig. S2** The Scanning electron microscope (SEM) images of $_{2\%}$TU-Au@Agr and $_{2\%}$PDT-Au@Agr.

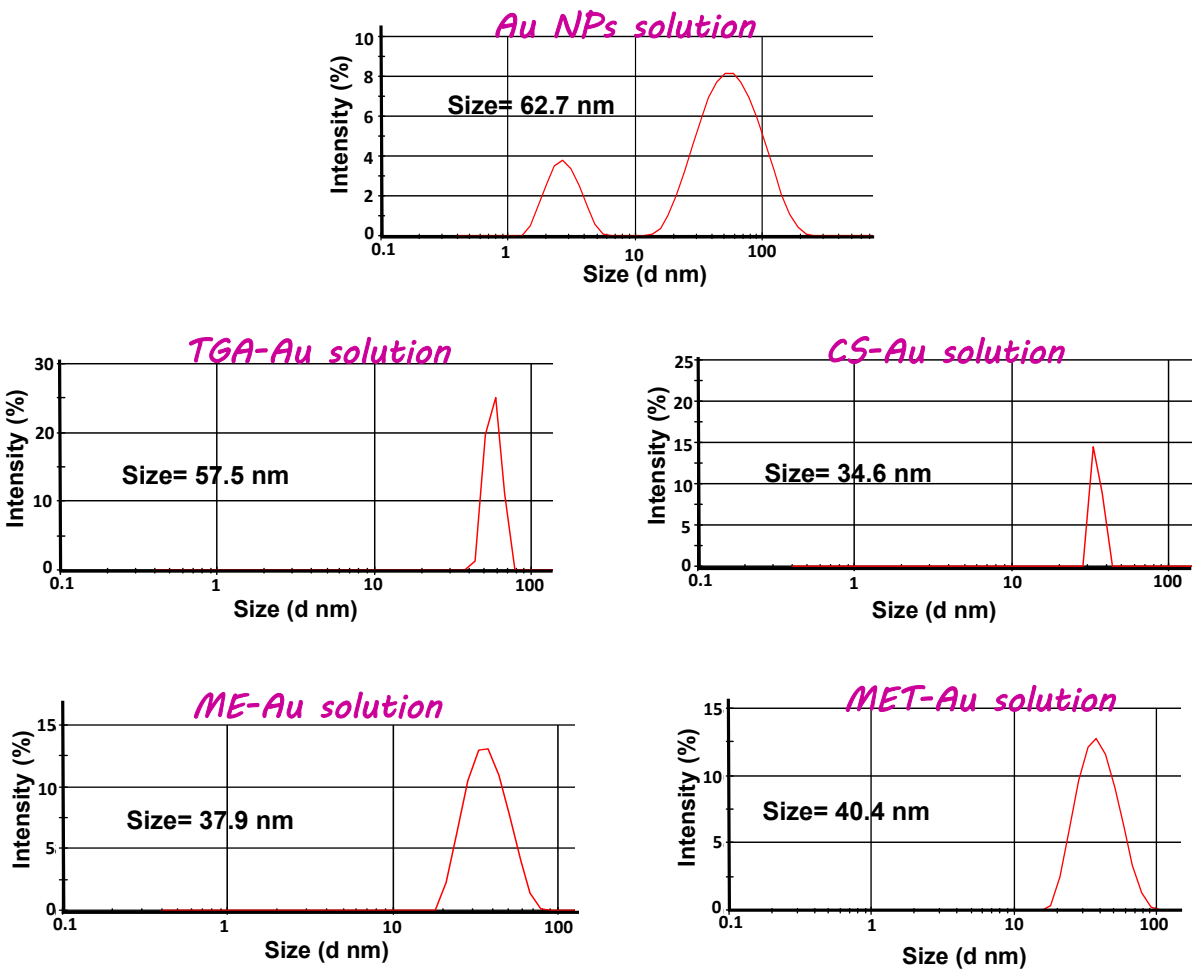



**Fig. S3** The dynamic light scattering (DLS) analysis showing particle size of freshly prepared Au NPs solution, and TGA, CS, ME and MET fragmented Au NPs in solution.

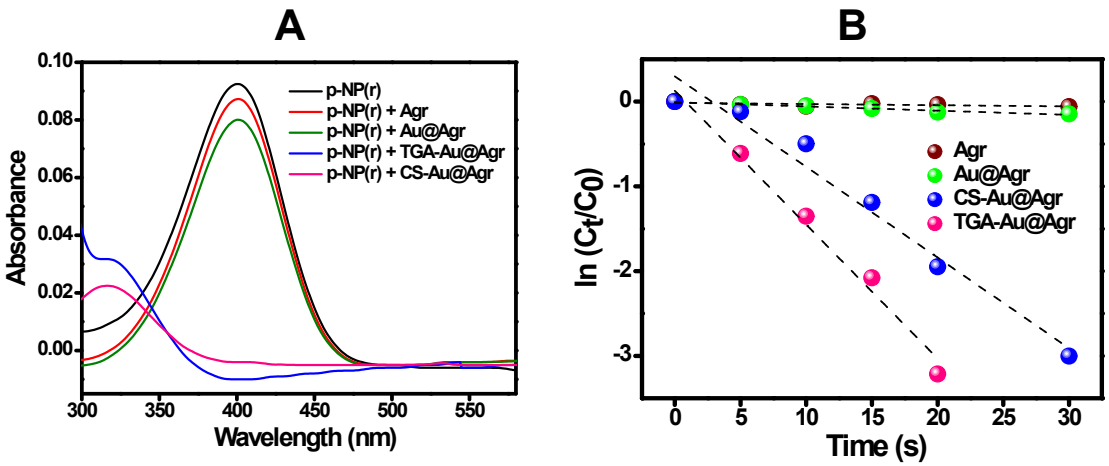



**Fig. S4** (A) The Uv-visible spectra showing comparative study of p-nitrophenol (p-NP) reduction by Agr. Au@Agr, TGA-Au@Agr, and CS-Au@Agr films. (B) A comparative plot of ln ($C_t/C_0$) vs time showing a pseudo-first order rate of reduction reaction of p-NP catalysed by Agr, Au@Agr, TGA-Au@Agr, and CS-Au@Agr films.

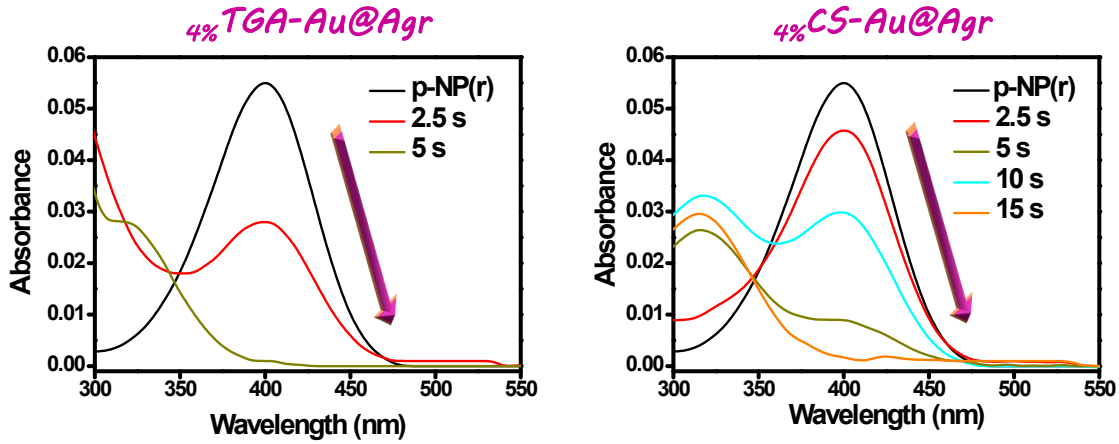



**Fig. S5** The UV-visible absorption spectral analysis showing super catalysis of reduction reaction of p-nitrophenol (p-NP) to p-aminophenol (p-AP) using $_{2\%}$TGA-Au@Agr and $_{2\%}$CS-Au@Agr as efficient catalysts. p-NP(r) is the p-nitrophenolate ions produced by adding freshly prepared excess solution of $NaBH_4$ to p-NP solution.

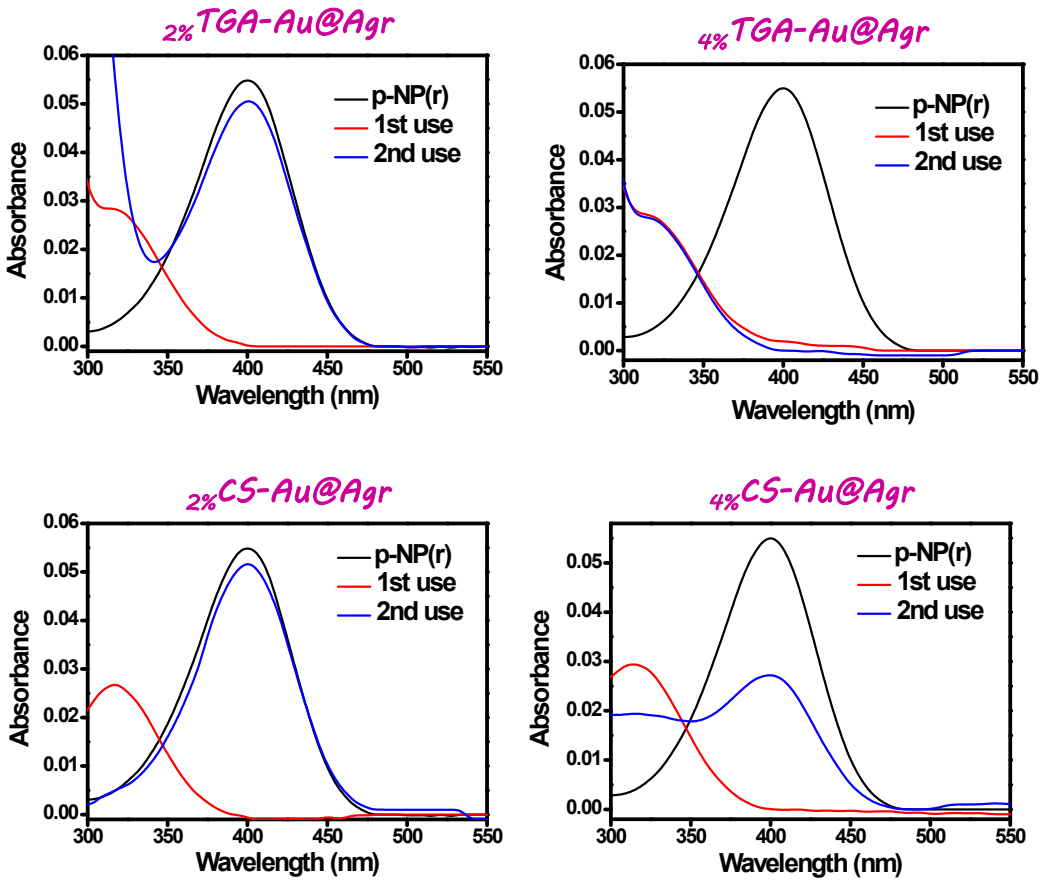



**Fig. S6** The UV-visible spectra showing reusability study of $_{2\%}$TGA-Au@Agr, $_{4\%}$TGA-Au@Agr, $_{2\%}$CS-Au@Agr and $_{4\%}$CS-Au@Agr films catalysed p-NP reduction reaction.

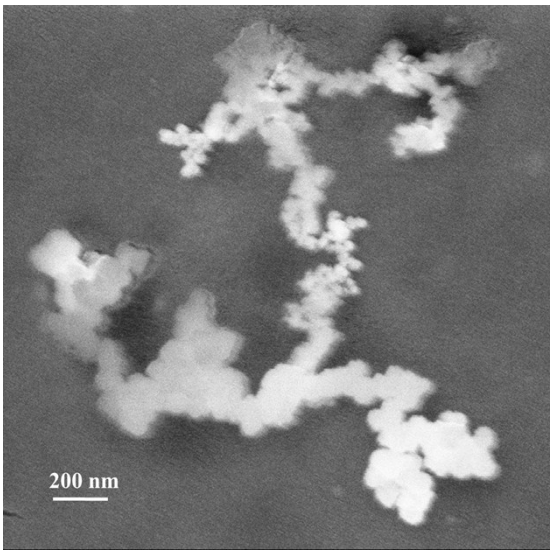
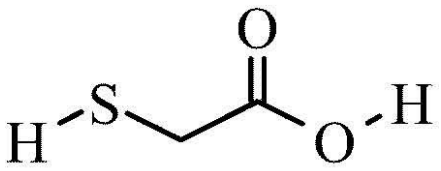
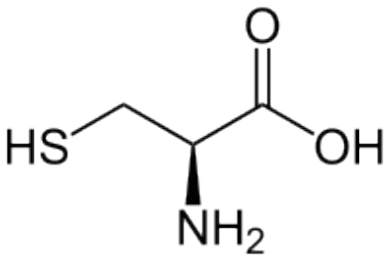


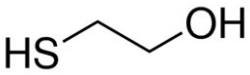

**Fig. S7** The SEM image of $_{2\%}$TGA-Au@Agr film after its 1$^{st}$ catalytic cycle of p-NP reduction reaction.



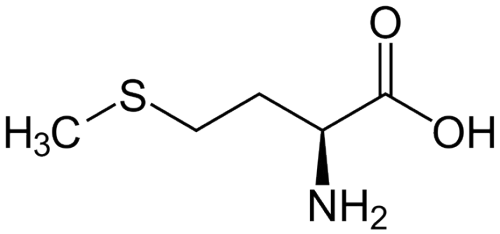

Thioglycolic acid (TGA)



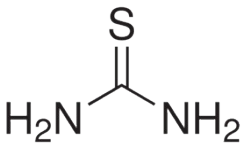

Cysteine (CS)




2-Mercaptoethanol (ME)




L-Methionine (MET)




Thiourea (TU)


1, 3-Propanedithiol (PDT)

**Fig. S8** The molecular structure of all the six thiols used in the study.